Dear Friends,

The South Dakota School of Mines and Technology is a special place. I knew that when I came here as its President in 2003, and my opinion hasn't changed. In fact, I'm now convinced that the School of Mines is even more special than I first thought.

The School of Mines offers the programs, and the faculty, to help students achieve success — in the classroom, in life, and in the workforce. The caring people on campus also are undertaking a constant effort to build on an already excellent university. Faculty and administrators search for ways to take classes, majors, and the university to a new level of excellence. They investigate majors and programs we should offer in the future to guarantee we meet the needs of our students. That effort will continue — I promise you that. That means you can be assured that you will have access to the most current teaching practices and the most modern equipment and laboratories. It also means that we can help you reach your life and career goals, whether they are in science or engineering, or in medicine, law, or some other professional field. Many students come to the School of Mines without a clear idea of what they want in life. That's OK. We can help you build a strong educational foundation and find your place. For those of you who choose a science or engineering major, we look forward to helping you follow in the footsteps of our many successful alumni.

So many of our alumni succeed because they have the experiences they need before they graduate. They are using their skills to make their communities, the nation, and the world, a better place. The School of Mines is doing that, as well. Research projects create economic development opportunities and advance our knowledge of cutting edge fields such as nanotechnology, friction stir processing, and laser additive manufacturing.

I'm glad you will join us in this adventure. If you see me on campus, please introduce yourself. I am eager to hear about your experiences as a School of Mines student. I also challenge you to consider joining the many alumni who call South Dakota School of Mines and Technology home and who serve as drivers for economic development and technology advancement.

Sincerely,

Charles Ruch
President

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DEGREE ABBREVIATIONS

A.A. - Associate of Arts
B.S. - Bachelor of Science
M.S. - Master of Science
Ph.D. - Doctor of Philosophy

MISSION, VISION, AND GOAL

The South Dakota School of Mines and Technology serves the people of South Dakota as their technological university. Its mission is to provide a well-rounded education that prepares students for leadership roles in engineering and science; to advance the state of knowledge and application of this knowledge through research and scholarship; and to benefit the state, regions, and nation through collaborative efforts in education and economic development.

The School of Mines is dedicated to being a leader in 21st Century education that reflects a belief in the role of engineers and scientists as crucial to the advancement of society. Our vision is to be recognized as a premiere technological university in the United States.

Most immediately, our goal is to be recognized as the university of choice for engineering and science within South Dakota and among our peer group of specialized engineering and science universities.

STRATEGIC INITIATIVES

1. Reshape the Learning and Teaching Experience
2. Promote the Acquisition, Discovery, and Application of Knowledge
3. Engage and Serve the Broader Community
4. Prepare for Our Future as a National Player in Science and Engineering Education and Research

UNIVERSITY INFORMATION

South Dakota Board of Regents

Mr. Terry Baloun, Highmore
Dr. Richard G. Belatti, Madison
Dr. James O. Hansen, Pierre
Mr. Harvey C. Jewett, Aberdeen
Dr. Kathyrn O. Johnson, Hill City
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Officers of the Board
President: Mr. Harvey C. Jewett
Vice President: Mr. Randall K. Morris
Secretary: Mr. Dean M. Krogman

Executive Director
Dr. Robert T. Tad Perry

South Dakota Public Higher Education Institutions

Black Hills State University, Spearfish
Dakota State University, Madison
Northern State University, Aberdeen
South Dakota School of Mines and Technology, Rapid City
South Dakota State University, Brookings
University of South Dakota, Vermillion

Degrees

The following degrees are offered at the South Dakota School of Mines and Technology in the designated fields of study.

Associate of Arts
- General Studies

Bachelor of Science
- Chemical Engineering
- Chemistry
- Civil Engineering
- Computer Engineering
- Computer Science
- Electrical Engineering
- Environmental Engineering
- Geological Engineering
- Geology
- Industrial Engineering
- Interdisciplinary Sciences
  - Areas of Specialization:
    1. Atmospheric Sciences:
    2. Business Applications in Science and Technology:
    3. Pre-Professional Health Sciences:
    4. Science, Technology, and Society:
- Applied and Computational Mathematics
- Metallurgical Engineering
- Mechanical Engineering
- Mining Engineering and Management
- Physics

Master of Science
- Atmospheric Sciences
- Chemical Engineering
- Civil Engineering
- Computer Science
- Electrical Engineering
- Geology and Geological Engineering
- Materials Engineering and Science
- Mechanical Engineering
- Paleontology
- Technology Management

Doctor of Philosophy
- Atmospheric and Environmental Sciences
- Geology and Geological Engineering
- Materials Engineering and Science
- Nanoscience and Nanoengineering

Further information concerning the engineering and science curricula leading to the Engineering and Science degrees may be found in the individual College sections of this catalog.

Accreditation

The South Dakota School of Mines and Technology is accredited by the Higher Learning Commission of the North Central Association of Colleges and Secondary Schools, the recognized accrediting agency for the north central states. In addition, the curriculum in Chemistry is accredited by the American Chemical Society. All engineering programs with the exception of Environmental Engineering and Mining Engineering and Management, which are new programs, are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET), a special accreditation body recognized by the Council on Post-Secondary Accreditation and the U.S. Department of Education. The computer science program is accredited by the Computing Accreditation Commission of the Accreditation Board for Engineering and Technology.

EQUAL OPPORTUNITY POLICY

South Dakota School of Mines and Technology is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, national origin, ancestry, religion, gender, age, sexual orientation, marital status, pregnancy, military/Veteran's status, or disability. In adhering to this policy, South Dakota School of Mines and Technology abides by all Federal and State statutes and regulations for the protection of employees against discrimination. Inquiries regarding compliance may be directed to the Director of Human Resources, South Dakota School of Mines and Technology, 501 East Saint Joseph St., Rapid City, SD 57701, (605) 394-1203.

HUMAN RESOURCES

The Office of Human Resources provides services to School of Mines employees, students, and the general public. These services include administering campus payrolls, employee recruitment and retention, benefits, performance, employee relations, interpretation and enforcement of policies and procedures.

The Director of Human Resources serves as the campus Title IX/EEO (Equal Employment Office) representative for human rights issues and is Co-Coordinator of ADA (Americans with Disabilities Act).

CAMPUS BUILDINGS

The **Arch** is located in the center of campus in the Quad area. The stones used in the construction of the arch were from the third building (Liberal Arts Building) constructed on campus. The first phase of that building was completed in 1901. Due to structural problems, the building was razed in the summer of 1994, and the stones used in the original "Arch" were carefully dismantled by hand to facilitate its reassembly during the 1995-96 year.

The **Chemistry/Chemical Engineering Building** was completed and occupied in early 1957. It is fully equipped with classrooms and laboratories and houses the Department of Chemical and Biological Engineering and the Department of Chemistry.

The **Civil/Mechanical Engineering Building**, completed and occupied in 1951, houses three major engineering departments. They are Civil and Environmental Engineering, Industrial Engineering, and Mechanical Engineering. The building also houses the Environmental Engineering Program. During 2005, a 10,000 square foot addition will be added for Computational Mechanics. This building is equipped with classrooms, faculty and graduate student offices, PC computing facilities, work-station computing facilities, and a wide range of engineering laboratories. Laboratory facilities include: materials testing, heat transfer, composite materials, controls, robotics and integrated manufacturing, hydraulics, geotechnical, environmental and work methods, and measurements. This building was completely renovated during the 1999-2000 year. The Center for Advanced Manufacturing and Processing (CAMP), the Additive Manufacturing Laboratory, and the Advanced Materials Processing and Joining Laboratory (AMP), are housed in this building.

The **Electrical Engineering/Physics Building**, completed in 1973, provides offices and laboratory facilities for the Electrical and Computer Engineering and the Physics Departments. This building houses the computer services staff, and provides technology equipped classrooms.

The **McLaury Building,** built in 1920, provides classrooms, laboratories, and offices for the Mathematics and Computer Science Department, the Biology Program, and Title III.

The **Mineral Industries Building** was occupied in 1962. It is a three-story building of 52,000 square feet. The Geology and Geological Engineering Department, the Materials and Metallurgical Engineering Department, the Mining Engineering and Management Department, the Atmospheric

Sciences Department, and the Institute of Atmospheric Sciences are located in this building. The Office of Research Affairs, Office of Graduate Education, Office of Sponsored Programs, Engineering and Mining Experiment Station, and South Dakota Space Grant Consortium are also housed in this building. This structure provides classroom and laboratory facilities for undergraduate and graduate study in several fields related to materials and earth systems sciences and engineering. the mineral industries and earth systems.

The **Classroom Building**, completed and occupied in the fall of 1989, houses the Departments of Humanities, Social Sciences, and Military Science, and distance learning classrooms including the Digital Dakota Network studios and the Governor's Electronic Classroom. This three-story building of 44,000 square feet provides more than 20 air-conditioned classrooms that are used to support all programs. This structure features divisible classrooms, a computer lab, art gallery, and faculty lounge.

The **Darold D. "Dud" King Center** for physical education building was completed and occupied in 1976. Seating for 2,100 spectators at athletic events is available. Two handball/racquetball courts, one squash court, offices, training rooms, swimming pool, and a basketball court are provided in this 60,000-square-foot structure. During the 2003-2004 year, the building was renovated to provide a wellness center and new locker rooms.

The **Christensen Hall of Fame** addition to the King Center honors past athletes, coaches, teams, athletic traditions and contributors by permanently dedicating a place to remember the past and to look to the future with pride for what the School of Mines stands for on the playing field and in the classroom. The Christensen Hall of Fame also honors Jim and Nancy Christensen, longtime supporters of the School of Mines. The Christensens' ties to School of Mines, its athletic programs and the Hardrock Club are deep. While Jim was a School of Mines student in the 1950s, he was a member of the Hardrocker football and track teams. He graduated from the School of Mines with a degree in General Engineering in 1957. A donation from the Christensens made the Hall of Fame possible.

The **Physical Plant Building**, completed in 1974, provides an excellent base for the operation of the university in the areas of electrical, mechanical, and other maintenance. This building also houses the campus mailroom.

The **Old Gymnasium** is used for intramural activities. It also houses the Office of Multicultural Affairs, and Museum of Geology laboratories.

O'Harra Field is one of the most unique athletic fields in the region. The architects took advantage of natural topographic features on three sides of the field to construct parking terraces that can accommodate approximately three hundred automobiles from which spectators can view the field. The playing field is encircled by an all-weather running track, renovated in 2002. The stadium is located on the north side of the field. The stadium was renovated in 1994.

Connolly Hall, completed in 1948, and remodeled in 1964, furnishes living accommodations for male and female students.

Palmerton Hall, completed in 1969, accommodates both male and female students. It is a completely carpeted five-story building with access to each floor provided by both elevator and stairs.

Howard Peterson Hall is a 300-bed residence hall that was occupied for the first time during the fall 2004 semester. It is located adjacent to the north end of the Surbeck Center. Room configurations include suites and standard double rooms. Study lounges, a kitchen, and an exercise room are included. Since the residence hall connects to the Surbeck Center's main floor, the cashier's office, the campus safety office, and a common front desk operation will serve both. The residence hall is named after Dean of Students Emeritus Howard Peterson, a School of Mines alumnus. who continues his service as a volunteer to the Foundation, the Alumni Association, and other aspects of campus life.

The **March-Dake Plaza**, located close to the former site of March-Dake Hall, honors two former School of Mines presidents who played important roles in making the excellent university it is today. The plaza honors the legacy that current university leaders strove to follow as the School of Mines moves into the future.

In 2004, renovations to the **Devereaux Library** opened another floor for collections, new study areas for students, news areas for special collections, and created a friendlier atmosphere for study and research. The library, completed in 1970, includes 56,000 square feet of modern space that is carpeted and air conditioned. The library houses the Tech Learning Center and serves as the Patent and Trademark Depository for the state.

Surbeck Center, the student union for the School of Mines provides more than just 71,000 square feet of space devoted to campus and community activities. It also provides information services, equipment check-out for students, and scheduling services for the campus. Surbeck Center's main office serves as a one-stop scheduling center that assists with the reservation and coordination of university resources for the various activities of the university - academic, student, departmental, community, and professional. Additionally, Surbeck Center staff provide assistance for all on-campus activities, events, academic, and summer conference scheduling.

Surbeck Center's main floor houses a large student lounge, the SDSM&T Alumni Association office, the bookstore, banquet-ballroom, the Career Planning, Placement, and CO-OP Education office, conference rooms, Counseling and Student ADA Services, the Vice President for Student Affairs and Dean of Students office, Health Services, mail boxes for all students living on campus, Student Accounts and Cashiering Services, the main office for Residence Life, and the Surbeck Center offices. The dining hall, snack bar, recreation area, Student Activities and Leadership Center, the Information Technology Services help desk, Ivanhoe International Center, the Multicultural Activities office, Campus Ministries, and display areas can be found in the lower level, in addition to more meeting rooms and "hang-out" space for students. Surbeck Center includes newly renovated spaces completed in 2004.

The **O'Harra Memorial Building** was completed in the summer of 1942 as a joint State and Federal Work Projects Administration Project. It houses the administration offices, the SDSM&T Foundation, and the Museum of Geology, and is named in honor of Dr. C.C. O'Harra, President and Professor of Geology at the university from 1911 to his death in 1935.

The **Kids Kastle Little Miner's Clubhouse** was established in 1995 to provide child-care services for students, faculty, staff, and area alumni.

HISTORY

The South Dakota School of Mines and Technology was originally established by the Dakota Territorial Legislature as the Dakota School of Mines in 1885 to provide instruction in mining engineering at a location where mining was the primary industry.

The School of Mines opened for instruction on February 17, 1887. Dr. Franklin R. Carpenter, a graduate of Ohio University, was appointed President and Dean of the Faculty. Degrees were initially offered in mining engineering, civil engineering, and general science. When North and South Dakota were granted statehood in 1889, the school was re-designated as the South Dakota School of Mines.

During the presidency of Dr. Robert Slagle (1896-1905), field geology was introduced, and a large collection of Badlands fossils and minerals was added to the geological museum. During that period, the third building was constructed on campus and the first School of Mines magazine was published. Faculty size and student enrollment reached a peak in 1905 that was not to be exceeded until 1920.

The university's reputation as a diversified science and engineering school was established following World War I with the rapid increase of engineering students and the termination of college preparatory courses. In 1943, the state legislature changed the name of the institution to the South Dakota School of Mines and Technology, in recognition of the school's expanded role in new areas of science and technology. Since that time, the university has expanded its curriculum to include ten engineering and six science undergraduate degrees and graduate programs leading to the master of science degree in ten engineering and/or science disciplines. The School of Mines offers programs leading to the doctor of philosophy degree in geology and geological engineering, materials engineering and science, atmospheric and environmental sciences, and nanoscience and nanoengineering.

As the bounds of technology continue to expand, the university continues to meet the challenge of preparing students for highly technical careers in engineering and science.

Location

Rapid City, South Dakota's second largest city, is located at the base of the Black Hills in the southwestern part of the state. Directly to the west is the beautiful Black Hills region, and to the east lie the awesome White River Badlands. Mount Rushmore and Crazy Horse Memorial are within a one-hour drive from the campus, and throughout the Black Hills are attractions that focus on the Native American and the early Gold Rush history of the area.

The Black Hills area is a naturalist's dream. There are many caves to explore, mountains to hike and ski, and streams to enjoy. In addition, there are a vast variety of rocks and minerals, wildlife, and plant life indigenous to the area.

The Badlands, formed by natural erosion, offer the viewer an eerie but beautiful landscape of multicolored peaks and deep ravines. The Badlands area, as well as the northwest and southwest portions of South Dakota, offer some of the world's most prolific sources of fossils. Discoveries of a Tyrannosaurus rex skeleton, a Triceratops skull, and a mammoth butcher site have added to this reputation. More than four million visitors enjoy the Black Hills/Badlands area each year.

Campus Safety

The School of Mines is committed to the safety of students and employees. Safety personnel regularly monitor the campus and work closely with the Rapid City Police Department to enforce community, state, and federal laws.

Emergency telephones are located on the campus. In addition, the campus escort service may be utilized 24 hours a day by calling campus safety at (605) 394-6100.

With the assistance of the Rapid City Police Department, the School of Mines provides safety and security education and awareness programs. The purpose of these programs is to make the campus community aware of safety issues and techniques. The programs also cover alcohol and drug abuse control and prevention.

Campus emergency procedures and statistics are outlined in the campus safety brochure that is distributed annually to all students and university personnel. It is also available on the School of Mines web site and from the Dean of Students Office and Vice President for Student Affairs.

SDSM&T Alumni Association

The South Dakota School of Mines and Technology Alumni Association promotes communication and interaction among alumni, students, faculty, and administrators of the School of Mines with the objective of strengthening the university's academic, research, and service roles. The association also provides an alumni network and support services for graduates throughout the world.

Services provided by the Alumni Association include maintenance of the alumni database, an semiannual publication (the Hardrock) mailed to friends of the school and all alumni, a weekly electronic newsletter (the Hardrock E-News), a biennial alumni directory, coordination of alumni recognition programs, area meetings, class reunions and get-togethers, and an all-school reunion every five years. The most recent five-year reunion was held July 6-10, 2005.

The Alumni Association also provides student support funds and mentoring, and helps coordinate the Tech Alumni Recruiting Program (TARP). The Alumni Association is a 501(c)3 non-profit South Dakota corporation governed by a Board of Directors. The Alumni Office is located in the Surbeck Student Center. For more information regarding the Alumni Association, please visit or contact the office at (605) 394-2347 or via e-mail at alumni@sdsmt.edu.

SDSM&T Foundation

The South Dakota School of Mines and Technology Foundation is a tax exempt 501(c)3 charitable organization that exists solely to serve the university by seeking the resources necessary to provide exceptional intellectual, professional, and personal development opportunities. Resources provided by the SDSM&T Foundation include student scholarships and graduate fellowships, the short-term loan program, general student assistance, faculty assistance, and areas of greatest need. Assistance is also provided to faculty for faculty development and research, educational leaves, travel costs, seminars, paper presentations, and educational support.

Campaigns to solicit funds from alumni and campus staff are held annually, as well as mini-campaigns for special purposes and an on-going approach to corporations for support. The Foundation's portfolio is professionally managed and all accounts are audited yearly.

The Foundation Office is located in the lower level of the O'Harra Building.

TECH VENTURES, INC.

Tech Ventures, Inc. is a for-profit corporation wholly owned by the South Dakota School of Mines and Technology Foundation. Its purpose is to support commercialization of research projects linked to School of Mines faculty and researchers. Tech Ventures Inc. assists in all aspects from start up, to seeking venture capital, to operating the new companies. Through these partnerships, Tech Ventures generates unrestricted revenues used to support the Institution.

Mines Matters: In the summer of 1994, School of Mines formalized an agreement with the Technische Universitat, Bergakademie, Freiberg, Germany to initiate and exchange students and to develop further academic cooperation. Participating undergraduate students pay their tuition and fees at School of Mines but attend classes in Germany. Both universities recognize academic credits received by the students. For more information contact Academic and Enrollment Services at (605) 394-2400.

ADMISSIONS

Authorization for Individual Institutional Policies

Each university may adopt specific admission regulations, consistent with law and the requirements set by the Board of Regents, as may be required for each school or program to assure acceptable student preparation and enrollment levels. A copy of such regulations and any subsequent amendments shall be filed with the Executive Director and shall be subject to review by the Board of Regents.

New Admissions Requirements For Fall 2006

The Board of Regents (BOR) requires that all students meet the minimum course requirements for admission to the South Dakota School of Mines and Technology. These are described below under South Dakota Board of Regents Minimum Undergraduate Admissions Requirements.

In addition, The Board of Regents approved the following requirements for admission to the School of Mines, effective Fall 2006.

School of Mines will **review and consider for acceptance** students who meet BOR requirements

AND

- obtain an ACT composite score of at least 21 (or equivalent SAT-I score)

OR

- obtain an ACT math subscore of at least 21 (or equivalent SAT-I score)

OR

- achieve a high school GPA of at least 2.75 on a 4.0 scale.

School of Mines will **automatically accept** for admission students who:

- obtain an ACT composite score of at least 25 AND obtain an ACT math subscore of at least 25 (or SAT-I equivalent score)

OR

- obtain a high school GPA of at least 3.5 on a 4.0 scale and have taken four years of mathematics

OR

- are South Dakota Regents' Scholars

Students who meet the South Dakota Board of Regents requirements for baccalaureate degree admissions but do not meet School of Mines requirements may enroll in the Associate of Arts in General Studies degree program.

South Dakota Board of Regents Minimum Undergraduate Admissions Requirements

A. Baccalaureate Degree Admissions for High School Graduates

For admission to baccalaureate degree programs, high school graduates must:

- meet the minimum course requirements with an average grade of C (2.0 on a 4.0 scale);

OR

- demonstrate appropriate competencies in discipline areas where course requirements have not been met;

AND

- rank in the top 60 percent of their high school graduating class;

OR

- obtain an ACT composite score of 18 (SAT-I score of 870) or above;

OR

- obtain a high school GPA of at least 2.6 on a 4.0 scale.

SDSM&T ACT CODE - 3922
SDSM&T SAT CODE - 6652

1. Minimum Course Requirements

Effective the fall of 1996, all baccalaureate or general studies students under twenty-one (21) years of age, including students transferring with fewer than twenty-four (24) credit hours, must meet the following minimum high school course requirements.

a. Four years of English — Courses with major emphasis upon grammar, composition, or literary analysis - one year of debate instruction may be included to meet this requirement.
b. Three years of advanced mathematics — Algebra, geometry, trigonometry, or other advanced mathematics including accelerated or honors mathematics (algebra) provided at the 8th grade level; not included are arithmetic, business, consumer, or general

mathematics or other similar courses.

c. Three years of laboratory science — Courses in biology, chemistry, or physics in which at least one (1) regular laboratory period is scheduled each week. Accelerated or honors science (biology, physics, or chemistry) provided in the 8th grade shall be accepted. Qualifying physical science or earth science courses (with lab) shall be decided on a case-by-case basis.
d. Three years of social studies — History, economics, sociology, geography, government — including U.S. and South Dakota, American Problems, etc.
e. At the time of admission to a South Dakota Board of Regents university, it is expected that students will have basic keyboarding skills and have had experience in using computer word-processing, database and spreadsheet packages, and in using the Internet or other wide-area networks. These expectations may be met by high school course work or demonstrated by some other means. Incoming students assessed and found deficient in this area may be required to complete specific computer skills courses.
f. One year of fine arts effective Fall 2002 for students graduating from South Dakota high schools in 2002 – Art, theatre, or music (appreciation, analysis, or performance). Documented evidence of high school level non-credit fine arts activity will be accepted for students graduating from high schools in states that do not require completion of courses in fine arts for graduation.

2. <u>Alternate Criteria for Minimum Course Requirements</u>

a. Students who do not successfully complete four years of English may meet minimum course requirements through one of the following:
   i. An ACT English subtest score of eighteen (18) or above;
   ii. An Advanced Placement Language and Composition or Literature and Composition score of three (3) or above.
b. Students who do not successfully complete three years of advanced mathematics may meet minimum course requirements through one of the following:
   i. An ACT mathematics subtest score of 20 or above;
   ii. An Advanced Placement Calculus AB or Calculus BC score of three (3) or above.
c. Students who do not successfully complete three years of laboratory science may meet minimum course requirements through one of the following:
   i. An ACT science reasoning subtest score of seventeen (17) or above;
   ii. An Advanced Placement Biology, Chemistry, or Physics B score of three (3) or above.
d. Students who do not successfully complete three years of social studies may meet minimum course requirements through one of the following:
   i. An ACT social studies/reading subtest score of seventeen (17) or above;
   ii. An Advanced Placement Microeconomics, Macroeconomics, Comparative or United States Government and Policies, European or United States History, or Psychology score of three (3) or above.
e. Effective Fall 2002, students graduating from South Dakota high schools in 2002 who do not successfully complete one year of fine arts may demonstrate fine arts knowledge or competency through the following:
   i. An Advanced Placement History of Art, Studio Art drawing, or general portfolio or Music Theory score of three (3) or above.

B. Associate Degree Admissions for High School Graduates

A student who seeks admission to an associate degree program may gain acceptance by meeting any one of the following criteria:

- Baccalaureate admissions requirements; OR
- Ranking in the top 60% of their graduating

class;
OR
- A composite score of eighteen (18) or above on the enhanced ACT;
OR
- A cumulative GPA of 2.6 while in high school.

Individual degree programs may have additional admissions requirements.

Associate Degree students who did not meet the baccalaureate degree admission requirements and who want to enter a baccalaureate degree program must:
- Complete at least fifteen (15) credit hours of the system general education requirement with a 2.0 GPA;
AND
- Meet university minimum progression standards.

Exception Group: Each university may admit a group of students to associate programs, limited in size to 10% of the previous year's freshman class, at the discretion of the university.

C. Non-High School Graduates, Including Home Schooled Students

An applicant for baccalaureate or associate admissions who is not a high school graduate must:
- Obtain an ACT composite score of eighteen (18), ACT English sub-test score of eighteen (18) or above, Mathematics sub-test score of twenty (20) or above, Social Studies/Reading and Science Reasoning sub-test scores of at least seventeen (17), and meet any university determined requirements for admission to baccalaureate programs. Students must be at least eighteen (18) years of age, or the high school class of which the student was a member must have graduated from high school;
OR
- completed the General Equivalency Diploma (GED) with a combined score of 225 and minimum of 40 on each test (paper based) or 2250 combined score and minimum of 410 on each test (computer based).

D. Non-Traditional Students

For purposes of admission, a degree-seeking student who has attained the age of twenty-one (21) and has not previously attended any post-secondary institution is classified as a non-traditional student. It is the policy of School of Mines to recognize that there is a great diversity in the background and goals of non-traditional students seeking college admissions. Each individual will be evaluated for admission to School of Mines based on the minimum requirements as prescribed by the Board of Regents and the School of Mines admission standards. Additional consideration will be given to non-traditional students who do not meet the BOR undergraduate admission requirements.
- Non-traditional students who are high school graduates and meet the BOR minimum requirements will be admitted.
- Non-traditional students who are not high school graduates and have obtained an ACT composite score of 18, ACT English sub-test score of at least 18, Mathematics sub-test score of at least 20, and Social Studies/Reading and Science reasoning sub-test scores of at least 17, and meet any university determined requirements for admission will be admitted.
- Non-traditional students who are not high school graduates and have completed the General Equivalency Diploma (GED) with a combined score of 225 and minimum of 40 on each test (paper based) or 2250 combined score and minimum of 410 on each test (computer based) will be admitted.
- Non-traditional students who do not fit within the above categories will be considered for admission based on life experience and other evidence of success. Applications will be reviewed by a review group composed of the Director of Retention and Testing, the Director of Admissions, and an Admissions Counselor. An applicant accepted under this section will be placed on a one semester probationary status. The review group reserves the right to impose additional conditions.

E. Exception Group

Each university may admit a group of students to baccalaureate programs, limited in size to 3% of the previous year's freshman class, at the discretion of the university.

F. Regents Scholars

Effective Fall 2001, South Dakota high school graduates completing the following high school courses with no final grade below a "C" (2.0 on a 4.0 scale) and an average grade of "B" (3.0 on a 4.0 scale) shall be designated as Regents Scholars and shall be eligible to receive a Regents Scholar Diploma upon request by a high school administrator to the Department of Education and Cultural Affairs. High school graduates designated as Regents Scholars automatically are admitted to all six public universities. (Regent Scholars still need to submit the admission application.)

- **4 units of English**: Courses with major emphasis upon grammar, composition, or literary analysis; one year of debate instruction may be included to meet this requirement.
- **4 units of algebra or higher mathematics**: Algebra, geometry, trigonometry, or other advanced mathematics including accelerated or honors mathematics (algebra) provided at the eighth grade level; not included are arithmetic, business, consumer or general mathematics, or other similar courses.
- **4 units of science including 3 units of approved laboratory science**: Courses in biology, chemistry, or physics in which at least one (1) regular laboratory period is scheduled each week. Accelerated or honors science (biology, physics, or chemistry) provided in the eighth grade shall be accepted. Qualifying physical science or earth science courses (with lab) shall be decided on a case-by-case basis.
- **3 units of social studies**: History, economics, sociology, geography, government—including U.S. and South Dakota, American Problems, etc.
- **2 units of a modern (including American Sign Language) or classical language**
- **1 unit of fine arts**: Effective Fall 2002 for students graduating from South Dakota high schools in: Art, theatre, or music appreciation, analysis, or performance.
- **1/2 unit of computer science**: Students will have basic keyboarding skills and have had experience in using computer word-processing, database and spreadsheet packages, and in using the Internet or other wide-area networks.

UNDERGRADUATE TRANSFER ADMISSION

A. Transfers to Baccalaureate Programs

Students under twenty-one (21) years of age transferring into baccalaureate degree programs with fewer than twenty-four (24) transfer credit hours must meet the baccalaureate degree admission requirements. Students with twenty-four (24) or more transfer credit hours with a GPA of at least 2.0 may transfer into baccalaureate degree programs at the discretion of the university. If students are applying for federal financial aid, they must meet federal guidelines for transfer students.

Technical Institute and Community College Credits

Technical Institute courses are designed to prepare students to enter the workforce for careers requiring less than a baccalaureate degree. Acceptance of these courses for credit at the South Dakota public universities is strictly the function of the receiving institution. Students who wish to transfer credits to a South Dakota public university for programs other than the Bachelor of Applied Technical Science degree not available through the School of Mines should contact the Admissions Office of that desired university for an evaluation of their program objectives and technical institute transcript. An individual evaluation of course credits will be made by the receiving public university in accordance with institutional and Board of Regents policy.

Total transfer credit for work at a junior, community college (2 year), and/or two-year technical college may not exceed one-half of the hours required for completion of the baccalaureate degree at the accepting institution. Students who have completed more than the acceptable semester hours of junior, community or technical college work may apply completed, transferable courses to specific course requirements and thereby may not be required to repeat the courses. The semester hours of credit for those additional courses may not be applied toward the minimum credit hours required for the degree.

B. Students who Transfer to Associate Programs

Students younger than twenty-one (21) years of age transferring into associate degree programs with fewer than 12 transfer credit hours must meet the associate degree admission requirements. Students with 12 or more transfer credit hours with a GPA of at least 2.0 may transfer into associate degree programs at the discretion of the university. If students are applying for federal financial aid, they must meet federal guidelines for transfer students.

C. Students from Accredited Colleges or Universities

At the discretion of each university, students may be accepted by transfer from other colleges within or outside of the state; preferential consideration shall be given to applicants from institutions which are accredited by their respective regional accrediting association. Advanced standing shall be allowed within the framework of existing rules in each college.

D. Students from Non-Accredited Colleges

A university may refuse to recognize credits from a non-accredited college or may admit the applicant on a provisional basis and provide a means for the evaluation of some or all of the credits. The validation period shall be no less than one (1) semester and no longer than one (1) academic year.

An applicant for admission to the South Dakota School of Mines and Technology is considered a transfer applicant if he/she has enrolled for any college level work, full or part-time, since graduation from high school. The applicant must be in good standing and eligible to return to all colleges/universities attended. In general, a "B" quality average in courses attempted at other institutions is expected. Applicants from accredited institutions ordinarily are granted credit toward their degree for work satisfactorily completed at the previous institutions, provided such courses are equivalent or comparable to those required in the program an applicant is considering at School of Mines. Credits from institutions, which are not accredited by a regional accrediting association, will be provisional and subject to validation. No credit is allowed for remedial courses.

E. Former Students

A student returning to the institution or a student who has attended another higher education institution in the Board of Regents system is not required to pay the application fee, but he or she must submit an application for readmission and other required documents if he or she has interrupted attendance by two (2) or more semesters. A former student shall be considered as a transfer student if he or she has attended another institution during the period of interruption of attendance.

F. Suspended Students

A transfer applicant under academic suspension from the last college attended shall not be considered for admission during the period of suspension or, if suspended for an indefinite period, until one (1) semester has passed since the last date of attendance at the previous school.

G. Disciplined Students

A transfer applicant under disciplinary suspension shall not be considered for admission until a clearance and a statement of the reason for suspension is filed from the previous institution. The university shall take into account the fact of the previous suspension in considering the application.

SPECIAL (NON-DEGREE SEEKING) STUDENTS

A prospective student at South Dakota School of Mines and Technology who wishes to be classified as a special student must complete the Application for Non-degree Seeking Students. Special students are ineligible for all federal financial aid programs, and are limited to enrolling in no more than 30 credit hours of courses without meeting the School of Mine's admission requirements by becoming a degree-seeking student. Non-Degree seeking students must submit an official copy of their previous college transcript(s) if necessary to verify prerequisites.

Dual Enrollment of High School Students

High school students who wish to take courses at School of Mines should begin by contacting the Admissions Office at School of Mines and then the Principal's Office or Guidance Office at the high school they are currently attending to receive the high school's approval to participate. This approval should accompany the School of Mines Admissions Application. Please refer to the following legislative bill for further information.

SDCL 13-28-37, enacted by the South Dakota Legislature in 1990, states the following:

"Any student in grades eleven and twelve may enroll in not more than two (2) courses per fall or spring semester which are offered at an institution of higher education or post-secondary vocational education institution. The student shall obtain the school district's approval of the post-secondary course prior to enrolling in the course. If approved, the student shall receive full credit toward high school graduation as well as post-secondary credit for the post-secondary course. The resident school district is not responsible for any costs involved with attendance at the post-secondary institution by a student enrolled in the district. The student is responsible for any additional fees and costs involved with attending a post-secondary institution in accordance with this section. If a failing grade is received in a post-secondary course under this section, the student receiving the failure is no longer eligible to enroll for post-secondary courses under this section."

Additional Admissions Policies and Practices

Institutions authorized by the Board of Regents to offer graduate study programs may admit students selected according to regulations established by each faculty. A graduate student will be defined as one who has been accepted into a graduate school.

Effective spring semester 2000, all entering students seeking an associate or baccalaureate degree must provide valid Enhanced ACT scores or must take the ACT COMPASS examination in the areas of writing skills, mathematics, and reading. All non-degree seeking students enrolling in English and mathematics courses must provide Enhanced ACT scores or must take the ACT COMPASS examination in the areas of writing skills and mathematics.

Students enrolled prior to Spring 2000 who have already been placed into their initial mathematics and English coursework, and transfer students who have completed equivalent general education coursework in English and mathematics are exempt from this requirement.

Students transferring within the South Dakota Board of Regents system will be allowed to transfer their placement test scores and continue their sequence of courses in English and/or mathematics.

The placement process will be consistent for all Regental institutions.

Applications and Procedures

A. Application for Tuition and Fee Reductions and Scholarships Established by the Legislature

Students should contact the Admissions Office at each university for information on eligibility for tuition and fee reductions and scholarships established by the Legislature.

B. Application Submission

An applicant for admission must submit the required application for admission and the necessary official transcript or transcripts and other required documents to the Enrollment Services Center (414 E. Clark Street, SDU 317, Vermillion, SD 57069, (800) 404-1547).

C. Records Required

Applicants who are twenty-one (21) years of age or younger must submit Enhanced ACT (or SAT-I) results, an official high school transcript, if a high school graduate, or proof of GED and an official transcript for all previous college work as part of their application. Applicants who are older than twenty-one (21) years of age and who do not have valid ACT / SAT-I exam results, or who have not taken the exams are not expected to take the exam. However, they are required to submit an official high school transcript, if a high school graduate, and an official transcript for all college work. Applicants should also submit any other records, data, or letters required to support eligibility for admission, including competency test scores. SAT scores will be converted to ACT equivalencies according to a conversion table approved by the Board of Regents. Note: An official transcript is one that bears the original seal and signature of the official in charge of records at that institution.

D. Preadmission Immunization Requirements

1. All students, whatever their classification or status, who reside on campus or who receive instruction at one of the residential campuses, and students who attend classes at USDSU in Sioux Falls must document their immune status for measles, mumps and rubella. Students who attend classes only at other self-support centers, or who take classes only through the Internet, are not subject to preadmission immunization requirements. Proof of two (2) doses of measles vaccine or of the presence of an immune antibody titer against measles shall be required. Immunization for tetanus, diphtheria, poliomyelitis, varicella and meningitis is recommended, as is a tuberculin test. Vaccination for hepatitis B is also recommended and is required for students enrolled in certain healthcare programs. Each institution will compile information about current program-related vaccination requirements and make this information available to students along with other curricular and registration materials. This documentation may be accomplished by either a State Health Department certificate, or it may be included as part of the institution's physical exam report.

2. A student who fails to provide satisfactory documentation of his or her immune status shall not be permitted to register for or to attend classes. An institution's president or the president's designee may grant an extension of the deadline for an amount of time determined necessary. In no case may the extension be longer than one semester.

3. Students who are unable to ascertain their immunization status may obtain, at their own expense, the necessary tests and vaccination from the student health service of their university.

4. In the event the South Dakota State Department of Health declares an epidemic of measles or rubella, the institution involved shall provide to the State Department of Health a list of students who have not submitted immunization documentation. Subsequent campus actions shall consider the advice and authority of the South Dakota State Department of Health. Students who have no vaccination or immunity against the required preventable infectious diseases may be dismissed from the campus.

FRESHMAN CHECKLIST

- Submit application for admission.
- Enclose non-refundable application fee with application for admission ($20.00).
- ACT or SAT I scores must be on file in the Admissions Office.
- Applicants must arrange to have an official copy of their high school transcript forwarded to the Enrollment Services Center (414 E. Clark Street, SDU 317, Vermillion, SD 57069) after their junior year is complete and grades have been recorded. A final transcript will also be necessary in order to verify final class rank, graduation, and satisfaction of the minimum course requirements for admission to South Dakota Public Higher Education Institutions.
- Prospective freshmen desiring scholarship consideration must be accepted for admission prior to March 1.

TRANSFER CHECKLIST

- Application for admission.
- Non-refundable application fee of $20.00. If the student has previously attended a South Dakota state university and paid the application fee, it is not assessed again.
- An official transcript from each post-secondary institution attended. (Sent by the institution attended directly to the Enrollment Services Center, 414 E. Clark Street, SDU 317, Vermillion, SD 57069.)

- All applicants must submit a high school transcript, or other proof of graduation from high school; or, if not a high school graduate, they must submit copies of their high school equivalency/GED scores and an official transcript of high school work completed.
- Applicants younger than twenty-one (21) who have completed less than 24 semester credits of college work must submit official copies of SAT I or ACT scores in addition to the above documents.
- Applicants who will be less than twenty-one (21) years of age at the beginning of the semester for which they are applying for admission, and who have completed less than 24 credit hours of college course work must meet the minimum course requirements for admission to SD Public Higher Education Institutions. (See "South Dakota Board of Regents minimum Undergraduate Admission Requirements.")

Transfer applicants will be notified of their admission status at School of Mines shortly after all of the above documents have been submitted. No transfer credit evaluation will be made until "final" college/university transcripts are on file. Transfer credit evaluation is made by the Office of Academic and Enrollment Services in consultation with the chair of the academic department in which the applicant intends to major.

Undergraduate International Student Admission

To be considered for admission, international students must meet the following requirements:

1. Rank in the upper half of secondary school graduation class.
2. Have a 3.0 (B) grade average if transferring from a college or university in the United States.
3. Be proficient in English or attend an approved intensive English as a Second Language (ESL) program upon arrival.
4. Be financially self-sustaining. (Admission to School of Mines is not dependent on the ability to show adequate financing for education, but the I-20 will not be issued without this information.)

The following items are necessary before a request for admission can be processed, acceptance granted, and the United States Department of Justice Form I-20 issued. The form I-20 is necessary for admission to the United States for college attendance. The US Embassy or Consulate will supply detailed information on student status and required visas.

1. A completed application for admission to the Office of Admissions submitted prior to June 30 (Fall) or November 10 (Spring) and the State of South Dakota application fee of $20.00. (The application will not be processed until the $20.00 US fee is paid.) The deadline for the application is at least sixty (60) days prior to the beginning of the term for which admission is desired.
2. Academic credentials (translated into English). All documents submitted to School of Mines to substantiate a request for admission must be certified by an official school or governmental seal.
3. English proficiency for students from countries in which English is not the native language must be verified by the TOEFL (Test of English as a Foreign Language) examination that is published by the Educational Testing Service (ETS). The results must be sent to the Office of Academic and Enrollment Services (AES), South Dakota School of Mines and Technology, 501 E. Saint Joseph Street, Rapid City, SD 57701-3995. A TOEFL score of 530 (paper-based) or 200 (computer-based) or better is required for undergraduate applicants.

   For Norwegian students, School of Mines will accept in lieu of the TOEFL examination a favorable recommendation from a Norwegian professor who has been on a School of Mines exchange status, or who is familiar with admissions standards at School of Mines. Information on worldwide test centers for the TOEFL, as well as registration information, can be obtained by contacting any U.S. Embassy or Consulate or by writing to Test of English as a Foreign Language, ETS, Princeton, NJ 08540, or by visiting their web site at www.toefl.org.
4. Recommendations from two (2) professors or instructors familiar with the academic

performance of the applicant.

5. Affidavit of Financial Responsibility. Admission to School of Mines is not dependent on the ability to show adequate financing for education, but the I-20 will not be issued without this information. The United States Immigration and Naturalization Service (INS) requires that a U.S. college or university issuing form I-20 or IAP-66 establish that the person to whom the form is issued is able to pay all educational and incidental expenses. The international applicant must provide a statement of finances (in English). This includes a financial (bank) statement from the student or sponsor, which must be verified by a bank official. (The bank statement must show the actual amount—or more—that is available to the student. A statement that says "ample funds" is not acceptable.) If the student has a financial sponsor, a letter or affidavit of support must accompany the financial statement. If the sponsor is a government agency, a letter of award and instructions for invoice procedures should be sent. International students are not eligible for School of Mines or federal loan programs and should not apply for such financial assistance.

International Students must attend the school specified on their visa or they may be refused admittance to the United States. A student entering the United States for study must maintain his/her status. More information is available at the Ivanhoe International Center. Prospective students should not enter the United States on a B-1 or B-2 visitor's visa, as the Immigration and Naturalization Service may not approve a change to the F-1 student visa. International students must not, under any circumstances, enter the United States with a WT if they are planning to become a full-time student. The WT status cannot be changed or extended, under any circumstances, once the student is in the United States.

New US government reporting requirements have been added for international students (F and J status). As a result of the regulations that became effective on January 1, 2003, the Family Educational Rights and Privacy Act (FERPA) is waived for F and J students in respect to these specific reporting requirements. The regulations will be strictly enforced by the appropriate bureau(s) within the US Department of Homeland Security (DHS) and information will be reported electronically to DHS via Student and Exchange Visitor Information System (SEVIS). The consequences to students for non-compliance with the new regulations are severe. Contact the Director of the Ivanhoe International Center for additional information.

Electronic University Consortium

In Fall 2000, the Electronic University Consortium (EUC) came on-line at www.WorldClassEducation.org. The EUC provides a single connection point for distance education offerings from South Dakota School of Mines and Technology, as well as our sister institutions South Dakota State University, University of South Dakota, Dakota State University, Northern State University, and Black Hills State University. Students from throughout the world are able to register for and participate in classes offered via the Internet from any of these institutions. Courses offered by two-way interactive video and by correspondence are also listed on the EUC.

Western Undergraduate Exchange

South Dakota School of Mines and Technology participates in the Western Undergraduate Exchange (WUE), a program of the Western Interstate Commission for Higher Education and other western states. Through WUE, certain new freshmen and transfer students who began their attendance at a South Dakota public university in the Fall 1989 semester, or later semesters, and are not residents of South Dakota, but who are legal residents of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, Utah, Washington, or Wyoming may enroll at South Dakota School of Mines and Technology at a cost of 1.5 times the resident tuition rate (plus other fees that are paid by all students). This represents a substantially lower cost than the standard nonresident tuition rate.

Information about the WUE program may

be obtained from the Office of Admissions.

Because South Dakota participates in the WUE program, residents of South Dakota may enroll under the same terms in designated institutions and programs in other participating states. South Dakota residents may obtain information about WUE programs in other states from the South Dakota WICHE Student Exchange Program Officer, South Dakota Board of Regents, 306 East Capitol Avenue, Suite 200, Pierre, SD 57501, Telephone: (605) 773-3455; or from WICHE Student Exchange Program, P.O. Box 9752, Boulder, CO 80301-9752, Telephone: (303) 541-0214.

RESIDENT AND NONRESIDENT CLASSIFICATION OF STUDENTS

Purposes of Classification

Each person who applies for admission to a university shall be classified as a resident or a nonresident for admissions and tuition and fees purposes (See Policy 2:3 Admissions and Policy 5:5 Tuition and Fees).

Information, Burden of Establishing Residency, Reclassification

A. The decision shall be based upon information provided by the student and all other relevant information.

B. The institution is authorized to require such written documents, affidavits, verifications, or other evidence as are deemed necessary to establish the residence of the student, including proof of emancipation, adoption, or appointment of a guardian.

C. Students have the burden of establishing residency by clear and convincing evidence.

D. Students may appeal the original classification decision by written petition to a reviewing body appointed by the chief executive officer of the institution within thirty (30) days after registration for that semester. The recommendation of the reviewing body shall be submitted to the chief executive officer for a decision. The decision of the chief executive officer shall be final, but students who have been classified as nonresidents retain full rights to petition the Executive Director of the South Dakota Board of Regents for reclassification after they have remained in South Dakota continuously for 12 months.

E. After twelve (12) months continuous presence in South Dakota, students who were initially classified as nonresidents may petition for reclassification.

F. Petitions for reclassification shall be filed with the Executive Director, who shall act upon them. The Executive Director shall report his disposition of such petitions to the Board at its regularly scheduled meetings. These reports shall be summarized in a manner consistent with the Family Educational Rights and Privacy Act.

G. If a petition for reclassification is granted, the reduced tuition rate shall become effective with the first semester or session following the date on which the petition is granted. Students who fail to request resident status prior to a particular semester or session or to pursue a timely appeal shall be deemed to have waived any claim for reduced tuition for that semester or session.

H. A student or prospective student who knowingly provides false information or refuses to provide or conceals information for the purpose of improperly achieving resident student status is subject to the full range of penalties, including expulsion, provided for by the Board of Regents.

Establishing Bona Fide Residency

For tuition purposes, residence means the place where a person has a permanent home, at which the person remains when not called elsewhere for labor, studies or other special or temporary purposes, and to which the person returns at times of repose. It is the place a person has voluntarily fixed as the person's permanent habitation with intent to remain in such place for an indefinite period. A person, at any one time, has but one residence and a residence is not lost until another is gained.

A. The residence of an unemancipated person younger than twenty-one (21) years of age follows that of the parents or of a legal guardian who has actual custody of the person or administers the property of the person. In the case of divorce or separation, if either parent meets the residence requirements, the person shall be considered a resident.

Students who enter the state for the predominant purpose of attending a Board institution and who are under the custody of a guardian in fact, that is, a person who has been designated in writing by the students' parents or legal guardian to serve as their attorney in fact for purposes related to the individual unemancipated student's affairs, may file a residency petition with the Board at the time of admission.

B. A person shall be classified as a resident student if the person has continuously resided in South Dakota for at least 12 consecutive months immediately preceding the first scheduled day of classes of the semester or other session in which the individual registers in the regental system; except that unemancipated students whose parents established their residence in South Dakota for reasons not predominantly related to qualifying their children for reduced tuition, may be classified as residents, notwithstanding the fact that they have not resided in South Dakota for the requisite 12 months prior to the first scheduled day of classes.

   If it appears that the parents of a person properly classified as a resident student under the provisions of this section have removed their residence from South Dakota, the person shall be reclassified to the status of nonresident unless the parents have been residents for the 12 months immediately preceding such removal. However, no such reclassification is effective until the beginning of a semester next following the removal.

C. Physical presence in South Dakota for the predominant purpose of attending an institution of higher education controlled by the Board does not count in determining the 12-month period of residence. Absence from South Dakota to pursue postsecondary education does not deprive a person of resident student status.

D. A person once properly classified as a resident student shall be deemed to remain a resident student so long as remaining continuously enrolled in the regental system until the person's degree shall have been earned, subject to the provisions of (B) above.

E. International students whose visas permit them to establish domiciles in the United States or its territories or protectorates may qualify for resident tuition in the same manner as United States citizens.

Factors to Be Considered When Determining Whether Students Have Entered South Dakota for the Predominant Purpose of Attending a Public University

A. The following factors shall be considered relevant in evaluating a requested change in a student's nonresident status and in evaluating whether the person's physical presence in South Dakota is for the predominant purpose of attending an institution of higher education controlled by the Board:
   - The residence of an unemancipated student's parents or guardians;
   - The situs of the source of the student's income;
   - To whom a student pays taxes, including property taxes;
   - The state in which a student's automobile is registered;
   - The state issuing the student's driver's license;
   - Where the student is registered to vote;
   - The marriage of the student to a resident of South Dakota;
   - Ownership of property in South Dakota and outside of South Dakota;
   - The residence claimed by the student on loan application, federal income tax returns, and other documents;
   - Admission to a licensed profession in South Dakota;
   - Membership in civic, community, and other organizations in South Dakota or elsewhere; and
   - The facts and documents pertaining to the person's past and existing status as a student.

B. The existence of one or more of these factors does not require a finding of resident student status, nor does the nonexistence of one or more require a finding of nonresident student status. All factors shall be considered in combination, and resident student status may not result from the doing of acts which are required or routinely done by sojourners in the state or which are merely auxiliary to the fulfillment of educational purposes.

C. The fact that a person pays taxes and votes in the state does not in itself establish residence.

D. Students who do not meet the requirements of this policy may still be classified as residents if their situation presents unusual circumstances and their classification is within the general scope of this policy.

Retention of Residence While in Military Service

In determining the residence status for tuition purposes, it is presumed that persons in military service who list South Dakota as their "home of record" and who, immediately upon release, return to South Dakota to enter college shall be classified as residents.

*Mines Matters: In just its fifth year of competition, the South Dakota School of Mines and Technology captured **first place** in the 2005 Aero Design West remote-controlled airplane competition in Fort Worth, Texas. The School of Mines team spent months designing, building and testing the remote-controlled biplane that features a 5-foot wingspan. At the competition, the plane carried 19 pounds of added lead weight, the most of any of the nearly 40 teams, and placed third in design.*

TUITION AND FEES

TUITION, LIVING, AND OTHER EXPENSES

Using Academic Year May 9, 2005 - May 7, 2006
For current information see the web site: www.sdsmt.edu

All charges and procedures listed are subject to change pending Board of Regents action.

TUITION AND FEES

Tuition and Fees	Resident	Non-Resident
Tuition		
Undergraduate on-campus per semester credit	$ 76.35	$ 242.60
Graduate on-campus per semester credit	$ 115.80	$ 341.45
University Support Fee - per credit	$ 62.80	$ 62.80
General Activity Fee - per credit	$ 19.40	$ 19.40

See accompanying text for the description of fees
for Engineering and Science courses as well as labs.

* For residency information, contact the Admissions Office or refer to Board of Regents Policy at: www.sdbor.edu/policy/5_FinanceBusiness/.

Reduced tuition is available for children of alumni, residents of Minnesota, Nebraska, and Iowa and states participating in the Western Interstate Commission for Higher Education - currently, Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, Utah, Washington, and Wyoming. Tuition assistance is also available to National Guard members, ROTC cadets, SD State Employees, certain elementary and secondary school teachers and vocational instructors, and persons 65 years of age or older. Graduate student who hold a state contract for an assistantship or fellowship may also be entitled to special reduced tuition and should contact the Graduate Education Office at (605)394-1206.

CAMPUS ROOM AND BOARD COSTS

Meal Plan, per semester

Students have a choice of five Meal Plans ranging from $585.00 to $1,036.00 per semester. Freshman students living in the residence halls must have either the Platinum, Gold, or Silver meal plan. For more detailed information, contact the Campus Dining Office at (605)394-1953.

Resident Hall Rent - per semester	Resident	Non-Resident
Double Occupancy (Palmerton/Connolly)	$ 915.20	$ 915.20
Single Occupancy (Connolly)	$ 1,198.45	$ 1,198.45
Double (Peterson)	$ 1,058.50	$ 1,058.50
Double Deluxe (Peterson)	$ 1,114.00	$ 1,114.00
Quad (Peterson)	$ 1,267.30	$ 1,267.30
Deluxe or Study Quad (Peterson)	$ 1,369.50	$ 1,369.50

TYPICAL EDUCATION EXPENSES FOR FULL TIME UNDERGRADUATE FOR ONE SEMESTER

	Resident	Non-Resident
Tuition and Fees - 15 credits	$ 2,537.00	$ 5,031.00
Books and supplies (estimate)	$ 500.00	$ 500.00
Room and Board	$ 2,096.00	$ 2,096.00
Total	$ 5,133.00	$ 7,627.00

PAYMENT PROCESS

All tuition and fees are required to be paid in full or other financial arrangement made with the Cashier's Office no later than the third day of fall and spring semester classes and first day of summer semester classes. If no financial arrangement is made by these dates, a late charge will be assessed on the next day. Examples of other financial arrangements may include payment plans, deferments, for financial aid, or third party payments.

Students who owe a balance after the end of the add/drop period due to changes in class schedules are required to pay in full or to make other financial arrangements by the 19th class day for fall and spring semester. Since summer semester add/drop periods vary, check with the Cashier's Office for final financial arrangement dates for add/drop courses. If no financial arrangement is made, enrollments shall be cancelled.

DEBIT CARD SYSTEM

The South Dakota School of Mines Debit Card is a money management system activated through each student's ID card. After money is deposited into the student's personal Debit Card Flex Account, purchases made with the card will be deducted from the balance. The Debit Card can be used at the following locations: Dining Services, Miners' Shack Snack Bar, and School of Mines Bookstore. A Debit Card Flex Account can be established by making a deposit with Student Accounts/ Cashiering Office in the upper level of the Surbeck Center.

FEES

Application Fee

Non-refundable charge upon initial application for admission. $20 undergraduate and $35 graduate.

General Activity Fee

A fee assessed per credit hour to cover health, student union, student organizations and activities, music, child care, athletics, and intramurals.

University Support Fee

A fee assessed per credit hour used to purchase equipment, materials and services in support of the instructional programs. Also, to assist in providing services that benefit students which are not funded from other sources.

Late Payment Charge

If tuition and fees are not paid before established due dates, late payment charges will be assessed. If financial obligations are not met when due, student may be administratively withdrawn for the University.

Special Expenses for Engineering and Science

A fee of $18.05 per credit hour is charged for courses in engineering, physics, computer science, mathematics, chemistry, paleontology, technology management, and geology.

Lab Fee

$28.50 is charged to each lab course. These funds are used for lab supplies, materials and equipment.

Credit by Examination

This $81.00 fee is charged for each course in which a student seeks credit by examination.

International Student Enrollment

This one-time $110.40 fee is assessed at the time of the international student's first semester enrollment in addition to the regular application fee.

Vehicle Registration
All motor vehicles parked on campus must be registered with the Campus Safety Office. Contact this office at (605) 394-2251 for options, amounts and appropriate display of parking permit.

Transcript Fee
A transcript of credits is an authentic copy of the student's academic record. One complete transcript of credits is provided without charge to each student upon graduation. After that the charge is $5.00 each, and $2.50 each copy thereafter per request.

INDEBTEDNESS
A student who is indebted to the university and does not satisfy financial obligations when due may be withdrawn after notice from the university and will not be permitted to register or receive a transcript of grades until the indebtedness is paid. This applies to indebtedness for university tuition, room, board, fees, financial aid, and fines but not to student organizations. If a student's account is placed with a collection agency, the student will be responsible for all collection costs, attorney's fees, and any other costs necessary for the collections of any unpaid balance.

REFUNDS

Withdrawal Refunds Information
Students who withdraw, drop out or are expelled from School of Mines within the add/drop period (10% of term) receive a 100% refund of tuition and course related fees. Students who withdraw, drop out, or are expelled from the University after the add/drop period for the enrollment period for which they are assessed may be entitled to a refund of tuition and fees and institutional charges calculated through sixty percent of the enrollment period. The refund shall be determined by computing the percentage of an enrollment period remaining after the date of withdrawal times the tuition and fees originally assessed the student.

A student's withdrawal date is: 1) When the student began the withdrawal process or officially notified School of Mines of intent to withdraw by contacting School of Mines Registrar's Office, or 2) The midpoint of the period for a student who leaves without notifying School of Mines; or at School of Mines option, the student's last documented date of academically related activity.

Federal Financial Aid Recipients: The U.S. Department of Education requires institutions to use the **Return of Title IV Funds** policy for students withdrawing from school and who are receiving Federal Title IV student financial aid. Title IV funds refers to the federal financial aid programs authorized under the Higher Education Act of 1965 (as amended) and includes the following programs: Federal Stafford Loan, Unsubsidized Stafford Loans, Parent Loans for Undergraduate Students (PLUS), Federal Perkins Loans, Federal Pell grants, and Federal Supplemental Grants.

Return of Title IV Funds is based on "earned" and "unearned" financial aid as related to the period of time the student is enrolled. Institutional charges comprise the amounts that had been assessed (paid or unpaid) and are not used in determining the Return of Title IV funds for a withdrawing student. During the first 60% of the period (academic term) a student "earns" Title IV funds and other applicable aid on a per diem prorated manner based on a percentage of the enrolled period by dividing the number of days a student attended by the number of days in the period. Calendar dates are used, except breaks of at least 5 days are excluded from the calculation. A student who remains enrolled beyond the 60% point earns all aid (100%) for the period.

The "unearned" Title IV funds must be returned to the aid programs. Unearned aid is the amount of disbursed Title IV aid that exceeds the amount of Title IV aid earned based on attendance in the enrollment period. Unearned charges are derived from the unearned percentage calculation for the period multiplied by the institutional charges.

Repayment of unearned aid is first paid by any unearned (refunded) institutional charges. The student owes the difference between the total unearned amount and the refunded institutional charges.

Return of Title IV funds, by programs disbursed, are allocated in the following order: Unsubsidized Federal Stafford Loan, Federal Stafford Loan, Federal Perkins Loan, PLUS Loans, Federal Pell Grant, Federal Supplemental Grant, other title IV assistance, other federal sources of aid other state, institutional, and private aid, and last to the student.

Responsibilities of School of Mines include providing information on the Return of Title IV Funds policy and procedure to students. This information is available at the School of Mines Financial Aid Office. The School of Mines is also responsible to complete calculations of the Return of Title IV Funds for federal financial aid recipients who are withdrawing from School of Mines and to return any Title IV finds to the respective Title IV funds account. The student is responsible to repay any Title IV funds that the student was determined to be ineligible for via the Return to Title IV funds calculation.

Textbook Refunds will be given in full on textbooks purchased no earlier than one week before classes begin and returned, **with receipt only**, no later than two weeks after classes begin for fall and spring semester and no later than one week after classes begin for summer. New textbooks that are damaged or that have any marks on them will be refunded at used retail price. No refunds can be issued after the designated add/drop deadline.

Bookstore Buyback The bookstore buys back textbooks during final test week of the fall and spring semesters. Summer school buyback is held the last day of summer school classes.

Food Service and Room Rent Refunds
Student with a room contract or food service contract will receive a refund based on the unused portion of the fee at the time of withdrawal up to the 60% point of the period. The balance of dining flex plan dollars will be refunded at 100%.

A petition process does exist for students or parents who feel that individual circumstances warrant exceptions for the published refund policy. Contact the Registration Office at (605) 394-2553 or O'Harra room 216.

Return of Title IV Funds Example

Example A: Student withdraws on the 27th of a 108-day period for a 25% (27/108) earned financial aid disbursement. The charges on the student account were $1,600 for tuition and fees. The student did not contract with the institution for room and board. The total Federal Student Aid (Title IV) disbursed from $2,400, with $1,600 being applied to tuition and fees and $800 given to the student.

Earned aid:
$2,400 (aid disbursed) x 25% - $600

Unearned aid to be returned:
$2,400-$600=$1,800

Unearned percentage:
100-25% (earned) = 75% unearned

Unearned charges: 75% (unearned) x $1,600 (charges) = $1,200

The institutional share is the lesser of $1,800 (unearned aid to be returned) and $1,200 (uncoverable charges).

The student's share is $1,800 (unearned aid) - $1,200 (uncoverable charges) = $600

Thus, of the total $1,800 total to be returned to the Federal Aid Programs, $1,200 (75% of $1,600 used for payment of charges) is to be returned by the institution and $600 (75% of $800 paid to student) is to be repaid by the student.

Example B: Same as A, except the student withdraws on the 65th day of a 108-day period (65/108=60.2%). Since this is beyond the 60% point in the semester, no Return of Title IV calculation are made.

FINANCIAL AID

Many college students have limited funds and find it necessary to supplement their personal and family financial resources for college. The South Dakota School of Mines and Technology administers a comprehensive financial aid program that amounted to more than $11 million for 2004-2005. Staff members are available in the Financial Aid Office to help students secure needed financial aid. Members of the staff make every effort to develop a financial aid package (some combination of loan, job, and grant) that will make it possible for capable, qualified, and needy students to finance college and living costs. However, the student should still be prepared to pay for a portion of college costs through savings from employment, and parents of dependent students are expected to assist with the student's cost of education to the extent to which they are able. Results of the Free Application for Federal Student Aid (FAFSA) or Renewal FAFSA received by the Federal processor on or before the March 15 priority date will be processed first. FAFSA results received and considered ready for packaging after that date will be processed on a rolling basis. The information provided here is only a brief overview. For more detailed information, please go to the web site at www.sdsmt.edu, click on "Current" or "Prospective" student, and then click on "Financial Aid & Scholarships."

Contact our office for additional information

If the student needs additional information or has any questions regarding the information provided here, contact the Financial Aid Office, South Dakota School of Mines & Technology, 501 E. Saint Joseph Street, Rapid City, SD 57701-3995. You may call us at (605) 394-2274, or toll free 1-800-544-8162, Extension 2274. Our e-mail address is FinancialAid@sdsmt.edu.

POLICIES GOVERNING FINANCIAL AID AWARDS

Students must complete a new FAFSA or Renewal FAFSA each year to determine their eligibility for all Federal Aid Programs. Students can not receive Federal Student Aid unless they are pursuing a degree at School of Mines.

Aid awarded based on full time attendance

Since the student's enrollment plans may change after they complete their aid application, we do not use the planned enrollment reported on the Free Application for Federal Student Aid (FAFSA) as the basis for our aid awards. A place is provided on the award letter to indicate the student's planned enrollment status. The student must let us know immediately if their plans change.

Complete the School of Mines Authorization to Apply Federal Student Aid form

All charges to the student's account are related to their attendance at School of Mines. As a result, all financial aid will be used to satisfy charges on their account for tuition/fees, room/board and authorized bookstore charges. The Authorization to Apply Federal Student Aid form, which is included with the Financial Aid Award Letter, must be completed and returned to our office before we can complete further processing of their Federal Aid.

Complete all forms

In order to finalize the award, the student must sign, date, and return their original award letter. In addition, they must complete, sign, and return all required forms.

Additional awards

Students at School of Mines are eligible to apply for a wide variety of assistance from organizations outside the University. As a result, they must report any other resources received during the year, such as from active duty, National Guard, Reserves, ROTC or VA educational benefits, Voc-Rehab, scholarships, loans, gifts, assistance received from a cooperative education or internship employer, etc. If the student receives a scholarship that was not awarded by School of Mines, a copy of the check or the award notification must be provided to the Financial Aid Office. As a result, the aid package will be reevaluated and, if necessary, an adjustment made to their financial aid award. A revised award letter will be sent for confirmation. Failure to notify the Financial Aid Office may result in a partial or total cancellation of their Financial Aid and repayment of any financial aid funds they have received.

Complete the Stafford Loan Master Promissory Note (MPN)

If this is the first time borrowing a Stafford Loan at School of Mines, before returning to us the signed award letter, the student must go to our web site at www.sdsmt.edu. Click on either Current or Prospective Students and then on Financial Aid & Scholarships. Click on the APP EXPRESS link. The student will be able to complete an electronic MPN as long as they have their U.S. Department of Education PIN available to electronically sign the MPN. If the student's lender is not listed on the pull-down menu, they need to contact our office. They may need to use an alternative method to apply for their Stafford Loan.

Loan Entrance Counseling for first time student loan borrowers at School of Mines

If the student is accepting either a Stafford or Perkins student loan, they must complete Entrance Loan Counseling before their loan funds will be disbursed to them. If the student last borrowed a Perkins Loan at School of Mines prior to the 2001-2002 school year, they must complete Perkins Loan counseling again. All Entrance Loan counseling is completed on-line by going to our web site at www.sdsmt.edu, click on either "Current Student" or "Prospective Student", then on "Financial Aid & Scholarships" and then on the link to "Loan Counseling (Entrance & Exit)." School of Mines will automatically be notified when this requirement has been completed.

The Cashiers Office will mail a billing statement before each semester. Please pay attention to the amount owed and the payment guidelines set by the Business Office. Be advised that aid that requires the student's endorsement on a check and Work-Study paychecks will not appear on their billing statement.

Disbursement of aid

With the exception of Federal Work-Study, which is paid monthly, and some scholarships, which are paid according to the wishes of the donor, financial aid is either credited to the student's account or disbursed by check at the beginning of each semester, or after aid eligibility is determined, whichever is later. Unless their lender does not participate in the Electronic Funds Transfer (EFT) process, the Stafford and PLUS loan programs will be processed electronically and disbursed via EFT to the student's account at School of Mines. If financial aid exceeds the student's institutional costs, they will either receive a cash disbursement at fee payment, or in the cashier's office after the final add/drop date each semester. In the event that there are delays in disbursing of aid, students should always have available enough money to meet immediate expenses they might incur at the beginning of each semester, such as the purchase of books and supplies.

Multi-Institution Students

At times it may be necessary to take classes at one of the other SD Board of Regents universities in order to complete the student's degree requirements. No special arrangements need to be made in order to include those classes in their enrollment status for financial aid purposes at School of Mines. However, if they plan to take classes at a non-Board of Regents school, they must contact the Financial Aid Office to determine if classes taken there can be used to fulfill degree requirements at School of Mines and to determine their overall semester enrollment status.

Correspondence Studies

School of Mines does not offer courses via correspondence. However, students are advised to discuss possible options with the Financial Aid Director for receiving assistance to help pay for this type of course work taken at another eligible institution.

Summer financial aid and affect on eligibility for the coming school year

Students who are interested in receiving aid for the summer must have completed the FAFSA for the coming school year. Their aid award will be based on a summer, fall and spring academic year. As a result, receiving aid for the summer will directly impact the amount of aid available for the fall and spring semesters. Generally, students must carry at least a half time course load [six (6) credits for undergraduate and four and one-half (4.5) for graduate students] to be eligible for summer financial aid. A School of Mines Summer Aid Application, which is available after March 31, must be completed before they will be considered for summer aid.

Satisfactory Academic Progress

Students must make satisfactory academic progress toward the completion of their degree at School of Mines. Students must maintain the grade point average required for graduation (2.00 for undergraduate and 3.00 for graduate), successfully complete 67% of attempted credit hours and not exceed 150% of the credit hours needed to complete their degree in order to remain eligible for Federal and most other types of financial aid. For a full description of the satisfactory academic progress requirements at School of Mines, go to our web site at www.sdsmt.edu. Click on either "Current" or "Prospective" students and follow the links on the Financial Aid Office web site.

Withdrawal and refunds

Due to circumstances that may be beyond the student's control, it may become necessary to withdraw from all classes prior to the end of a particular semester. Depending on the withdrawal date, the student may be entitled to a full or partial refund of tuition and fees, and if contracting with the university for room and board.

A withdrawal is considered to be official when the student comes to the Academic and Enrollment Services Office (AES), Room 216 of the O'Harra Building to initiate the process. If that is not possible, they may call 1-800-544-8162, Ext. 2400 or local at 605-394-2400. In the event that the student leaves school without notifying AES, or simply never attends classes and receives a 0.00 GPA for the semester, the university has the option of considering the withdrawal date to be: 1) the midpoint of the period of enrollment; 2) the last documented date of academically related activity; or 3) if they did not notify AES due to circumstances beyond their control, the date relative to that circumstance.

It is important that students clearly state that they are withdrawing from all classes. Dropping a class and withdrawing from all classes have a different impact on their status with the university. If they are enrolled at more than one campus within the South Dakota Board of Regent university system, they must inform AES staff whether they are withdrawing from all campuses, or just from the School of Mines. Please review the withdrawal procedures outlined elsewhere in this college catalog. Information is also available on our web site at www.sdsmt.edu, click on "Current" or "Prospective" student, then on the "Financial Aid & Scholarships." and then on "Withdrawal & Refunds." Examples are provided regarding what a student could expect to receive based on when they withdraw.

Program Descriptions

Unless otherwise noted, federal student aid programs are available to both graduate and undergraduate students.

WORK-STUDY, OFF-CAMPUS EMPLOYMENT AND STUDENT LOANS

Federal Work-Study (FWS)

Priority is given to students who meet our March 15 priority awarding date. This program provides both on and off campus jobs for students who show financial need. On registration day of each semester, work-study students must attend an information session to learn more about their FWS responsibilities. A valid ID and their Social Security Card must be brought to the session.

Off-Campus Employment

Occasionally, the Financial Aid Office will become aware of possible off-campus employment opportunities. Notices are posted on the bulletin board outside the Academic and Enrollment Services office in the O'Harra Building, Room 216.

Federal Perkins Loan Program

This loan program is administered by School of Mines and like any loan, must be repaid. Priority is given to students with exceptional financial need and who meet our March 15 priority awarding date. Students are under no obligation to accept a student loan and should do so only after considering the long-term implications of borrowing. Arrangements will be made to obtain the borrowers signature on the promissory note before loan funds are applied to their account. Repayment is to be worked out with the Business Office when they graduate or are no longer enrolled at least half time at an eligible post-secondary institution or if they have been approved for one of the many available deferments. During the repayment period, the interest rate on this loan is 5% on the unpaid principal balance. Depending on how much has been borrowed, students may have up to ten (10) years to repay.

Federal Direct Loan Program

School of Mines does not participate in this loan program. Students who are transferring from a Direct Loan participating institution will still be able to consolidate their Direct Loans with the Stafford and Perkins Loans they would be eligible to receive at School of Mines.

Federal Stafford Loan Program

This loan is obtained from a bank or credit union, and like any loan, must be repaid. The interest rate is variable, subject to change as of July 1 of each year, and is currently capped at 8.25%. While you are in school, the Federal Government pays interest on the Subsidized Stafford for the student; however, the student is responsible to pay the interest on the Unsubsidized Stafford. Lenders are authorized to withhold up to 4% from the loan proceeds as an origination fee and insurance premium to offset the processing of the loan. The award letter shows the eligible loan program and the maximum amount that can be borrowed based on grade level, Estimated Cost of Attendance, Expected Family Contribution and other financial aid the student is receiving. Students are under no obligation to accept a student loan and should do so only after considering the long-term implications of borrowing more than what is really need to attend college.

With few exceptions, School of Mines electronically processes Stafford Loans and receives loan funds via EFT to be applied to the student's account in School of Mines Student Accounts Office. Students are advised to carefully read and respond immediately to information received from their lender or guaranty agency, especially if forms must be completed, signed and returned to them. They should keep copies of any correspondence sent to them for future reference. Loan proceeds are sent to the school for disbursement to the student. Borrowers are not required to make payments on the principal balance until six (6) months after they cease to be at least a half-time student or during any eligible deferment period.

Consolidation Loan Program

Students and parents may have borrowed from multiple federal loan programs or multiple lenders. If that is the case, they may be having difficulty making the monthly payments. A loan consolidation can help to lower the monthly payments while giving the borrower more time to repay. Although a consolidation loan can help to ease the burden of monthly payments, the borrower will pay much more in interest over the life of the loan and lose many of the provisions of their original loan promissory note. The advantages and disadvantages should be weighed carefully before agreeing to a loan consolidation. Students should contact their lender for more information.

Federal Parent Loan for Undergraduate Students (PLUS)

This loan is obtained from a bank or credit union, and like any loan, must be repaid. The interest rate is variable, subject to change as of July 1 of each year, and is currently capped at 9%. The PLUS Loan Program is available to parents with good credit histories who wish to borrow for a dependent student enrolled at least half time. The annual loan limit is the estimated cost of education minus any financial aid received by the student (i.e., grants, loans, scholarships, work, etc.). The lender is authorized to withhold up to 4% from the loan proceeds as an origination fee and insurance premium to offset the processing of the loan. Although applying for financial aid using the FAFSA is currently not required, it is strongly recommended. If the parent's lender participates in the EFT process, the proceeds will be applied to the student's account. If not, then a paper loan check will be mailed to our office for disbursement. Any PLUS loan funds in excess of what is needed to pay the student's bill are for the use of the student not the parent. Parents should carefully consider how much they agree to borrow. Instructions regarding repayment are included with the application.

What lender should you use?

If there has been previous borrowing from the Federal Family Education Loan Programs (Stafford or PLUS), we recommend that the same lender be used. Since we need the name of the lender to process a Stafford or PLUS loan, check prior records and enter their name and location on the award letter. If it is an out-of-state lender, please provide the lender's full address and the name of the guaranty agency. If there hasn't been any previous borrowing under the Federal Family Education Loan Programs, the student/parent should check their bank or credit union to see if they participate.

Alternative Loan Programs

Larger banking institutions often offer private loan programs to assist students who are unable to obtain sufficient Federal Student Aid in order to attend college. Eligibility for this type of loan program is based on the borrower's creditworthiness. A co-signer for the loan may be required. Contact the Financial Aid office for further information on this type of loan program.

GRANTS, SCHOLARSHIPS AND OTHER NON-REPAYABLE ASSISTANCE

Federal Pell Grant

Available only to undergraduate students. The Pell Grant award is based on the Expected Family Contribution listed on the Student Aid Report and full time attendance. The actual amount received will be based on the student's enrollment status as of the final add/drop date each semester. If the student is enrolled in less than 12 credit hours as of the add/drop date each semester, an adjustment will be made to the amount of Pell Grant funds applied to their account. Adjustments are made for ¾ time (9 - 11.99 credits), ½ time (6 - 8.99 credits) and less than ½ time (0.50 - 5.99 credits). As a result, if the adjustment had not been previously made, there will be an unpaid balance due on the student's account. Therefore, it will be very important to inform the Financial Aid office on the award letter if the student will be enrolled less than full time.

Federal Supplemental Educational Opportunity Grant (SEOG)

Available only to undergraduate students. Priority is given to Pell Grant recipients who meet our March 15 priority awarding date.

Leveraging Educational Assistance Partnership (LEAP, formerly known as the State Student Incentive Grant Program)

The State of South Dakota does not participate in this program.

Scholarship information from sources outside School of Mines

Occasionally the Financial Aid Office is notified of scholarship opportunities that are awarded outside the university. Information is posted in the Admissions Office entrance in the O'Harra Administration Building. Awards that are awarded annually from outside organizations are also posted at www.hpcnet.org/sdsmt/scholarships. The site is updated as new information is received. Check for updates from time-to-time. Students who receive a scholarship that was not awarded by School of Mines need to provide a copy of the check or award notification to the Financial Aid Office. Failure to notify the Financial Aid Office may result in a partial or total cancellation of financial aid awarded and repayment of any funds received.

Students who want to further investigate outside sources of scholarship funding should look into the potential opportunities available at www.mapping-your-future.org/features/schrlshp.htm. This resource is free to the user.

Scholarships and Fellowships from School of Mines

Unlike most institutions, students do not apply for funds from the individual scholarship donors that are listed on the following pages. Students apply for and are awarded a "scholarship" to attend School of Mines. The Foundation Office then matches scholarship recipients to the various donors based on the donor's criteria.

The 2006-2007 Freshman Scholarship Application is available on-line after September 1 at www.hpcnet.org/finaid/scholarship.info/scholar ship.app . The application must be received no later than midnight March 1st prior to the academic year the student plans to attend. Incomplete scholarship applications will not be considered. Since this is an electronic process, all applications are date stamped with the time and date of receipt into our system. Access to the on-line application is revoked as soon as possible the next business day after March 1.

All current students are automatically considered for continuing scholarships based on academic performance at School of Mines and scholarship criteria. All scholarship recipients must maintain full time enrollment (at least twelve (12) credit hours per semester at School of Mines) and maintain the grade point average as required by the scholarship.

Graduate students should contact the Graduate Education and Research Office at School of Mines regarding available fellowships.

The following is a listing of scholarships at School of Mines. Eligibility requirements are also indicated. Eligibility requirement descriptions are:

ChE	Chemical Engineering
Chem	Chemistry
CEng	Computer Engineering
CE	Civil Engineering
CSc	Computer Science
EE	Electrical Engineering
Engr	Engineering
GeoE	Geological Engineering
Geol	Geology
IE	Industrial Engineering
IS	Interdisciplinary Sciences
Math	Mathematics
ME	Mechanical Engineering
Met	Metallurgical Engineering
MEM	Mining Engineering and Management
Phys	Physics
Sci	Science
Fr	Freshman
So	Sophomore
Jr	Junior
Sr	Senior
GPA	Grade Point Average
Grad	Graduate Student

Four Year Support Scholarships

The most prestigious scholarship assistance on campus provides assistance for incoming freshmen with guaranteed renewable support for four years provided the recipient maintains a minimum 3.0 grade point average (based upon a 4.0 scale) and is continuing progress toward completion of a degree.

Distinguished Scholars: minimum yearly award of $7,000.

SURBECK - Established by Homer (Met ’24) and Margaret Surbeck Estate; preference: South Dakota high school graduates.

PRESIDENTIAL: Minimum yearly award of $1,000.

NELS AND ELISE AFDAHL - Established by Anson Yeager to honor his stepfather and mother.

MONTE D. BELL MEMORIAL - Established by Marilyn Bell to honor her husband (CE ’59).

CHARLES AND GRACE BENNETT ACADEMIC - Established by Charles Bennett.

HELEN JENNIE AND KEITH BOYLAN MEMORIAL - Established by Edna Hulbert to honor her sister and brother-in-law.

WILLIAM G. BUEHLER - Established by William G. Buehler (EE ’29).

RICHARD E. AND BEVERLY COLE - Established by Richard and Beverly Cole.

JOHN F. AND CATHERINE CORKILL MEMORIAL - Established by John F. Corkill Jr., Mary C. Richter, and Sharon C. Walker to honor their mother and father.

DALE AND DONNA CORRINGTON - Established by Dale (Gen ’41) and Donna Corrington.

JOHN G. COVER - Established by a bequest from the John G. Cover (EE ’67) Trust.

ROYAL CRAWLEY MEMORIAL - Established by Royal Crawley Estate.

QUENTIN P. DYCE MEMORIAL - Established by Quentin and Lois Dyce upon the death of Quentin P. Dyce (Met ’49).

BERTAL A. AND MARGUERITE A. FLISNES MEMORIAL - Established from the Estate of Bertal and Marguerite Flisnes.

PEGGY LEE HANSEN - Established by Walter G. Hansen (CE ’53) to honor his wife; preference: females.

WILLIAM HOFFERT - Established by William Hoffert (EE ’33).

HOFFMAN - Established by Roy L. Hoffman (EE ’59) to honor his parents, Rose and Donald Hoffman.

GEORGE R. AND PHYLLIS J. HOKENSTAD - Established by George R. (EE ’52) and Phyllis J. Hokenstad.

WILLIAM AND CECILE HUDSON - Established by William Hudson (CE ’28).

ROGER KIEL - Established by Roger (GE ’58) and Dolores Kiel.

WILLIAM AND JENNIE KOOIMAN - Established by Robert (ME ’52) and Clare Kooiman to honor his parents; preference: Minnesota residents.

GAIL MARCH - Established by Ervin Pietz (EE ’34) to honor Gail March; preference: females.

LANNY AND CAMILLE OUTLAW - Established by Lanny Outlaw (GE ’58); preference: Aberdeen and Black Hills, SD.

ARTHUR B. SHUCK MEMORIAL - Established by Marian S. Shuck to honor her husband (Met ’42).

EVERETT AND HELEN SIEGER - Established by Donal (ME ’77) and Catherine Sieger to honor his parents.

TEETS-BUNCH MEMORIAL - Established by Rex (EE ’59) and JoAnn Teets to honor his parents, Mr. and Mrs. Fred Teets and her parents, Mr. and Mrs. Harvey Bunch.
Renewable: Awards of $500 to $999 yearly.

M.F. AND VELMA H. ANDERSON - Established from the Estate of Velma H. Anderson.

JOHN BOLAND SR. AND JOHN BOLAND JR. MEMORIAL - Established from the Estate of Ethel Boland to honor her husband and son.

CLAUDE A. AND MARTHA D. HANN - Established by Martha Hann to honor her husband.

CLEM AND RUTH KNECHT MEMORIAL - Established by Ann Kirkham and Jane Trittipo to honor their parents.

JOHN KNECHT ACADEMIC MEMORIAL - Established by Don and Bob Knecht to honor their father.

GEORGE KOVICH MEMORIAL - Established by Darlene Kovich May to honor her husband (ME ’51).

DEAN AND MARY JANE KURTZ - Established by Dean Kurtz (CE ’50).

LISS/WORMSER - Established by V. Mitchell (ChE ’47) and Janice Liss to honor their parents, Mike and Mary Liss and I.M. and Florence Wormser.

CRISTI AND CARLYN PRYER - Established from the Estate of Carlyn Pryer.

CHRIS AND LOUISE SATTLER MEMORIAL - Established by Donald Sattler (CE ’56) to honor his parents and family.

LOWERY J. SMITH - Established by Lowery (GeoE ’51) and Mary Ann Smith.

Other Scholarships and Prizes

Income from Investments: The following award amounts depend upon income from investments. All students must be in good academic standing at School of Mines. Although some of these awards require students to have greater than a 2.00 cumulative GPA in order to qualify for the first disbursement, all recipients must maintain at least a 2.00 cumulative GPA in order to receive subsequent scheduled disbursements. Failure to do so will result in the scholarship award being cancelled.

ABBOTT VERTEBRATE PALEONTOLOGY FUND - Grad in vertebrate paleontology.

ALVA ISAAC ADDY AND NELLIE BRUMBAUGH ADDY MEMORIAL SCHOLARSHIP - So or Jr in ME.

AISES/DR. JACK WEYLAND SCHOLARSHIP - Native American, So, Jr, or Sr who is an active member of the School of Mines Chapter of AISES.

ELROSE AND REUBEN ANDERSON SCHOLARSHIP - Sci or Engr with cumulative 3.0 GPA.

ANONYMOUS SCHOLARSHIP - Unrestricted.

FRANK APLAN - Native American, Met.

HAROLD ARTHUR SCHOLARSHIP - CE

D. SHERWIN ARTUS SCHOLARSHIP - So, Jr, or Sr in GeoE with cumulative 3.0 GPA and financial need.

CHAD NIENHUESER ASCE MEMORIAL SCHOLARSHIP - Participates in American Society of Civil Engineers activities.

MACY BARESCH SCHOLARSHIP - GeoE and Geol with financial need.

BAUER FAMILY CROSS-COUNTRY and TRACK SCHOLARSHIP - Varsity cross-country or track athlete.

JEFF L. BAUER MEMORIAL SCHOLARSHIP - So, Jr, or Sr in Geol or GeoE and be involved in non-academic campus activities.

RUTH AND RUDY BAUKOL SCHOLARSHIP - So, Jr, or Sr.

GUS AND ILA BEKA SCHOLARSHIP - Unrestricted.

MARILYN R. BELL MEMORIAL SCHOLARSHIP - Student who is active in extra curricular activities; preference: female.

C. L. BENNETT ATHLETIC SCHOLARSHIP - Athlete in varsity sport.

DONALD BENTLEY MEMORIAL SCHOLARSHIP - Unrestricted.

EDWIN H. BITTNER/JOHN P. CAMPBELL MEMORIAL SCHOLARSHIP - So, Jr, or Sr in Geol, GeoE, Met, or MEM.

GUY N. BJORGE SCHOLARSHIP - Geol, Met, or MEM.

BLACK HILLS CORPORATION SCHOLARSHIP - 2.75 GPA or above with financial need.

DR. CONRAD F. J. BLUNCK MEMORIAL FELLOWSHIP - Grad in CE (support of research in advanced composites and their application to the medical field).

GARY BONER/SONNY COYLE ATHLETIC SCHOLARSHIP - Varsity football athlete; preference: So, Jr, or Sr.

BRADLEY C. BORGEN MEMORIAL SCHOLARSHIP - Jr or Sr in Phys; preference: involved in Military Science.

ELDON A. AND VIRGINIA BOWEN MEMORIAL SCHOLARSHIP - The recipient shall have high moral character, a good family background, and demonstrate drive and ambition in pursuit of their degree. A one-page essay should be submitted. (See Financial Aid Office.)

ERNEST BOWERMAN MEMORIAL SCHOLARSHIP - Jr in ChE.

LESLIE E. BOYD MEMORIAL SCHOLARSHIP - IS with financial need and/or exceptional talent.

LESLIE E. BOYD TECHNICAL COMMUNICATIONS AWARD - Outstanding student in Tech Comm I.

JOSEPH BRACKETT MEMORIAL SCHOLARSHIP - Financial need.

FRANK R. BRADY MEMORIAL SCHOLARSHIP - Jr or Sr in CE with 2.75 GPA or above.

DAVID L. AND ANN BRAUN SCHOLARSHIP - So, Jr or Sr in ME with minimum 3.0 GPA.

MYRENE AND LOUIS BRAUN SCHOLARSHIP - Sci or Engr with cumulative 3.0 GPA; preference: students who have resided at the Children's Home in South Dakota.

SCOTT AND SUSAN BREKENFELD SCHOLARSHIP - Sci or Engr Fr with high school GPA of 3.0 and with financial need; preference: Belle Fourche High School graduate; then western SD high school graduate.

BRINK FAMILY SCHOLARSHIP - Preference: varsity athlete.

LESTER ROBINSON BROWN, JR. AND VIOLETTE H. BROWN SCHOLARSHIP - Unrestricted.

G. GREGORY AND GERTRUDE S. BRYAN SCHOLARSHIP - Jr in Geol, GeoE, Met, or MEM with 3.0 GPA or above.

CAIN SCHOLARSHIP - Fr, So, Jr, or Sr with cumulative 3.0 GPA, rotating yearly between ME and Chem.

PAUL A. AND MARY M. CECIL MEMORIAL ATHLETIC SCHOLARSHIP - Athlete from SD with 2.8 GPA or above.

RAY AND JEANNE CHAUSSEE ATHLETIC SCHOLARSHIP - Athlete; preference: Chamberlain, SD; then varsity football.

JOHN J. CHISOLM MEMORIAL SCHOLARSHIP - Unrestricted.

CLASS OF '34 SCHOLARSHIP - Jr or Sr who requires financial assistance.

CLASS OF '40 SCHOLARSHIP - Unrestricted.

MAURICE L. CLELAND MEMORIAL SCHOLARSHIP - EE and CEng. SD native or resident.

JOSEPH P. CONNOLLY MEMORIAL AWARD - Geol or GeoE.

ROY H. COOK MEMORIAL SCHOLARSHIP - Jr or Sr in Phys with 3.4 GPA or above; preference: U.S. citizen.

HAROLD E. CORWIN SCHOLARSHIP - Sci or Engr.

BILL COYLE - ATHLETIC/CIVIL ENGINEERING SCHOLARSHIPS - One to an Engr athlete and one to a CE student.

BILL COYLE/DELTA SIGMA PHI ATHLETIC SCHOLARSHIPS - One to a male athlete and one to a female athlete with 3.0 GPA or above majoring in Sci or Engr.

BILL AND MYRNA COYLE SCHOLARSHIP - Jr or Sr in CE with 3.0 GPA or above.

RALPH AND MARY ELLEN CRAIG SCHOLARSHIP - Engineering undergraduate with 2.5 GPA and financial need.

JIM AND DARLYS CURNOW SCHOLARSHIP - So, Jr, or Sr ChE with 3.0 GPA or above.

EARL J. DAILEY FAMILY FUND - To be used to support athletes through the Hardrock Club.

DALE AND DIEDE SCHOLARSHIP - Jr or Sr with 3.0 GPA or above; one award to Geol, GeoE, MEM, or Met; preference: Met; one award to an EE or CEng, and if funds are available, one award to a female in Engr or Sci.

EARL D. DAKE MEMORIAL SCHOLARSHIP - Residents of SD enrolled in CE.

LLOYD L. DARNALL SCHOLARSHIP - Jr or Sr in CE with 3.0 GPA and financial need.

HOMER DAVIS MEMORIAL SCHOLARSHIP - So, Jr, or Sr in GeoE with financial need.

VIC DEJONG SCHOLARSHIP - Jr or Sr Engr.

GERALDINE DELGER KRIER AND HENRY AND FERN DELGER MEMORIAL SCHOLARSHIP - Engr; preference: residents of McCook or Hanson counties, then Triangle member.

DELTA SIGMA PHI MEMORIAL SCHOLARSHIP - So, Jr, or Sr with cumulative GPA of 3.0 or above who is a member of School of Mines Chapter of Delta Sigma Phi.

ROBERT L. DILLY MEMORIAL SCHOLARSHIP - Jr or Sr in CE.

SAM DOERING MEMORIAL SCHOLARSHIP - Male So, Jr, or Sr with financial need.

J.V.N. DORR SCHOLARSHIPS - ChE, Met, or CE.

J.V.N. DORR (DORRCO) FELLOWSHIP - Monthly stipend for graduate study and research in Met, ChE, and CE.

DRAINE BOOK SCHOLARSHIP - Non-traditional South Dakota resident who is a Jr or Sr in CE, Geol, GeoE, or MEM.

R. E. DRISCOLL SR. SCHOLARSHIP - Unrestricted.

FRANCES M. DUNN MEMORIAL SCHOLARSHIP - Single mother who is So, Jr, or Sr in IS. An IS freshman may receive this award upon recommendation by the Dean of the College of Science and Letters.

WAYNE AND IRIS ECHELBERGER SCHOLARSHIP - So, Jr, or Sr in CE with specialty interest in the area of Environmental Engineering with cumulative 3.5 GPA. Involved in ASCE and extra curricular activities.

DAVID J. AND LESLIE R. ENGEBRETSON LEADERSHIP SCHOLARSHIP - Jr or Sr in MEM with cumulative 2.7 GPA or above who has demonstrated leadership capability through elected and participatory student activities and three months of pertinent work experience.

BENARD A. ENNENGA SCHOLARSHIP - Student with 2.8 GPA or above who is not receiving governmental financial assistance but has financial need.

JANET LIND ERICKSON MEMORIAL SCHOLARSHIP - So, Jr, or Sr in MEM with 2.5 GPA or above.

HAROLD R. EYRICH MEMORIAL SCHOLARSHIP - So, Jr, or Sr in MEM.

ARTHUR W. FAHRENWALD SCHOLARSHIP - Unrestricted.

LYLE AND DOROTHY FEISEL SCHOLARSHIP - EE or CEng. If So, Jr, or Sr, must have cumulative 3.0 GPA.

PHILLIP AND LAVERNA FENNER SCHOLARSHIP - EE or CEng; preference: freshman who graduated from Sturgis High School. If upperclassman, must have cumulative GPA between 3.0 and 3.5.

ROBERT AND CORINNE FERRIS SCHOLARSHIP - EE, CEng, or CSc with cumulative 3.0 GPA or above.

'51 FOOTBALL SPIRIT AWARD - Varsity football.

IRMA BEATRICE FLAIGG AND LILLIAN G. FLAIGG MEMORIAL - SD high school graduate in CE with financial need.

NORMAN G. FLAIGG SCHOLARSHIP - SD high school graduate in CE with financial need.

HAROLD AND EARL FOGLESONG MEMORIAL SCHOLARSHIP - EE or ME

MALACHI FOLEY MEMORIAL SCHOLARSHIP - So, Jr, or Sr.

CATHERINE D. FOWDEN MEMORIAL SCHOLARSHIP - Unrestricted.

DR. HARVEY R. FRASER SCHOLARSHIP - Unrestricted scholarship established by School of Mines President Emeritus.

JEAN FRASER SCHOLARSHIP FOR WOMEN - Female.

GREG FRENCH ECONOMIC GEOLOGY FELLOWSHIP - Economic Geol Grad studying in hard rock area.

DOUGLAS W. FUERSTENAU MATERIALS AND METALLURGICAL ENGINEERING SCHOLARSHIP - Met; preference: So or Jr with 3.0 GPA.

ERWIN, HAZEL, AND RICHARD FUERSTENAU SCHOLARSHIP - Jr or Sr in Geol, GeoE, Met, or MEM. South Dakota high school graduate.

MAURICE C. FUERSTENAU SCHOLARSHIP - So, Jr, or Sr in Met with 3.0 GPA or above.

NOEL A. GAGSTETTER MEMORIAL SCHOLARSHIP - EE with financial need.

ED AND PRISCILLA GAISER FUND - Athletes.

KARL GERDES AND PAMELA ROHRICH SCHOLARSHIP - So, Jr, or Sr with financial need; preference: graduates from small West River high schools.

MARY JANE GIACOMETTO SCHOLARSHIP - Non-traditional student with financial need; preference: female in IS.

BERNARD GIVOGRI MEMORIAL SCHOLARSHIP - So, Jr, or Sr Engr with 2.75 GPA or above; Lead High School graduate.

HELEN GOTH MEMORIAL SCHOLARSHIP - So, Jr, or Sr in ChE with 2.5 GPA and financial need; preference: non-traditional female; then traditional female.

REE AND JOHN (JACK) GOTH SCHOLARSHIP - Preference: varsity athlete from Clark, SD, then varsity athlete in GeoE, Geol, Met, or MEM, then varsity athlete.

PAUL G. GRIEBEL MEMORIAL SCHOLARSHIP - Unrestricted.

DR. JOHN PAUL AND VIRGINIA GRIES FUND - Undergraduate or Grad pursuing an education in minerals exploration.

WILLIAM A. GRIFFITH FELLOWSHIP - U.S. Citizen Grad in Geol, GeoE, ChE, Met, or MEM.

WILLIAM A. GRIFFITH SCHOLARSHIP - U.S. Citizen Jr or Sr in Geol, GeoE, ChE, Met, or MEM.

GROW FAMILY SCHOLARSHIP - So, Jr or Sr in EE or CEng with 3.0 GPA or above.

GUKEISEN-HIEB FAMILY MEMORIAL SCHOLARSHIP - Engr or Sci Fr who graduated in the top 25 % of high school and has financial need; preference: high schools in Bon Homme, Charles Mix, Douglas, or Hutchinson SD counties.

ROBERT J. GUNN MEMORIAL SCHOLARSHIP - So, Jr, or Sr in Chem or ChE.

GUSTAFSON STUDENT LEADERSHIP SCHOLARSHIP - Jr or Sr with leadership and involved in campus activities and organizations.

DELLA M. HAFT MEMORIAL SCHOLARSHIP - Unrestricted.

MARY HALE SCHOLARSHIP - Unrestricted.

DANIEL S. HAMWAY MEMORIAL - ChE.

RALPH W. HANSEN SCHOLARSHIP - Jr in CE who has demonstrated special aptitude in the area of structures and structural design.

WALTER HANSEN & MARILYN JACKSON NATIVE AMERICAN SCHOLARSHIP - Fr, So, Jr, or Sr Native American student. Current student must have minimum cumulative 2.5 GPA.

WALTER G. HANSEN SCHOLARSHIP - CE.

JOHN AND BLANCHE HANTEN MEMORIAL ATHLETIC SCHOLARSHIPS - One male athlete and one female athlete participating in varsity sports.

JAMES O. HARDER MEMORIAL SCHOLARSHIP - Jr or Sr U.S. citizen in Geol, GeoE, or MEM with initiative and leadership qualities; preference: resident of SD with need if all other candidate qualifications are equal.

HARDROCK CLUB MEMORIAL SCHOLARSHIP - Varsity athlete.

ALVIN AND ALEITHA HAUGEN MEMORIAL SCHOLARSHIP - So, Jr, or Sr in EE with 3.0 GPA or above; preference: SD high school graduate.

HARROLD H. HAYES ATHLETIC SCHOLARSHIP - Athlete with financial need; preference: from Jackson, MI, area.

BOB AND BETTY HEIRIGS SCHOLARSHIP - So, Jr, or Sr in CE to assist students working their way through school.

HARRISON AND ROSE HERBER SCHOLARSHIP - Custer, SD, high school graduates; preference: incoming Fr with 2.5 GPA; then current Fr, So, Jr, or Sr with 2.5 GPA; participated in high school athletics.

WILLIAM A. AND PHYLLIS HIXSON MEMORIAL SCHOLARSHIP - EE.

FRANK MOORE HOWELL JR. MEMORIAL SCHOLARSHIP - Met; preference: American born U.S. citizen.

JULANE AND LEROY HOYER MEMORIAL SCHOLARSHIP - Sci or Engr.

HRACHOVEC FAMILY SCHOLARSHIP - Jr or Sr.

R. B. HUGHES MEMORIAL SCHOLARSHIP - So, Jr, or Sr in EE, CEng, or ME.

LARRY E. HUISENGA SCHOLARSHIP - Upon recommendation by the Music Program Director.

BOB AND HELEN HUNT ATHLETIC SCHOLARSHIPS - One to a female varsity basketball athlete and one to a male varsity basketball athlete.

DARRELL OTTO HUWE MEMORIAL SCHOLARSHIP - Phys with a 3.5 GPA or above; preference: graduate of Lemmon High School or other rural areas in ND and SD; or students with a goal of teaching high school Physics; or students from Norway or Germany.

IVANHOE EXCELLENCE AWARD - Grad from any country or state with financial need studying for M.S. in Sci or Engr who is not receiving other fellowship assistance.

IVANHOE FELLOWSHIP FUND - Grad from Democratic People's Republic of Korea, the People's Republic of China, Mongolia, and Turkey with financial need studying for M.S. These fellowships honor: L.F. Bus Ivanhoe, John Liss, Roderick Ivanhoe, M. King Hubbert, Guy March, A.I. Levorsen, John Carver, Arthur Meyerhoff, Richard Vaughn, Garrett Hardin, Walter Youngquist, and Colin Campbell.

CLARENCE AND VINCENT IVERS MEMORIAL SCHOLARSHIP - Unrestricted.

SRINIVASA L. IYER SCHOLARSHIP - Sr or Grad in CE. Work in the field of advanced composites or related to the area of economic development.

JANOVY FAMILY ACADEMIC SCHOLARSHIP - EE.

JANOVY FAMILY ATHLETIC SCHOLARSHIP - Athlete in football, women's basketball, or women's volleyball.

ZAY JEFFRIES SCHOLARSHIP - Met; preference: So.

STEPHENIE MARIE JESCHKE MEMORIAL SCHOLARSHIP - Jr or Sr female Engr.

ARTHUR (A.I.) AND WILLMETA JOHNSON SCHOLARSHIP - Jr or Sr in Geol, GeoE, Met, or MEM.

ARTHUR LOUIS JOHNSON MEMORIAL SCHOLARSHIP - So, Jr, or Sr.

JERALD L. JOHNSON SCHOLARSHIP - Fr in Math, Engr, or Sci; preference: Fr from South Shore High School; then So from South Shore High School.

LINDSAY F. JOHNSON MEMORIAL SCHOLARSHIP FUND - MEM.

MERLE DELOS JONES MEMORIAL SCHOLARSHIP - Engr with financial need; preference: southeastern SD resident.

WILLIAM AND MARY JONES MEMORIAL SCHOLARSHIP - Resident assistants.

EARL AND BLANCHE KELLER SCHOLARSHIP - Unrestricted.

GERRY KELLER ATHLETIC SCHOLARSHIP - Athlete.

MARK J. KENNER MEMORIAL SCHOLARSHIP - So, Jr, or Sr with 2.7 GPA or above; preference: Rapid City, SD area, then varsity athlete.

CHARLES N. KEOWN MEMORIAL SCHOLARSHIP - Unrestricted.

DAROLD "DUD" AND ELEANOR KING MEMORIAL ATHLETIC SCHOLARSHIP - Varsity athlete.

JOHN KNECHT ATHLETIC SCHOLARSHIP - Varsity athlete.

GRANT A. KOPPELMAN MEMORIAL SCHOLARSHIP - So, Jr, or Sr in Met with 3.0 GPA or above.

CHARLES KYRISS MEMORIAL SCHOLARSHIP - Entering Fr or transfer student who is a graduate of a Nebraska high school; preference: western Nebraska.

DANIEL AND BARBARA LANDGUTH SCHOLARSHIP - Basketball athlete; preference: RC Stevens graduate, then Black Hills area graduates.

JOSEPH E. LARSON MEMORIAL SCHOLARSHIP - Preference: National Guard and U.S. or Canadian citizens.

CLAIRE D. LECLAIRE MEMORIAL SCHOLARSHIP - Sci or Engr.

RAY E. LEMLEY, M.D., MEMORIAL SCHOLARSHIP - Geol or GeoE in Summer Field Camp with financial need.

DANIEL E. LIPKIE SCIENCE SCHOLARSHIP - CSc, Math, Chem, or Phys with 3.4 GPA or above.

EDWARD W. LOGAR SCHOLARSHIP - Financial need; preference: Native American.

CLIFFORD B. LOWE SCHOLARSHIP - Phys; preference: financial need.

DEEPAK MALHOTRA FELLOWSHIP - Grad in EE that has not previously received any financial aid or graduate assistance and will not receive financial assistance during year of fellowship. Alternates annually with Deepak Malhotra Scholarship.

DEEPAK MALHOTRA SCHOLARSHIP - Female EE with 3.0 GPA that has not previously received any financial aid or School of Mines scholarships and will not receive financial assistance during year of scholarship. Alternates annually with Deepak Malhotra Fellowship.

GUY E. MARCH SCHOLARSHIP - So, Jr, or Sr in Math and CSc.

FLOYD L. MATTHEW MEMORIAL SCHOLARSHIP - Jr or Sr in CE; preference: women and non-traditional students.

RUBY MAUCH MEMORIAL SCHOLARSHIP - Unrestricted.

UNA (BINKLEY) McGARVIE MEMORIAL SCHOLARSHIP - Fr from SD high school with leadership abilities and has financial need.

ALEXANDER E. McHUGH MEMORIAL SCHOLARSHIP - Geol, GeoE, Met, or MEM.

P. DEFORREST AND EDITH M. McKEEL SCHOLARSHIP - EE, CEng, Math, or CSc; preference: students who intend to become electrical or electronic engineers or major in mathematics.

JOHN McLEARIE TECHNICAL COMMUNICATIONS AWARD - Sponsored by Dr. L. Homer Surbeck (Met '24). Outstanding student in Technical Communications II.

RODNEY AND MARLENE MEADOR ATHLETIC SCHOLARSHIP - Varsity athlete; preference: CE with financial need.

KIRK T. MEARS MEMORIAL SCHOLARSHIP - Graduate of Rapid City high school.

GRACE MICKELSON AND JOANN KLEIN SCHOLARSHIP - Jr or Sr in Math or CSc with 3.0 GPA or above.

JOHN C. MICKELSON FELLOWSHIP - Grad Teaching Assistant in Geol or GeoE; preference: soft rock area.

RONALD F. MILLER MEMORIAL SCHOLARSHIP - Graduates of a SD high school; preference: student from a small town.

DALE D. MODEN MEMORIAL - Unrestricted.

DONN J. MOHRMAN MEMORIAL SCHOLARSHIP - GeoE, Geol, MEM, or MET with 3.25 GPA or above.

RICHARD J. MONHEIM SCHOLARSHIP Fr, So, Jr, or Sr in EE or CEng with cumulative 3.0 GPA or high scores on entrance exams and has financial need.

ROBERT AND DEBORAH MUDGE SCHOLARSHIP - So, Jr, or Sr with financial need, rotating yearly between Met, IS, ME, CE, and ChE.

MARLIN J. "MICK" AND SHARON MURTHA MEMORIAL SCHOLARSHIP - Second semester So in ChE with 2.7 GPA or above and has financial need.

JOSEPH F. NELSON OUTSTANDING SCHOLAR AWARD - Undergraduate or Grad in Chem, ChE, Phys, Geol, GeoE, Math, or Atmospheric Sciences with 3.0 GPA or above or in the upper one-fourth of his/her class.

JOSEPH F. NELSON SCHOLARSHIP/FELLOWSHIP - Undergraduate or Grad in Chem, ChE, Phys, Geol, GeoE, Math, or Atmospheric Sciences with 3.0 GPA or above or in the upper one-fourth of his/her class; preference: financial need.

NEXT CENTURY SCHOLARSHIP - To recruit the brightest and best students as Fr and retain them as So.

FRED N. OBERG MEMORIAL SCHOLARSHIP - Met.

ALDEEN AND ESTHER OCHSNER MEMORIAL SCHOLARSHIP - Engr with 2.5 GPA; preference: incoming Fr who graduated from Mobridge High School; then So, Jr, or Sr who graduated from Mobridge High School; then golf athletes.

LEONARD AND LUCILLE OHLSON MEMORIAL SCHOLARSHIP - Unrestricted.

"OLD JOCKS" ATHLETIC SCHOLARSHIP - Athlete.

DEAN AND MARLENE OLIVA ATHLETIC SCHOLARSHIP - Athlete; preference: Huron or Tyndall, SD, multi-sport athlete in basketball, football, or track and field.

RALPH S. O'NEILL SCHOLARSHIP - So, Jr, or Sr in CE with 2.5 GPA or above; preference: SD student working part time or during summer.

HAROLD AND LAURA ORVILLE GRADUATE FELLOWSHIP - Grad in Atmospheric Sciences; preference: entering Grad, then current Grad, then Grad in environmental field.

EDWIN OSHIER MEMORIAL SCHOLARSHIP - MEM.

LARRY OWEN ENDOWMENT - Grad in Technology Management.

ROBERT W. OWENS MEMORIAL SCHOLARSHIP - So, Jr, or Sr in CE with need.

RUSSELL PALMER MEMORIAL SCHOLARSHIP - Sr in CE.

PAPPEL STUDENT LEADERSHIP AWARD - Students who have demonstrated exemplary leadership and commitment through personal involvement in campus activities.

LARRY V. AND LINDA J. PEARSON SCHOLARSHIP - Students who graduated from high school in northeast Nebraska or central South Dakota and have 3.0 GPA.

HOWARD C. PETERSON SCHOLARSHIP Fr in top 5 percent of graduating class or So, Jr, or Sr with 3.0 GPA or above.

JAMES P. AND MILDRED T. PETERSON SCHOLARSHIP - So, Jr, or Sr Engr from rural SD towns or neighboring states with need and has GPA of 3.3 or above; preference: CE.

LENATT M. PETERSON MEMORIAL SCHOLARSHIP - female non-traditional student, then female student.

EVA STENGER PHILLIPS SCHOLARSHIP - Unrestricted.

KIRK G. PHILLIPS MEMORIAL SCHOLARSHIP - Unrestricted.

PIETZ CREATIVITY SCHOLARSHIPS FOR INDUSTRIAL ENGINEERING - One to IE So, one to IE Jr, and one to IE Sr, all need 3.25 GPA or above.

TIM AND LAURA PIKE SCHOLARSHIP - Jr or Sr in CSc or Engr with financial need.

PAUL A. PORTER, JR. MEMORIAL SCHOLARSHIP - ChE; preference: Aberdeen, SD, area.

ROBERT POWELL MEMORIAL SCHOLARSHIP - Unrestricted.

EDITH AND JAMES RANGE MEMORIAL SCHOLARSHIP - So, Jr, or Sr in EE; preference: athlete.

MAYME T. REDMON SCHOLARSHIP - Unrestricted.

IVAN AND DORIS REYNOLDS MEMORIAL SCHOLARSHIP - Jr or Sr Eng or Sci with cumulative 3.0 GPA or above. Restricted to students from SD with an agricultural background.

ROY ROADIFER SCHOLARSHIP - GeoE or Geol.

ELMER AND ELSIE ROGGE ATHLETIC SCHOLARSHIP - Varsity Athlete.

LESLIE AND VALETA ROGGENTHEN SCHOLARSHIP - Geol, GeoE, Met, or MEM; preference: residents of Spink County.

PEGGY ARBUCKLE ROSE SCHOLARSHIP - Incoming Fr from Belle Fourche, SD, who shows financial need and good academic achievement in Math.

GLADYS ROSENBAUM MEMORIAL SCHOLARSHIP - Undergraduate with financial need.

BERNARD J. “BUN” ROSKOS MEMORIAL ATHLETIC SCHOLARSHIP - Varsity football athlete.

C. W. “WINNIE” AND DOROTHY ROUNDS SCHOLARSHIP - Jr or Sr in CE and SD high school graduate with 3.0 GPA.

DEAN R. ROUNDS MEMORIAL SCHOLARSHIP - CE.

JAMES, MAURICE, AND MARCIA SCANLAN SCHOLARSHIP - Unrestricted**.**

LARRY SIMONSON ATHLETIC SCHOLARSHIP - Varsity athlete.

MARJEAN SIMONSON MEMORIAL SCHOLARSHIP - EE or CEng.

MARLYS AND LESLIE SIMONSON ELECTRICAL AND COMPUTER ENGINEERING SCHOLARSHIP - Fr, So, Jr, or Sr in EE or CEng.

NEIL G. SIMPSON MEMORIAL AWARD - Participant in competitive team sport including intramurals, with 2.0 GPA or above.

DELL SKLUZAK SCHOLARSHIP - Fr, So, Jr or Sr participating in Student Association, with minimum 2.5 GPA; preference: Met

A. L. AND P. M. SLAUGHTER MEMORIAL SCHOLARSHIP - So, Jr, or Sr in Geol, GeoE, Met, or MEM; preference: Black Hills area.

SDSM&T MEMORIAL SCHOLARSHIP - Memorial contributions from relatives, alumni, and friends of the university for general scholarship purposes. Memorials of five hundred dollars or more are recognized as follows: THEODORE J. ANDERSON, ROBERT ASHEIM, EDWARD D. BECKER, DENNIS LYNN BEUG, IVAN BOE, JAMES BORCHERT, SCOTT BURRILL, GLENN COATES, ROY K. AND RUTH E. DEAN, PAT DIXON, PAUL B. DONALDSON, RICHARD FINLEY, JON G. FLOWER, ELTON GEIST, CHARLES HALLSTROM, CLYDE HARBISON, HARROLD R. HAYS, LEON AND MAUDE HENRY, CHARLES F. HOFFMAN, LLOYD HOLMGREN, ARVO MATTHEW KORPI, CONSTANCE MARIE KORPI, ELMER C. LEE, HRONE S. MAKREDES, ANTHONY MASTROVICH, CHARLES G. MATHISON, FRANK MAYER, FORREST E. MCFALL, MAX MONHEIM, GODFREY LYON OAKLAND, CLIFFORD OLSON, WAYNE L. OLSON, ROBERT H. OSBORN, G.G. OSTERHOF, ROBERT A. QUINTAL, MILO SCHNEIDER, ROBERT F. SHERMAN, DAN TUSCHER, ARNOLD ULMER, WALLACE DIXON WARD, ROBERT WARRINER, BOYD E. WILSON.

SDSM&T MUSIC SCHOLARSHIPS - One instrumental and one choral, awarded on competitive audition. Cumulative 2.5 GPA.

SDSM&T WOMEN'S CLUB MEMORIAL SCHOLARSHIP - Unrestricted.

JANE SPEICE MEMORIAL SCHOLARSHIP - So, Jr, or Sr in Geol, GeoE, Met, or MEM with 2.5 GPA or above; preference: participating in a university sanctioned activity and has financial need.

STARR MEMORIAL SCHOLARSHIP - Alternate between CE and Met with 2.5 GPA or above.

E. R. STENSAAS MEMORIAL - Jr or Sr in ME.

PETER STEPHANS SCHOLARSHIP - So, Jr, or Sr in EE or CEng with 3.0 GPA or above.

LAVERN STEVENS FAMILY MEMORIAL SCHOLARSHIP - Athlete, preference: female in track and/or cross-country.

JAMES C. STIEGELMEYER MEMORIAL SCHOLARSHIP - CE with emphasis on students active in ASCE.

DR. CHARLES E. STUTENROTH MEMORIAL SCHOLARSHIP - Unrestricted.

HOMER SURBECK PHYSICS PRIZE - Jr in Phys.

AGNES AND HARRY TALICH MEMORIAL SCHOLARSHIP - Hermosa.

KATE SIMMONS TESKEY GRADUATE FELLOWSHIP - Grad with 3.0 or above. U.S. citizen.

GEORGE TLUSTOS MEMORIAL SCHOLARSHIP - CE from central, SD; preference: student from Gregory, SD.

EDWARD L. TULLIS ACADEMIC AWARD IN GEOLOGICAL ENGINEERING - A Brunton Compass will be awarded to the top GeoE on Honor's Day (based on GPA at the end of the fall semester of senior year).

TWIN CITIES ALUMNI - JAMES FORCHTNER MEMORIAL/LOWERY SMITH SCHOLARSHIP - Minnesota residents.

FRANK AND PORTIA VAN LEUVEN MEMORIAL SCHOLARSHIP - Unrestricted.

CURT VELLENGA MEMORIAL SCHOLARSHIP - Phys.

RAJALAKSHMI VENKATARAMAN MEMORIAL FELLOWSHIP - Grad from India in CE.

P. VENKATARAMANUJAM (CIVIL ENGINEERING) FELLOWSHIP - Grad from India in CE.

ERWIN VOLK MEMORIAL SCHOLARSHIP - So, Jr, or Sr ChemE with 2.5 GPA or above.

JOHN T. VUCUREVICH SCHOLARSHIP - Jr or Sr with 3.0 GPA or above; preference: SD students with financial need.

THEODORE G. WAALE MEMORIAL SCHOLARSHIP - Unrestricted.

ALVIN WAGGONER MEMORIAL SCHOLARSHIP - Unrestricted.

CHARLES N. WATERMAN SCHOLARSHIP - Unrestricted.

HOWARD WELLS ATHLETIC SCHOLARSHIP - Athlete.

EMERSON WERTZ MEMORIAL SCHOLARSHIP - Entering Fr in ME; preference: SD high school graduate.

WHEELER MANUFACTURING COMPANY SCHOLARSHIP - Fr; award is available to recipient for two (2) years provided 2.5 GPA or above; preference: was employed or parent is currently employed by Wheeler MFG; then Fr from Lemmon, SD; then Fr from northwestern SD; then Fr from western SD.

JOHN AND GWEN WILLARD MEMORIAL SCHOLARSHIP - Female Fr in Engr or Sci with financial need.

WARREN D. WITHEE MEMORIAL SCHOLARSHIP - CE.

CHRIS AND ALICE WOODS SCHOLARSHIP - One to Jr or Sr in CE and one to Fr, So, Jr, or Sr in CE, both with 2.5 GPA or above.

LEITH L. WYMAN MEMORIAL SCHOLARSHIP - CE.

Current Gifts: The following award amounts depend upon current gifts. All students must be in good academic standing at School of Mines.

AMERICAN INDIAN EDUCATION SCHOLARSHIP - Fr, So, Jr, or Sr Native American student.

AMERICAN PUBLIC WORKS ASSOCIATION SCHOLARSHIP - So, Jr or Sr CE from Black Hills area.

AMERICAN SOCIETY OF CIVIL ENGINEERS AWARDS - Sponsored by the Student Chapter of ASCE. Two awards to most active Jr and Sr in ASCE.

AMERICAN SOCIETY OF CIVIL ENGINEERS PRIZE - Sponsored by the South Dakota Section and Black Hills Branch of ASCE. A cash prize plus entrance fee and one-year membership as associate member of ASCE. Most outstanding graduating Sr in CE.

ARMY ROTC SCHOLARSHIPS - Provides full tuition, campus and lab fees, textbooks and supply allowance, and monthly subsistence during the school year. All freshmen may compete for three-year scholarships and all sophomores may compete for two-year scholarships. ROTC participation is encouraged since scholarship recipients must complete ROTC requirements prior to graduation.

E.E. "BUDDY" AND DEANNE BELZER SCHOLARSHIP - Incoming Fr who graduated from De Smet High School or Lake Preston High School.

BLACK HILLS POWER, INC. SCHOLARSHIPS - So, Jr or Sr in EE or ME with 2.5 GPA, U.S. citizen; preference: female, Native American, then minority.

BLACK HILLS SECTION OF SME - GeoE, Met, and MEM.

BOEING SCHOLARSHIP - ME with 3.0 GPA or above, preference: minority or women

E. LAWRENCE BREVIK MEMORIAL SCHOLARSHIP - Jr or Sr in ChE with 3.0 GPA.

BROIN COMPANIES BIOCHEMICAL ENGINEERING SCHOLARSHIP - So, Jr or Sr pursuing biochemical engineering track.

JAMES C. AND DORIS H. BURRITT MEMORIAL SCHOLARSHIP - Sci or Engr.

CARGILL FOUNDATION SCHOLARSHIP - ChE, ME, and Met.

CARVER-CORNELISSEN SCHOLARSHIP - Geol or GeoE.

CATERPILLAR SCHOLARSHIP - EE, IE, ME, and Met with 3.0 GPA.

CHEMISTRY DEPARTMENT ALUMNI SCHOLARSHIPS - Chem.

CHEMICAL ENGINEERING DEPARTMENT ALUMNI SCHOLARSHIPS - ChE.

CIVIL ENGINEERING DEPARTMENT SCHOLARSHIP - CE.

CONSULTING ENGINEERS COUNCIL OF SOUTH DAKOTA - Jr or Sr in CE, EE, or ME.

ANNE CORWIN SCHOLARSHIP - Female.

CONTROL SYSTEM TECHNOLOGIES FELLOWSHIP - Grad pursuing MS in ME. Work will focus on the development of advanced integrated products and solutions.

CRAZY HORSE/LT. COM. HERRINGTON SCHOLARSHIP - Native American.

CRAZY HORSE/CHARLES A. MORSS MEMORIAL SCHOLARSHIP - Native American.

CRAZY HORSE/PAUL MUEHL SCHOLARSHIP - Financial need.

CRAZY HORSE/WALTER PAILING SCHOLARSHIP - Native American.

CRAZY HORSE/SOCIETY OF EXPLOSIVE ENGINEERS (SEE) SCHOLARSHIP - Native American student; preference: GeoE, Geol, or Met.

DOW CHEMICAL SCHOLARSHIP - Chem or ChE.

DOW CORNING SCHOLARSHIP - Chem or ChE.

CLARE & ALINE ECKLAND ATHLETIC SCHOLARSHIP - varsity athlete, alternating each year between female and male.

EDITOR'S SCHOLARSHIP - Incoming Fr with high entrance exam scores majoring in ChE, Chem, CEng, CSc, EE, GeoE, Geol, IE, IS, Math, ME, Met, or Phys; preference: Bennett County, SD, high school graduate; then South Dakota high school graduate.

ELECTRICAL & COMPUTER ENGINEERING DEPARTMENT SCHOLARSHIP - EE, CEng.

ELECTRICAL ENGINEERING DEPARTMENT FELLOWSHIP - EE.

ERICSSON SCHOLARSHIP - Incoming Math, Sci, or Engr Fr who graduated from McCook Central High School with high school GPA in math and science of 3.0 GPA or above.

JACK FIRST SCHOLARSHIP - So, Jr or Sr Eng female with minimum 3.0 GPA, special essay required.

FRESHMAN MINING ENGINEERING AND MANAGEMENT SCHOLARSHIP - Fr in MEM; preference: female.

DOUGLAS W. FUERSTENAU SCHOLARSHIP - Incoming Fr in Met.

RUSSELL GAMBERG FOOTBALL SCHOLARSHIP - Varsity football.

GEOLOGY/GEOLOGICAL ENGINEERING SCHOLARSHIP - Geol or GeoE.

GEOLOGY/GEOLOGICAL ENGINEERING FELLOWSHIP - Grad in Geol or GeoE.

WALTER N. GRAHAM AND DOROTHY D. GRAHAM SCHOLARSHIP - Unrestricted.

GRUBBY MATH MAJORS SCHOLARSHIP - Preference: incoming Fr in Math; then student changing major to Math.

GUNDERSON, PALMER, GOODSELL & NELSON, LLP SCHOLARSHIP - Fr who graduated from a west river area, SD, high school.

HARDROCK CLUB ATHLETIC GRANTS - Athlete.

HATTERSCHEIDT FOUNDATION EDUCATIONAL SCHOLARSHIPS - Entering Fr who rank in the upper 25 % of their graduating class and are in need of financial assistance.

DANIEL C. HIMELSPACH SCHOLARSHIP - Preference: high school graduates from Powder River County High School, Broadus, MT; then any MT high school graduate.

DALE HJERMSTAD MEMORIAL FELLOWSHIP - Grad with strong financial need; preference: atmospheric science; then computer science; then any discipline.

HORTON, INC. SCHOLARSHIP - ME.

GORDON INGWERSEN SCHOLARSHIP - Fr Engr who graduated from a Sioux Falls, SD, high school; special application from Sioux Falls Community Foundation required.

IS ADVISORS AWARD - IS.

IVANHOE WATER STUDIES FELLOWSHIP - Grad from foreign country that is enrolled in water studies.

CHERYL PUTNAM JAGANNATHAN SCHOLARSHIP - Preference: student who had cancer as a child; then who graduated from Bristol High School; then female in Met.

KRUSE EDUCATION TRUST - Native American.

GORDON A. LARSON SCHOLARSHIP - Preference: student from North Dakota.

MRS. E. H. LIGHTER SCHOLARSHIP - Female varsity athlete; preference: women's basketball.

DAVE AND LORI LITZEN SCHOLARSHIP - One to Jr or Sr women's basketball player and one to Jr or Sr football player.

MAPTEK SCHOLARSHIP - MEM.

MATH DEPARTMENT SCHOLARSHIP - Math.

MECHANICAL ENGINEERING DEPARTMENT SCHOLARSHIP - ME.

METALLURGICAL ENGINEERING DEPARTMENT SCHOLARSHIP - Met.

METALLURGICAL ENGINEERING FACULTY/ALUMNI SCHOLARSHIP - Met.

3M COMPANY SCHOLARSHIP - ChE, EE, and ME.

MINING ENGINEERING AND MANAGEMENT PROGRAM SCHOLARSHIP - MEM.

MONTANA-DAKOTA UTILITIES CO. SCHOLARSHIPS - Two awards with at least one to upperclassman; both from MDU service area.

SUDHIR B. MUTHYALAPATI FELLOWSHIP - Grad student from India in EE.

RAJESH NAMILE FELLOWSHIP - Grad student from India in CSc.

NATIONAL ASSOCIATION OF WOMEN IN CONSTRUCTION - So, Jr, or Sr in construction industry; preference: financial need.

NATIVE AMERICAN SCHOLARSHIP - Native American.

PENG MINING ENGINEERING AND MANAGEMENT SCHOLARSHIP - MEM.

PERRY RAHN SCHOLARSHIP - GeoE

RATHBUN MINING ENGINEERING AND MANAGEMENT SCHOLARSHIP - MEM

FRANK AND MARILYN RICHARDSON SCHOLARS - Top 3 outstanding current So, Jr, and Sr students from the university.

RITER-ALDRICH AWARD FOR EXCELLENCE IN TECHNICAL COMMUNICATIONS- Students excelling in Technical Communications II.

WILLARD L. "BILL" ROBERTS SCHOLARSHIP - Jr or Sr in Geol or GeoE; scholarship from Western Dakota Gem and MEMral Society.

TERRY ROCK ENTREPRENEURIAL SCHOLARSHIP - Recipients must participate in specific competition.

DICK AND MARY SCHLUMPBERGER CIVIL ENGINEERING SCHOLARSHIP - CE.

SCORE SCHOLARSHIP - Fr, So, Jr or Sr whose career objectives are to ultimately become entrepreneurs and businessmen and women.

SIOUX FALLS AREA ALUMNI SCHOLARSHIP - Sioux Falls area student with financial need.

SKY-VUE SCHOLARSHIP - If Fr; preference: western SD high school graduate with cumulative 3.5 GPA. If So, Jr, or Sr; preference: ME with cumulative 3.0 GPA and active in campus activities.

LOWERY AND MARY ANN SMITH ATHLETIC SCHOLARSHIP - Athlete.

SDSM&T CAMPUS CAMPAIGN SCHOLARSHIP - Contributions from School of Mines employees to support general scholarships at the university. Unrestricted.

SDSM&T SCHOLARSHIP - Contributions from alumni and friends of the college to support general scholarships at the university. Unrestricted.

SOUTH DAKOTA WATER AND WASTEWATER ASSOCIATION SCHOLARSHIP - CE.

TAU BETA PI SCHOLARSHIP FOR SOUTH DAKOTA ALPHA - Engr.

TECH CHALLENGE SCHOLARSHIPS - To recruit the brightest and best students as incoming Fr and retain them as So (two-year scholarship support).

THORNDYKE SCHOLARSHIP - Awards to provide "emergency funding" to Jr or Sr.

TSP THREE SCHOLARSHIP - Jr or Sr in CE with cumulative 3.0 GPA who graduated from a west river high school and is currently a SD resident.

WEST RIVER FOUNDATION SCHOLARSHIP - So, Jr, or Sr who graduated from a west river high school and has financial need.

WOMEN OF THE MOOSE SCHOLARSHIP - Unrestricted.

THE SDSM&T STUDENT ASSISTANCE FUND
Income from investments from the following

funds is used to support the Student Assistance Fund, which may include scholarships, loans, or any purposes directly benefiting School of Mines students.

FLOYD, LELAND, MARTIN, AND ADA ELLINGSON AND VERNA J. BUTLER FUND - Established by the estate of Verna Butler to honor her parents and two brothers.

LEONARD AND OLGA PONOMAREFF MEMORIAL SCHOLARSHIP FUND - Established by George Ponomareff to honor his parents.

J.H. STEELE MEMORIAL FUND - Established by Luther M. White to honor the first head of the School of Mines Civil Engineering Department.

SHORT TERM LOANS

SOUTH DAKOTA TECH FOUNDATION MEMORIAL STUDENT LOAN FUND - In addition to Federal Perkins and Stafford Student Loans, School of Mines also administers memorial and special loan funds established by alumni, relatives, friends of the college, and community organizations. These funds include:

Earl Ackroyd Memorial
V. Calvin Alleman Memorial
Etta Jay Anderson Memorial
Lt. Roger Anderson Memorial
Milo Barber Memorial
Gordon A. Beebe Memorial
Donald W. Carlson, Jr. Memorial
Richard V. Colvin Memorial
The Conklin Memorial
Charles Donnelly Memorial
S.R. Halley Memorial
Charles Hallstrom Memorial
Donald C. Huss Memorial
Cecil Lund Memorial
Mamie MacArthur Memorial
Mayberry Memorial
McLaury Memorial
R.B. and Flora J. Neill
H.A. Neilsen Memorial
Marc Pitz Memorial
Rapid City Lions Club-Swander Memorial
Rapid City Rotary Club-Minty Seeley
William E. Snyder Memorial
R. Carl Stuelpnagel Memorial
Betty J. Thomas Memorial
Mel Willigman Memorial

THE FLORENCE E. BELL MEMORIAL LOAN FUND - Loans are to be made to deserving students at the South Dakota School of Mines and Technology.

ANDRE DONEAUD MEMORIAL FOREIGN STUDENT ASSISTANCE FUND - Financial assistance for deserving students administered by SDSM&T Foundation.

RASHID MASHRIQUI MEMORIAL LOAN FUND - This fund is intended to provide short term loan support for foreign students.

HERBERT WEISZ MEMORIAL LOAN FUND - This is a short term loan fund for Mining Engineering students and is administered through the Mining Engineering Program.

Students who have completed at least one semester at School of Mines are eligible for assistance from the various loan funds but must have satisfactory scholastic records. Information regarding loans may be obtained from the Financial Aid Office.

ADDITIONAL INFORMATION

Requests for additional information should be directed to the Financial Aid Office, South Dakota School of Mines and Technology, 501 East Saint Joseph Street, Rapid City, SD 57701-3995, or call locally 394-2274, or toll free (800) 544-8162, ext. 2274.

GENERAL

ACADEMIC ORGANIZATION

Academic organization of the South Dakota School of Mines and Technology centers around two colleges and 16 departments.

Faculty of the colleges work closely together to support and develop:

- quality undergraduate educational opportunities;
- focused quality graduate education;
- research and other scholarly activities in support of educational opportunities at the undergraduate and graduate levels;
- service programs for the people of the state of South Dakota, the region, and the nation.

Academic departments at South Dakota School of Mines and Technology are organized in colleges as follows:

College of Engineering

Chemical and Biological Engineering
Civil and Environmental Engineering
Electrical and Computer Engineering
Geology and Geological Engineering
Industrial Engineering
Mechanical Engineering
Materials and Metallurgical Engineering
Mining Engineering and Management

College of Science and Letters

Atmospheric Sciences
Chemistry
Humanities
Military Science
Mathematics and Computer Science
Physical Education
Physics
Social Sciences

MINORS

- Minors are available in some science degree-granting departments and programs.
- Minors are not available in the engineering disciplines.
- No undergraduate degree program requires a minor.
- Regental undergraduate minors consist of 18-24 semester credit hours.
- No less than nine (9) semester credit hours in a minor must be taken at South Dakota Tech.
- A cumulative grade point average of 2.00 or better must be attained in the course work defining the minor.
- The specific courses required for a minor in each department and program offering a minor can be found in the section of this catalog where that program is described.
- Notification of intent to seek a minor is to be in effect no later than the time of registration for the first semester of the senior year (96 or more credit hours completed) on a form available in the Academic and Enrollment Services Office. This form must be approved and signed by the chair of the department from which the major will be awarded and the chair of the department from which the minor will be awarded.
- All minors will be checked and approved by the Degrees Committee prior to the minor being approved for inclusion on the student's transcript.

CREDIT HOURS DEFINITION

The amount of academic work scheduled or "carried" by a student is measured in terms of credit hours. A credit hour is three hours of in-class time and preparation combined per week for one (1) semester. A recitation or lecture is scheduled as one fifty-minute period plus two (2) hours of preparation for an average student per week per credit hour. Each credit hour of laboratory work is scheduled as one-hundred-ten to one-hundred-seventy (110 to 170) minutes per week. Laboratories scheduled for two (2) hours per credit hour are expected to require one (1) hour of work outside of the scheduled time per week per credit hour.

CLASSIFICATION OF UNDERGRADUATE STUDENTS

All undergraduate students will be assigned one of the following admissions categories:

1. Regular: An admitted, enrolled student, who may or may not be pursuing a degree at School of Mines.
2. Special: An enrolled student who has not been admitted, and is not pursuing a

degree, will be permitted to accumulate more than thirty (30) hours only on an exceptional basis. Special students do not qualify for federal student aid or institutional scholarships.

An Admissions Office review is required in order for a student to move from one admissions category to another.

Freshman, sophomore, junior, or senior classification of undergraduate students is based on accumulated credits for courses passed:

0 to 31.99 credits - Freshman
32 to 63.99 credits - Sophomore
64 to 95.99 credits - Junior
96 or more credits - Senior

Each year, the senior class applies supplementary credit-hour guidelines for senior privileges.

A full-time undergraduate student is defined as a student who is enrolled in at least twelve (12) credit hours during a regular semester. A regular semester is defined as fall, spring, and summer. A student on a cooperative education assignment who is registered for CP (Co-Op) credit shall be considered to have full-time status.

See the Graduate Student General Information section of this catalog for the definition of a full-time and half-time graduate student.

COURSE NUMBERING SYSTEM

Tuition for courses numbered 000 through 499 will be assessed at the undergraduate rate for all students.

Pre-College Courses

001-099 Pre-college, remedial skills, special improvement (non-degree credit)

Undergraduate Courses

100-199 Freshman level
200-299 Sophomore level
300-399 Junior level
400-499 Senior level (may be dual listed with 500 level graduate course)

Tuition for courses numbered 500 through 899 will be assessed at the graduate rate for all students.

Graduate Courses

500-599: Entry level graduate (may be dual listed with a 400 level undergraduate course and may include limited enrollments by undergraduates)

600-699: Graduate level (undergraduate enrollment only by exception)

700-799: Graduate level (Graduate students only)

800-899: Doctoral and post-doctoral level (Doctoral and post-doctoral students only)

Experimental Courses

Experimental courses can be offered for a maximum of two (2) times before formal approval is received, but they must be reported through the system curriculum approval process.

ENROLLMENT IN COURSES

A. Undergraduate Courses (001-499)

1. All undergraduate and graduate students enrolling at Regental universities in courses numbered 001-499 shall be admitted as an undergraduate student (either-degree seeking or non-degree seeking) and registered at the undergraduate level. For all undergraduate and graduate students enrolling at Regental universities in courses numbered 001-499, the courses shall be recorded on the transcript at the undergraduate academic level and included in the calculation of all undergraduate grade point averages.
2. When an undergraduate course is used on a converted credit basis (transferred for one level to another) to meet graduate plan of study requirements at Regental universities, the course shall be recorded on the transcript at the undergraduate academic level with the credit hours approved for the course and then duplicated at the graduate level through an internal transfer policy (Refer to BOR policy 2:5.16). At the undergraduate level, the credit is included in the calculation of the undergraduate institutional grade point average and the undergraduate cumulative grade point average at the full credit rate. At the graduate level, the credit is included in the calculation of the graduate institutional grade point average and the graduate

cumulative grade point average at the converted credit rate (transferred for one level to another).

3. Undergraduate courses required as prerequisites in preparation for registration in graduate courses shall be recorded on the transcript at the undergraduate level and will not be duplicated at the graduate level because the courses are not a part of the Regental graduate plan of study.

B. Graduate Courses (500-899)

1. All undergraduate and graduate students enrolling at Regental universities in courses numbered 500-899 shall be admitted as a graduate student (either degree seeking or non-degree seeking) and registered at the graduate level. For all undergraduate and graduate students enrolling at Regental universities in courses numbered 500-899, the courses shall be recorded on the transcript at the graduate academic level and included in the calculation of all graduate grade point averages.
2. When a graduate course is used on a converted (transferred for one level to another) or actual credit basis to meet undergraduate degree requirements for a Regental accelerated program, the course shall be recorded on the transcript at the graduate academic level with the credit hours approved for the course and then duplicated at the undergraduate level through an internal transfer policy (Refer to BOR policy 2:5.16). At the graduate level, the credit is included in the calculation of the graduate institutional grade point average and the graduate cumulative grade point average at the full credit rate. At the undergraduate level, the credit is included in the calculation of the undergraduate institutional grade point average and the undergraduate cumulative grade point average at the converted (transferred for one level to another) or actual credit rate.

C. Undergraduate Students Taking Graduate Courses

Undergraduate students who have completed a minimum of 96 credit hours may enroll in a limited number of 500 level courses. The Vice President for Academic Affairs may grant an exception for enrollment in a 600 level course. The student shall pay graduate tuition and the courses shall be recorded on a graduate transcript. These graduate courses may apply to an undergraduate degree.

D. Repeated Enrollment in the Same Course

1. A student may enroll in an undergraduate course (for which credit is granted only once) no more than three times without permission of the Vice President for Academic Affairs.
2. A student may enroll in a graduate course (for which credit is granted only once) no more than two times without permission of the Dean of Graduate Education.
3. A student will be allowed unlimited enrollments in an undergraduate or graduate course for which credit toward graduation may be received more than once. An institution may limit the number of credit hours for courses that may be taken more than once that apply toward the requirements for a major.

GRADUATE CREDIT

Graduate credit for School of Mines seniors, per faculty adopted regulations: "An undergraduate student who has senior standing at School of Mines and is ranked in the upper one-half of the class, may petition the Dean of Graduate Education on a form provided by the Academic and Enrollment Services Office for the purpose that a course be recorded on his/her graduate record."

The following conditions or limitations apply:

1. The student must attest that he/she is planning to continue work towards an advanced degree at the South Dakota School of Mines and Technology, but must understand that the university is under no obligation to credit courses so attempted toward any advanced degree until a graduate program of study has been approved.
2. The course(s) must be numbered 500-699.
3. The course(s) must not be required for his or her undergraduate degree; the hours may not be counted toward the 128 or 136

semester credit hours required for the Bachelor of Science degree.
4. The extra courses should not create an overload upon the individual student involved.
5. Not more than twelve (12) hours of graduate credit taken as a School of Mines undergraduate may be applied toward an advanced degree at the South Dakota School of Mines and Technology. Upon written justification by the chair of the student's major department, the Dean of Graduate Education may approve a minor variance from this limit.
6. Petitions from undergraduate students other than those defined above will not be accepted. (See Graduate Student General Information section of this catalog for Graduate Policy.)

Undergraduate Grading System

Undergraduate grades will be assigned to the undergraduate academic level and to all courses and sections with course numbers ranging from 001 to 499. Plus and minus grades are not used.

A Exceptional
4.00 grade points per semester hour

B Above Average
3.00 grade points per semester hour

C Average
2.00 grade points per semester hour

D Lowest Passing Grade
1.00 grade points per semester hour

F Failure
0.00 grade points per semester hour

S Satisfactory
Does not calculate into any gpa

U Unsatisfactory
Does not calculate into any gpa

RI Incomplete (Remedial)
Does not calculate into any gpa

RS Satisfactory (Remedial)
Does not calculate into any gpa

RU Unsatisfactory (Remedial)
Does not calculate into any gpa

W Withdrawal
Does not calculate into any gpa, no credit granted

AU Audit
Does not calculate into any gpa

I Incomplete
Does not calculate into any gpa

IP In Progress
Does not calculate into any gpa

EX Credit by Exam
Does not calculate into any gpa

CR Credit
Does not calculate into any gpa

LR Lab grade linked to Recitation Grade
O credit course

NR Grade not Reported by Instructor
Does not calculate into any gpa

NG No grade
O credit tracking course

Academic Amnesty*
Does not calculate in any gpa, no credit given
*Letter grade followed by an Asterisk indicates Academic Amnesty granted.

An incomplete grade may be granted only when all of the following conditions apply:

a. A student has encountered extenuating circumstances that do not permit him/her to complete the course.
b. The student must be earning a passing grade at the time the Incomplete is necessitated. Anticipated course failure is not a justification for an incomplete.
c. The student does not have to repeat the course to meet the requirements.
d. The instructor must agree to grant an incomplete grade.
e. The instructor and student must agree on a

plan to complete the coursework.

f. The coursework must be completed within one semester; extensions may be granted by the Vice President for Academic Affairs.
g. If the student completes the course within the specified time, the grades that may be assigned are A, B, C, D, F, S, RS, RU, or U.
h. If the student does not complete the course within the specified time, the grade assigned will be F (Failure) or U (Unsatisfactory) or RU (Remedial Unsatisfactory).

An in progress grade may be granted only when all of the following conditions apply:

a. The requirements for the course (for every student enrolled in the course) extend beyond the current term.
b. The extension beyond the current term must be defined before the class begins.
c. The instructor must request permission to award IP grades for a course from their Department Chair and Dean, and then approval must be obtained from the Vice President for Academic Affairs.
d. A definite date for completion of the course must be established in the course syllabus.

DEFINITION OF GRADE POINT AVERAGES

The following grade point averages are calculated each academic term (Fall, Spring, Summer):

Institutional GPA-based on credits earned at a specific Regental university. Utilized to determine if degree requirements have been met and to determine Honors Designation at Graduation.

System Term GPA-based on credits earned at any of the six (6) Regental universities within a given academic term (Fall, Spring, Summer). Utilized to determine minimum progression status.

Transfer GPA- based on credits earned and officially transferred from an accredited college or university outside the Regental system. When a letter grade that normally calculates into the grade point average exists for a non-academic course (*e.g.*, credit earned via examination), it will be included in the transfer GPA.

Cumulative GPA- based on all credits earned by the student (transfer credit plus system credit). Utilized to determine minimum progression status and to determine if degree requirements have been met.

Calculation of grade point averages when undergraduate courses are repeated

When a student repeats an undergraduate course, only the last attempt (take) that received a grade (excluding AU, any amnesty grade, I, IP, NR, RI, and W) will count toward graduation and into grade point averages. Also refer to BOR policies 2:4 and 2:5.

Minimum Progression Standards

Minimum progression standards and related actions are based on the student's cumulative grade point average and system term grade point average.

Class	Credit Hour Range	GPA Standard
Freshman	0-31.99	2.0
Sophomore	32-63.99	2.0
Junior	64-95.99	2.0
Senior	96+	2.0

1. A student with a cumulative grade point average of 2.0 or better is considered to be in good academic standing.
2. If a student's cumulative grade point average falls below 2.0 in any academic term (*i.e.* fall, spring, summer), the student is placed on academic probation the following term.
3. While on academic probation, the student must earn a system term grade point average of 2.0 or better.
4. When a student on academic probation achieves a cumulative grade point average of 2.0 or better, the student is returned to good academic standing.
5. A student on academic probation who fails to maintain a system term grade point average of 2.0 or better is placed on academic suspension for a minimum period of two academic terms.
6. Students on academic suspension will not be allowed to register for any coursework

at any Regental university except when an appeal has been approved by the Regental university from which the student is pursuing a degree. An approved appeal granted by one Regental university will be honored by all Regental universities. Also refer to policy 2:3.G Probation/Suspension of Students.
7. Only Academic Suspension will be entered on the student's transcript. Academic probation will be noted in the internal academic record only.

ACADEMIC AMNESTY

The goal of academic amnesty is to respond to the academic needs of matured individuals as they develop newly identified potential. Through the application of academic amnesty, the student's prior academic record can be excluded from current work under certain conditions.

Eligibility:
The student must:
1. be an undergraduate, full-time or part-time, degree-seeking student at one of the universities in the South Dakota Regental system.
2. not have been enrolled in any Regental university for a minimum of three calendar years (nine (9) consecutive terms including Fall, Spring, and Summer) prior to the most recent admission to the home institution. Exceptions may be granted in rare cases only by the Board of Regents Senior Administrator upon recommendation by the Vice President for Academic Affairs.
3. have completed a minimum of twenty-four (24) graded credit hours taken at any Regental university with a minimum grade point average of 2.0 for the twenty-four (24) credit hours after the most recent admission to the home institution.
4. not have earned a baccalaureate degree from any university.
5. not have been granted any prior academic amnesty at any Regental university.
6. submit a formal Academic Amnesty Petition to their home university following the procedures established by that university.

Conditions:
1. Academic amnesty does not apply to individual courses. Academic amnesty may be requested for either (a) all previous post-secondary education courses, or (b) all previous post-secondary education courses at a specific institution, or (c) a specified time period not to exceed one academic year (Fall/Spring).
2. Academic amnesty, if granted, shall not be rescinded.
3. Courses for which academic amnesty is granted will:
   a. remain on the student's permanent record.
   b. be recorded on the student's undergraduate transcript with the original grade followed by an asterisk (*).
   c. not be included in the calculation of the student's grade point average because no credit is given.
   d. not be used to satisfy any of the graduation requirements of the current degree program.
4. Academic amnesty decisions will be made by the student's home institution and will be honored by all other institutions within the South Dakota Regental system.
5. Universities outside of the South Dakota Regental system are not bound by the academic amnesty decisions made by the South Dakota Regental system.

DEAN'S LIST DESIGNATION

Undergraduate students may be designated for the Dean's List at the end of the fall and spring terms. The Dean's List designation is determined by the home university and is based on a student's total course registrations for academic credit for the term from any Regental university. The Dean's List designation does not appear on the transcript. To be awarded Dean's List designation, students must meet the following guidelines.
a. Students must have earned a minimum of twelve (12) credit hours during the term.
b. Students must achieve a System Term GPA of at least 3.50.
c. Students with F or I grades are not eligible regardless of System Term GPA attained.

Date for a Grade of W

Undergraduate and graduate students who drop a course, or withdraw from the System, shall receive a grade of "W" if that action occurs anytime between the day after the census day for that course and the day that corresponds with the completion of 70% of the class days for that course. Likewise, a student who withdraws from the system during that time period also shall receive grades of "W" for all the courses in which he/she is registered

For standard classes, the last day to receive a grade of "W" is determined by calculating 70% of the class meeting days in the term, counting from the first day of classes in the term and rounding up if the calculation produces a fractional value greater than or equal to 0.5.

For any non-standard course, the last day to receive a grade of "W" is based on the number of class meeting days for the course, using the method described above.

A notation of the date of withdrawal will be included on the student's transcript if he/she withdraws from the system.

Students may not drop a course or withdraw from the System after the time period specified above.

Withdrawal From the University

The effective date used for students withdrawing from the University is the date that the withdrawal process is initiated in the Office of Academic and Enrollment Services. This notice must be given by the student using the appropriate forms. Dates for withdrawing from the university will be proportionally adjusted for summer terms of instruction.

Complete withdrawal from the university from the day after registration day through 70% of the class meeting days in the term results in the assignment of "W" grades unless the professor-in-charge has previously assigned a final grade. A withdrawal from the university must be initiated in the Office of Academic and Enrollment Services and processed through the Director of Retention and Testing. A withdrawal from the university will be processed only when all courses at all Regental universities are being dropped by a student.

If a student withdraws from the university after completion of 70% of days, grades of "F" automatically are assigned by the Office of Academic and Enrollment Services in all courses for which the student was enrolled unless a final grade has previously been issued by the course instructor. In the event that a final grade has not been assigned, consideration may be given to extenuating circumstances that may warrant the assignment of a grade of "W." Should such extenuating circumstances exist, the student may appeal in writing to the Student Enrollment Appeals Committee for change of the automatically assigned "F" to "W." Such appeal must be filed within one semester after the semester in which the withdrawal occurred. The Student Enrollment Appeals Committee, the student's advisor, and the instructor(s) involved in said course(s) will meet to consider the student's appeal and the circumstances involved. The Student Enrollment Appeals Committee will render a final decision on change of grade from "F" to "W" for each individual course involved, based upon the information and recommendations provided by the course instructor(s) and the student's advisor.

Re-admission Following Withdrawal

A student may be readmitted by permission of the Vice President for Academic Affairs in the same semester after a withdrawal if the student has paid the appropriate tuition and fees.

Transcript of Credits

A transcript of credits is an authentic copy of the student's academic record from each Regental university attended. The fee is $5.00 for each copy, and $2.50 for each copy thereafter per request. A transcript must include all courses attempted. Transcripts are released only on written request with the signature of the individual concerned. This order must be placed in person, by mail, or by FAX to the Office of Academic and Enrollment Services. Upon graduation each student is entitled to one complete transcript of the credits earned without charge.

ATTENDANCE

Every student is expected to attend each lecture or laboratory session for which he or she is scheduled. The faculty has allowed no system of authorized "cuts." A student who fails to attend classes regularly must satisfy such requirements as the instructor in a course may prescribe.

Excused Absences for School Sponsored Events

The Faculty recognizes extracurricular activities to be a valued component of student development and education. When an activity results in a classroom absence, the Faculty members have agreed to accommodate students involved in these activities in accordance with this policy.

Procedures:

1. Students who participate in recognized activities will notify their instructors prior to the absence.
2. Students will be given the opportunity to make-up any exams missed in the course of the absence.
3. Students will consult with their instructors regarding the make-up/submission of other graded activities that will be missed as a consequence of the absence.
4. Recognized activities are those determined by the Advisor of the sponsoring School of Mines organization or the Coach of the involved athletic team. If there are any questions the Advisor/Coach should consult with the Vice President for Student Affairs/Athletic Director.
5. All other arrangements (if allowable) for absences not covered under this policy must be decided through consultation between the faculty member and the student, and/or under the guidelines of the class syllabus of the instructor.
6. Unresolved issues may be taken up following the established School of Mines Grievance Procedure for Students Policy III-A-31.

A list of School of Mines advisors is posted on the School of Mines website. Recognized activities under this policy are determined by the School of Mines advisor/coach. Upon request or as a standard process the advisor/coach may send an e-mail notice verifying the event.

Campus Clearing Policy

All graduating students are responsible for return of all college property, library books, keys, etc., and payment of all financial obligations to the college before their diplomas will be released.

Conduct

South Dakota School of Mines and Technology subscribes to the widely recognized traditions and lawful missions of tax-supported higher education in the United States. These traditions and missions work to: (1) to develop students to well-rounded maturity, physically, socially, emotionally, intellectually, and vocationally; (2) to develop, refine, and teach ethical and cultural values; (3) to teach the practice of excellence in thought, behavior, and performance; (4) to teach principles of patriotism, civil obligation, and respect for the law; and (5) to transfer the wealth of knowledge and tradition from one generation to the other. The regulations established by the Regents, faculty, or administration, have been developed to enhance the opportunities for fulfilling the above purposes. Students are expected to adhere to and support such policies.

In general, students are expected to conduct themselves as responsible citizens at all times and to uphold all federal, state and local laws. Conduct that is held detrimental to the college community (composed of students, faculty, and administration) may result in disciplinary action.

The Regents for the state supported institutions of higher learning in South Dakota have formulated the following policy statement relating to student conduct and behavior:

The attendance of a student at one of the higher education institutions under the jurisdiction of the Board of Regents is a voluntary entrance into the academic community. By such act the student assumes obligations of conduct and performance imposed by the institution. The constitutional rights of students will not be abridged by action of the academic community. The institutions may discipline or expel the student from the academic community for any intentional act, which disrupts or prevents the accomplishment of any lawful mission, process, or function of the institution or in order to *secure compliance with the obligations of conduct and performance imposed. (Regents Policy Manual, Sec. 10.1.2. June 1990)*

Complete details of current policy regarding student conduct, responsibilities, and disciplinary sanctions will be found in the student code of conduct brochure. A Code of Student Rights and Responsibilities and the Board of Regents Policy on Student Conduct was adopted in January of 1995. Adopted policy serves as a basic set of guidelines for students, faculty members, and administration. School of Mines judicial process provides all members of the student body with the facilities for appeal and adjudication.

Admission and enrollment in the university obligates the student to be familiar with and to abide by the standards and the rules and regulations of the University as well as the laws of the various levels of government. Students should be aware of and familiar with such laws, rules, and regulations with respect to their status on the campus, as defined in the Student Code of Conduct, printed annually is available to students at registration or upon request and on-line. Changes in some of these rules may be desirable from time to time, and student cooperation and participation in bringing about changes through appropriate channels is encouraged. However, violations of existing regulations will not be condoned and disciplinary sanctions may be imposed for such violations.

Photos Courtesy of SD Department of Tourism

Mines Matters: The beautiful Black Hills and surrounding area offer a variety of outdoor activities. Custer State Park, Mount Rushmore, Harney Peak, and Badlands National Park are a short distance from Rapid City.

REGISTRATION

ACADEMIC TERMS DEFINED

School of Mines operates a fall, spring, and summer term. Fall and spring shall operate on a semester basis. Summer term begins the day after spring semester ends and continues until the day before fall semester begins.

A semester shall consist of a minimum of fifteen (15) weeks. The number of class days in a given semester shall be inclusive of those days set aside for registration, assessment/performance testing and final examinations but exclusive of holidays and days set aside for new student orientation. New student orientation may be concurrent with or prior to registration.

Academic guidelines require that all courses offered for credit must involve a minimum of fifteen (15) contact hours over three (3) instructional days for each credit hour awarded.

Courses offered by distance education should have equivalent standards, rigor, student outcomes, substance and assignments as courses offered by face-to-face means. Distance education courses may be scheduled on a semester basis and require that students complete learning experiences on a particular timeline (i.e. each week). The required length for a distance education course is determined by course expectations and scheduling. The student will conclude the course upon completion of course requirements. Typically, a one credit hour course lasting for a semester equates to forty-five (45) hours of effort by the student.

Academic Calendar

Institutions of higher education, under control of the Board of Regents, shall operate on a common academic calendar with common periods during the summer term and the fall and spring semesters at each institution when classes are not in session. Academic calendars shall be designed a minimum of two (2) years in advance with annual extensions recommended to the Executive Director by the Council of Presidents and Superintendents no later than the May meeting.

Holidays

The schedule of holidays for the institutions of higher education is listed below. Classes shall not be scheduled to meet on holidays.

New Years Day
January 1*

Martin Luther King Jr. Day
Third Monday in January

Presidents Day
Third Monday in February

Memorial Day
Last Monday in May

Independence Day
July 4*

Labor Day
First Monday in September

Native American Day
Second Monday in October

Veterans Day
November 11*

Thanksgiving Day
Fourth Thursday in November

Christmas Day
December 25*
*If January 1, July 4, November 11, or December 25 fall on a Sunday, the Monday following shall be observed as the holiday; if they fall on a Saturday, Friday shall be observed as the holiday.

Drop and Add Period

The drop/add period is the time period during which students may adjust their academic schedule for the term without financial or academic consequences. The last day of the drop/add period for a course is designated as the census date for that course and is the official date for enrollment reporting. The end of the drop and add period for standard and non-standard courses offered in a semester shall be the date the first 10% of the term ends or the day following the first class meeting, whichever is later. When calculating 10% of the term, breaks of five (5) or more days are not included when counting the total number of days but Saturdays, Sundays, and holidays are. Student registrations can only be added to courses after the end of the drop and add period by approval of the chief academic officer of the university.

Registration Changes

All students will be assigned an academic mentor/advisor upon admission; thereafter, all course registrations and changes, other than withdrawal from the university, should be approved by the assigned mentor/advisor. Students may request advisor or major changes from the Office of Academic and Enrollment Services.

Credit Received Through Validation Methods

A. Credit earned through validation methods other than nationally recognized examinations is limited to a maximum of 32 hours of credit for baccalaureate degrees and 16 hours of credit for associate degrees.

1. Validation of Military credit is limited to an additional 32 hours of credit for baccalaureate degrees and an additional 16 hours of credit for associate degrees.

B. Credit for college level courses granted through nationally recognized examinations such as CLEP, AP, DANTES, etc., will be evaluated and accepted for transfer if equivalent to Regental courses and the scores are consistent with Regental policies.

C. When validation credits are accepted, equivalent courses are recorded on the transcript but are not calculated into the grade point averages.

D. In any subsequent evaluation, equivalencies for system common courses and system general education courses will not be changed. Equivalencies for unique courses may be changed, re-evaluated, or inactivated. Additional equivalencies may be added and evaluated.

E. The university-specific degree requirements determine if the validation credits accepted also are applicable to the student's degree program at that university.

Advanced Placement Program (AP)

Entering freshman students who have completed an honors course in high school and who have taken and successfully passed the appropriate College Entrance Examination Board Advanced Placement test with a score of three (3), four (4), or five (5) may receive course credit. South Dakota Board of Regents policy on specific courses for which credit is given and other requirements are found at www.sdbor.edu/administration/policy_planning/ap/default.htm.

College Level Examination Program (CLEP)

The South Dakota Board of Regents and its universities encourage high school students to pursue rigorous academic programs and to take advantage of opportunities available to them to earn college credit. The College Board's College Level Examination Program (CLEP) provides an opportunity to earn college credit. Colleges and universities award college credit for satisfactory performance on the CLEP examinations. Satisfactory performance on CLEP examinations can reduce the cost of a college education by reducing the number of courses a student must take to complete a degree.

The purpose of the Regents' guide is to provide information for high school students and teachers on how CLEP credit is awarded at South Dakota's public universities. CLEP credit awarded by one of the universities will transfer to all of the institutions. The minimum examination scores required are those suggested by The College Board and American Council on Education, and in some disciplines the universities award additional credit for higher scores. The guide is available on the SDBOR web site at www.sdbor.edu/administration/academics/CLEPRevised11182003.xls and includes the following information by institution for each CLEP examination:

1. minimum score required
2. credit hours awarded
3. courses for which credit is received
4. if credit meets general education, major, or elective only requirements.

Answers to questions about CLEP are provided from The College Board at www.collegeboard.com/clep/html/index001.html. South Dakota School of Mines and Technology accepts Subject Examinations only.

Credit By University Examination

The School of Mines faculty has adopted a policy to permit college credit by university examination. Any student enrolled in the college who has studied a subject independently or who has completed equivalent college level course work elsewhere for which he or she is unable to get a transcript acceptable to this institution may request a special examination to establish credit under the conditions specified below:

1. The student must consult his or her advisor and the chair of the department in which the course is offered, who will conduct a preliminary survey of the work in which the student claims to be prepared and will determine whether an examination is warranted, what topics it should cover, and what credit may be expected.
2. After determining eligibility to take an examination, the candidate pays a per subject fee at the Office of Student Accounts/Cashiering Services and then secures the appropriate form from the Office of Academic and Enrollment Services.
3. If the student successfully completes the examination, the permanent record will show "Credit by Examination." with a grade of "EX." No entry will be made on the permanent record if the examination is failed.

International Baccalaureate (IB)

School of Mines recognizes the rigor of IB courses and the IB Diploma Program, and encourages students to complete higher level courses and exams when ready. Students who complete higher level courses and exams and obtain a score of five (5) or above will be considered for advanced placement credit in the corresponding course.

Dual Use of Credit

Many high school students complete college-level courses while enrolled in high school. School of Mines encourages talented high school students to extend their educational background in this manner.

South Dakota law provides that students in grades 11 and 12 may enroll in not more than two (2) courses per fall or spring semester and have these courses applied towards Bachelor of Science degree requirements at School of Mines. With the school district's approval, these courses may be applied to high school graduation requirements. Documentation and additional admission procedures will be required see page 15 for further information.

Undergraduate Pass-Fail Option

1. Any undergraduate student with a minimum cumulative GPA of 2.00 at South Dakota School of Mines and Technology is eligible to elect one free elective course per semester on a pass or fail basis. Courses taken under the Pass/Fail option cannot be used to satisfy the sixteen (16) credit hours of humanities/social science requirement for the Bachelor of Science Degree.
2. The student shall notify the Office of Academic and Enrollment Services in writing of his or her request that the course be graded on a pass or fail basis. Only the Office of Academic and Enrollment Services and the student's advisor are to be notified of the intention of the student to be graded on a pass or fail basis. A student will have the option during the drop and add period of each semester to change from pass or fail to traditional grading, or vice versa.
3. The instructor will report the student's grade based on the college's regular grading system. If a grade of "D" or better is recorded, the student will receive a "Satisfactory," a grade of "U" will be recorded as a "Fail," and the "U" grade will count in calculating credits attempted.
4. Credits earned under this option may be used toward a student's graduation requirements, if appropriate and applicable, but only if a grade of "S" is recorded. A passing grade will be recorded as "S" and will not be used in the calculation of the student's GPA. A course taken on a pass or fail basis will not be converted, after a grade has been recorded, to a traditional grade for the purpose of improving a GPA.

5. The pass or fail option shall apply only to the student's first registration in a course.

Registration Retake Policy

The registration retake policy defines how many times a student may register for (take) a course.

The retake policies approved by the BOR are:

1. A student will be allowed a total of three takes for undergraduate courses (course numbers of 001 to 499) for which credit is only counted toward graduation once. The student must petition to the Vice President for Academic Affairs to be permitted to take an undergraduate course more than three times.
2. A student will be allowed a total of two takes for graduate courses (course numbers of 500 or above) for which credit is only counted toward graduation once. The student must petition the Graduate Dean for permission to take a graduate course more than two times.
3. A student will be allowed unlimited takes for an undergraduate or graduate course for which credit toward graduation may be received more than once (e.g., Independent Study, Thesis). All takes will count into grade point average calculations. Individual departments/majors may limit the number of credits allowed toward graduation in certain courses. Students should check with their mentor/advisor.
4. The Audit (AU) grade is the only grade that will not be counted as a take of a course. All other grades, including Withdraw "W" grade, will count as a take of a course.
5. Transfer courses and non-courses (CLEP, credit by exam) will also count as a take of a course.
6. The count for retakes will begin with courses in which students are enrolled Fall 2003. Takes of a course prior to Fall 2003 will not be counted.

Audited Courses and Registrations for No Credit

The outside preparation of auditors is entirely voluntary. Their participation in classroom discussions and examinations, and the minimum attendance requirements are subject to arrangements with the instructor of the course being audited. Failure to meet these arrangements will be cause for changing the grade in the course from "AU" to "W." An auditor is allowed neither credit nor a grade for the course even if the auditor satisfactorily passes the final examination of the course. An audited course cannot count toward the definition of a full-time load for purposes of securing financial aid nor for establishing eligibility to compete in intercollegiate contests. An audited course may not be used to qualify for a reduced tuition rate, but will be counted toward any upper limits on the number of credit hours a student may carry, and will be counted in determining requirements for paying campus fees.

A course taken for no credit but with a grade will be treated the same as an audited course except that the student will be expected to prepare and participate in the course to the same extent as all other students. The grade awarded will not be counted in the student's grade point average.

The request to audit a course or to enroll with no credit must be made at the time of the drop and add period by written petition to the Office of Academic and Enrollment Services. The petition has no effect on the tuition charges for a course.

Overloads

A normal student load is eighteen (18) credit hours or less. An overload is a course load in excess of 18 credit hours.

To register for an overload, students must consult with their academic advisors. Student requests for overload enrollments should be submitted in writing to their college dean at their "HOME" institution to grant the approval for registration in credits beyond the overload status. This approval will normally be granted based on a student's exceptional past academic experience.

Deadlines for Adding Courses

1. Students may add daytime or night courses to their schedules through the first 10% of the term. When calculating 10% of the term, breaks of five (5) or more days are not included but Saturdays, Sundays, and holidays are. This date is

listed in the Academic Calendar, which is on the inside front cover of this catalog.

2. In exceptional circumstances, students may add daytime or night courses with the permission of the instructor and the department chair responsible for the student's proposed additional course, through the 15th day of classes.
3. Students wishing to add daytime or night courses beyond the period specified above must file a written appeal with the Vice President for Academic Affairs (or their designee); the appeal must be signed by the student and approved by the instructor of the course involved and the student's advisor.
4. Students may add summer term courses through the first 10% of the term. When calculating 10% of the term, breaks of five (5) or more days are not included but Saturdays, Sundays, and holidays are.
5. In extreme circumstances, students may add summer school courses after this period with permission of the instructor and the Vice President for Academic Affairs (or their designee).
6. No student will be permitted to attend any class unless he/she is registered and listed on the class attendance roll.
7. Following fee assessment, the students are required to pay for all additional tuition and fees at the Student Accounts / Cashiering Services Office. Failure to pay may result in students being dropped from the sections that they added. It is the responsibility of the instructor in each class to check the class roll carefully during the first few weeks of each semester to be certain that all students attending a given class are listed on the class roll. Any student whose name does not appear on the class roll should not be permitted to attend that class, and should be referred to the Office of Academic and Enrollment Services promptly for clarification of his or her status.
8. Students can add and drop courses by using WebAdvisor, a Web interface to the Colleague Student Information System.

Deadlines for Dropping a Course

Please see "Date for a Grade of W" on page 54 for information about dropping a course.

Mandatory Placement Procedure

A mandatory placement procedure for mathematics and English is used at all Regental universities in the state. The instruments and criteria used for other mandatory placement are at the discretion of each institution.

Mines Matters: Rapid City is the second largest city in South Dakota, with a population of more than 60,000. Rapid City is the hub of commerce for western South Dakota, eastern Wyoming, and northwestern Nebraska. Twenty minutes from Mount Rushmore, Rapid City and the adjacent Black Hills National Forest offer summer and winter recreational activities such as skiing, hiking, camping, fishing, and biking.

BACHELOR OF SCIENCE GRADUATION REQUIREMENTS

HONORS DESIGNATION AT GRADUATION

The institution granting the degree determines the honors designation for its graduates. To earn an honors designation at graduation the student must meet both the following cumulative and institutional grade point averages:

Summa Cum Laude:
equal to or greater than 3.9

Magna Cum Laude:
equal to or greater than 3.7 and less than 3.9

Cum Laude:
equal to or greater than 3.5 and less than 3.7

A baccalaureate-level graduate student must have completed a minimum of sixty-four (64) credit hours at the institution granting the degree. Regental universities are considered to be earned from the institution granting the degree.

BACCALAUREATE DEGREE

The institution granting the degree determines the honors designation for its graduates. To earn a honors designation at graduation the student must meet both the following cumulative and institutional grade point averages:

Summa Cum Laude:
equal to or greater than 3.9

Magna Cum Laude:
equal to or greater than 3.7 and less than 3.9

Cum Laude:
equal to or greater than 3.5 and less than 3.7

The student must have completed a minimum of sixty-four (64) credit hours at the institution granting the degree. Courses that are part of a formal collaborative agreement among Regental universities are considered to be earned from the institution granting the degree.

ASSOCIATE DEGREE

The institution granting the degree determines the Honors Designation for its associate-level graduates. To earn an Honor Designation at graduation, an associate-level graduate must meet both the following cumulative and institutional grade point averages:

With highest honor:
equal to or greater than 3.9

With high honor:
equal to or greater than 3.7 and less than 3.9

With honor:
equal to or greater than 3.5 and less than 3.7

An associate-level graduate must have completed a minimum of 32 credit hours at the institution granting the degree. Courses that are part of a formal collaborative agreement among Regental universities are considered to be earned from the institution granting the degree.

TWO BACHELOR OF SCIENCE DEGREES FROM SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY

An undergraduate student who wishes to qualify for a second bachelor of science degree conferred by School of Mines must complete a minimum of thirty (30) semester hours of credit in residence beyond the credit hours used for the first B.S. degree.

Students should report their intent to pursue two (2) bachelor of science degrees to the Office of Academic and Enrollment Services. This action will initiate the assignment of an advisor in each discipline.

GENERAL REQUIREMENTS

The following rules on graduation requirements apply for the Bachelor of Science degree in any curriculum offered by the university. Requirements that apply to many or all programs are described below. Please refer to the curriculum for an individual degree program for specific course requirements. Each candidate for a degree is personally responsible for meeting all requirements for graduation. No university official can relieve a candidate of this responsibility.

The South Dakota School of Mines and Technology reserves the right to change any course of study or any part of a curriculum in keeping with accreditation, educational, and scientific developments.

General Education Core Requirements

General education core requirements must be completed within the first sixty-four (64) credits. Requests for exceptions to these general education requirements must be approved by the student's advisor and by the Vice President for Academic Affairs. The required core is listed below.

Goal #1

Students will write effectively and responsibly and understand and interpret the written expression of others.

Student Learning Outcomes: As a result of taking courses meeting this goal, a student will:

1. Write using standard American English, including correct punctuation, grammar, and sentence structure;
2. Write logically;
3. Write persuasively, with a variety of rhetorical strategies (e.g., expository, argumentative, descriptive);
4. Incorporate formal research and documentation in their writing, including research obtained through modern, technology-based research tools.

Each course meeting this goal includes the following student outcomes: Required: #1, #2, #3, and #4

Credit Hours: Six (6) hours

Courses:

ENGL 101	Composition I
ENGL 201	Composition II
ENGL 279/289	Technical Communications I and II[1]

[1] Engineering and sciences students at School of Mines take this six credit sequence in the sophomore and junior years. Both courses develop written and speech communications in an integrated fashion in the context of the major. Students must finish the entire sequence, as well as ENGL 101, to satisfy the requirements of Goal #1 and Goal #2.

Goal #2

Students will communicate effectively and responsibly through speaking and listening.

Student Learning Outcomes: Courses satisfying this goal will require students to:

1. Prepare and deliver speeches for a variety of audiences and settings;
2. Demonstrate speaking competencies including choice and use of topic, supporting materials, organizational pattern, language usage, presentational aids, and deliver;
3. Demonstrate listening competencies by summarizing, analyzing, and paraphrasing ideas, perspectives and emotional content.

Credit Hours: Three (3) hours

Courses:

ENGL 279/289	Technical Communications I and II[1]
SPCM 101	Fundamentals of Speech

[1] Technical Communications I and II develop written and speech communications in an integrated fashion in the context of the major. Students must finish the entire sequence, as well as ENGL 101, to satisfy the requirements of Goal #1 and Goal #2.

Goal #3

Students will understand the organization, potential, and diversity of the human community through study of the social sciences.

Student Learning Outcomes: As a result of taking courses meeting this goal, students will:

1. Identify and explain basic concepts, terminology and theories of the selected social science disciplines from different spatial, temporal, cultural and/or institutional contents.
2. Apply selected social science concepts and theories to contemporary issues;
3. Identify and explain the social or aesthetic values of different cultures.

In addition, as a result of taking course meeting this goal, students will be able to demonstrate a basic understanding of at least one of the following:

4. The origin and evolution of human institutions;
5. The allocation of human or natural resources within societies;
6. The impact of diverse philosophical, ethical or religious views;

Each course meeting this goal includes the following student learning outcomes:
Required: #1, #2, and #3
At least one of the following: #4, #5, or #6

Credit Hours: Six (6) hours (in two (2) disciplines)

Courses:

ANTH 210	Cultural Anthropology
ECON 201	Principles of Microeconomics
ECON 202	Principles of Macroeconomics
GEOG 101	Introduction to Geography
GEOG 212	Geography of North America
HIST 151/152	United States History I/II
POLS 100	American Government
POLS 210	State and Local Government
PSYC 101	General Psychology
SOC 100	Introduction to Sociology
SOC 150	Social Problems
SOC 250	Courtship and Marriage

Goal #4

Students will understand the diversity and complexity of the human experience through study of the arts and humanities.

Student Learning Outcomes: As a result of taking courses meeting this goal, students will:

1. Demonstrate knowledge of the diversity of values, beliefs, and ideas embodied in the human experience;
2. Identify and explain basic concepts of the selected disciplines within the arts and humanities.

In addition, as a result of taking courses meeting this goal, students will be able to do at least one of the following:

3. Identify and explain the contributions of other cultures from the perspective of the selected disciplines within the arts and humanities;
4. Demonstrate creative and aesthetic understanding;
5. Explain and interpret formal and stylistic elements of the literary or fine arts;
6. Demonstrate foundational competency in reading, writing, and speaking non-English language.

Each course meeting this goal includes the following student learning outcomes:
Required: #1, #2
At least one of the following: #3, #4, #5, or #6

Credit Hours: Six (6) hours (in two (2) disciplines or in a sequence of foreign language courses)

Courses:

ART 111/112	Drawing I and II
ARTH 211	History of World Art I
ENGL 221/222	British Literature I and II
ENGL 241/242	American Lit I and II
ENGL 250	Science Fiction
FREN 101/102	Introductory French I and II
GER 101/102	Introductory German I and II
HIST 121/122	Western Civilization I and II
HUM 100	Introduction to Humanities
HUM 200	Connections: Humanities and Technology
LAKL 101/102	Introductory Lakota I and II
MUS 100	Music Appreciation
PHIL 100	Introduction to Philosophy
PHIL 200	Introduction to Logic
PHIL 220	Introduction to Ethics
PHIL 233	Philosophy and Literature
SPAN 101/102	Introductory Spanish I and II

Goal #5

Students will understand and apply fundamental mathematical processes and reasoning.

Student Learning Outcomes: As a result of taking courses meeting this goal, students will:

1. Use mathematical symbols and mathematical structure to model and solve real world problems;

2. Demonstrate appropriate communication skills related to mathematical terms and concepts;
3. Demonstrate the correct use of quantifiable measurements of real world situations.

Credit Hours: Three (3) hours
Courses:

MATH 102	College Algebra
MATH 115	Precalculus
MATH 120	Trigonometry
MATH 123	Calculus I
MATH 125	Calculus II
MATH 225	Calculus III
MATH 281	Statistics

Goal #6

Students will understand the fundamental principles of the natural sciences and apply scientific methods of inquiry to investigate the natural world.

Student Learning Outcomes: As a result of taking courses meeting this goal, students will:

1. Demonstrate the scientific method in a laboratory experience;
2. Gather and critically evaluate data using the scientific method;
3. Identify and explain the basic concepts, terminology and theories of the selected natural sciences;
4. Apply selected natural science concepts and theories to contemporary issues.

Each course meeting this goal includes the following student learning outcomes:
Required: #1, #2, #3 and #4

Credit Hours: Six (6) hours
Courses:

BIOL 151/151L	General Biology I and Laboratory
BIOL 153/153L	General Biology II and Laboratory
CHEM 106/106L	Chemistry Survey/Laboratory
CHEM 108/108L	Organic Chemistry/Laboratory
CHEM 112/112L	General Chemistry I and Laboratory
CHEM 114/114L	General Chemistry II and Laboratory
GEOL 201/201L	Physical Geology/Laboratory
PHYS 111/111L	Introduction to Physics I and Laboratory
PHYS 113/113L	Introduction to Physics II and Laboratory
PHYS 211	University Physics I
PHYS 213/213L	University Physics II and Laboratory

Goal #7

Students will recognize when information is needed and have the ability to locate, organize, critically evaluate, and effectively use information from a variety of sources with intellectual integrity.

Student Learning Outcomes: Students will:

1. Determine the extent of information needed;
2. Access the needed information effectively and efficiently;
3. Evaluate information and its sources critically;
4. Use information effectively to accomplish a specific purpose;
5. Use information in an ethical and legal manner.

Assessment: Students fulfill the requirement by demonstrating competency through and assessment designed by the university.

Curricular Requirements

All Bachelor of Science programs require the General Education Core Requirements as describe earlier. Other requirements for each degree are determined by the faculty in each program, with approval through the university curriculum approval process. Some of these other program requirements are common to most or all programs offered at School of Mines. These include:

A. Mathematical Sciences: all programs, with the exception of Interdisciplinary Science and Chemistry-Applied Option, require a minimum of sixteen (16) credit hours of mathematics at the level of calculus and above. To qualify for MATH 123, Calculus I, a student must have completed at least three units of mathematics in high school and must have obtained an acceptable score on the School of Mines mathematics placement examination. A student with less preparation in mathematics may register as a freshman in engineering but will be required to start the mathematics sequence at a level indicated by his or her formal preparation and all School of Mines mathematics placement examination scores or ACT placement score. Mathematics courses taken below the level of MATH 123 are not totaled in the semester hours required for each curriculum with the exception of Interdisciplinary Sciences and Chemistry-Applied Option. MATH 021 and MATH 101 do not count toward any degree.

B. Basic Sciences: minimum of sixteen (16) credit hours - CHEM 112, 112L, PHYS 211, and PHYS 213 are required for all engineering curricula.

C. Humanities and Social Sciences: minimum of fifteen (15) or sixteen (16) credit hours - This subject area must include six credits in humanities and six (6) credits in social sciences. The number required in your major is listed in the department section of the catalog. Students majoring in engineering must complete at least three of these credits at an advanced level. See page 64 for courses that also meet general education core requirements.

Humanities

Art: ART 111, 112, ARTH 211, 321, 491, 492
English: ENGL 221, 222, 241, 242, 250, 300, 330, 343, 350, 360, 374, 383, 391, 392, 468
Foreign Language: FREN 101, 102, GER 101, 102, LAKL 101, 102, SPAN 101, 102
History: HIST 121, 122
Humanities: HUM 100, 200, 291, 292, 300, 350, 375, 410, 491, 492
Music: MUAP 200, 201, MUEN 330, MUS 100, 110, 250, 326
Philosophy: PHIL 100, 200, 220, 233
Religion: 230, 250

Social Sciences

Anthropology: ANTH 210
Business Administration: BADM 350, 360
Economics: ECON 201, 202
Geography: GEOG 101, 212, 240, 250, 400
History: HIST 151, 152, 492
Law: LAW 457
Political Science: POLS 100, 210, 350, 407, 430, 440, 453
Psychology: PSYC 101, 261, 323, 331, 391, 392, 441, 451, 461
Sociology: SOC 100, 150, 250, 351, 391, 392, 402, 411, 420, 459, 483, 511, 520
Social Work: SOCW 200, 210

All courses numbered 300 and above are upper level courses.

D. All degree candidates must complete ENGL 101, ENGL 279, and ENGL 289, which cannot be used to meet the humanities and social sciences requirements.

E. Physical Education: minimum of two (2) credit hours.

F. Electives: Free Electives vary with the individual department. Any course may be selected which is at freshman level or higher (i.e. 100 level or higher). ROTC credits may be accepted, depending on the number of degree electives available in each department. Science Electives-Courses may be selected from biology, chemistry, geology, physics, or atmospheric science.

For information regarding the Associate of Arts degree requirements, see page 124.

Semester Credit and Grade-Point Average

Additional requirements are listed with each departmental curriculum found in a later section of this catalog. All curricula require passing grades in the prescribed courses and a minimum cumulative grade point average of 2.00. Each engineering curriculum requires 136 hours of credit for graduation and each science curriculum requires one hundred twenty-eight (128) hours of credit.

Military Science Credits

Military Science credits may apply to all degrees as free electives. This option varies with the number of free electives available in an individual curriculum. A veteran may petition the Director of Academic and Enrollment Services to receive credit for Basic Military Science and Physical Education.

Transfer Credit

Articulation of credit may be allowed for previous college education if the courses are equivalent to required or elective courses at this university and if each course presented is of passing quality.

The acceptability of transfer credit is determined by the student's major department.

Definitions

Credits in Residence

A Credit in Residence within the Board of Regents system is a course offered by any of the degree-granting Regental institutions at any approved sites using any approved method of delivery.

Institutional Credits

An institutional credit is a credit offered by the degree granting institution and includes credits that are part of a formal collaborative agreement between that institution and another Regental institution.

Validated Credits

Credit earned for college level courses by validation methods such as Credit by Exam, CLEP, AP, portfolio, etc. within the Regental system will not be considered "credits in residence."

Institutional Credit Requirements for Degree-Seeking Students

1. Minimum number of credit hours that must be earned from the institution granting the degree:

Baccalaureate	32 hours
Associate	16 hours

2. Number of the last credit hours earned preceding completion of the degree that must be earned from the institution granting the degree:

Baccalaureate	16 of the last 32 hours
Associate	8 of the last 16 hours

3. Minimum number of credit hours specified in the major requirements that must be completed at the degree granting institution: 50%.

Required Check-out Procedure

All graduating seniors and students terminating enrollment at School of Mines are responsible for ensuring that they have returned all keys, library books, laboratory equipment, and other university property to the appropriate departments prior to graduation or their last day of enrollment. All financial obligations to the university or any of its departments must also be paid prior to graduation or termination of enrollment at School of Mines.

Perkins Student Loan recipients must complete an exit interview with a Business Office representative prior to graduation or termination of enrollment at School of Mines.

The university reserves the right to withhold a student's diploma and/or transcript of grades for failure to meet any of the above specified requirements.

CAAP Proficiency and Information Technology Exams

CAAP Proficiency Exams Required for Graduation

Effective spring semester 1998 for baccalaureate degree-seeking students and fall semester 1999 for associate degree-seeking students, the South Dakota Board of Regents has mandated that all students attending a state university in South Dakota and seeking their first undergraduate degree take and pass the Board of Regents Proficiency Examination. Baccalaureate degree-seeking students will sit for the exam on completion of 48 passed credit hours at or above the 100 level and associate degree-seeking students will sit for the exam on completion of 32 passed credit hours at or above the 100 level. Enrolled students who have already earned a baccalaureate degree are exempt from the requirement.

Testing will be offered during a two-week period during the fall and spring semesters. Students who fail to sit for the exam, when required to do so, will not be allowed to register for courses at any of the state universities for two academic terms.

Students failing to achieve the minimum proficiency level on one or more components of the exam, will be allowed to retest. Retesting must occur one year after initial testing. During that year, students may continue to enroll in courses. As preparation for retesting, students are required to develop, in collaboration with an academic advisor, a development plan for remediation to be completed within one year. Students will be able to retest twice during that year and a fee may be charged to cover the cost of testing.

Students will be informed by the testing office when they are eligible to test. Approximately 4-6 weeks after a student has tested, they will receive the results and an explanation of how to interpret their achievement. Students who failed to achieve an acceptable score within one year from initial testing will not be permitted to continue their registration. An appeal process for certification of proficiency using alternate methods is available to those students.

The Surbeck Center serves as the focal point for student activities on campus. The new addition was completed in summer 2004. It is designed to enhance the campus experience for students.

POLICIES AND PROCEDURES

The policies and procedures listed in this section were established by the South Dakota Board of Regents and/or South Dakota School of Mines and Technology. For further information regarding policies in this section, please contact one of the Vice President's Offices at the university or visit www.hpcnet.org/sdsmt/policies.

COMPUTER AND NETWORK USAGE GUIDELINES AND POLICY

Students, faculty, staff and others affiliated with School of Mines are provided access to computing and networking services for use in academic pursuits and other activities that advance the goals of the institution.

All computer users must be properly registered and authorized through Information Technology Services (ITS). In accepting authorization to use computing or networking services, a user agrees to comply with all applicable federal, state and local laws and all regulations and policies of both the university and the Regents of the state of South Dakota.

Individuals should guard their electronic identity. Choose secure passwords, and never reveal them to anyone. Individuals can be held liable for activity carried out by others using their accounts. Keep all passwords and access mechanisms secure and private. Facilities, modems, and network services are provided for use only by account holders, not their family members or friends.

Theft, misuse, or other abuse of computing or networking services will not be tolerated, and may result in loss of computer and/or network privileges, disciplinary action, criminal or civil prosecution.

ITS is piloting wireless access. The program requires a wireless equipped laptop and Window XP operating system. To participate in the program, please contact the ITS Help Desk. All guidelines and terms of use apply to ALL computer usage, wireless as well as wired desktop and laptop.

Unacceptable activities include, but are not limited to:

- Unauthorized file access or file transfer;
- Use of another individual's identification, password, or account;
- Use of computing or networking facilities that interferes with the work of another student, faculty member, or university official, or with the normal operation of computers, terminals, peripherals, or networks at the university or elsewhere;
- Making, acquiring or using unauthorized copies of computer software or violating terms of applicable software licensing agreements;
- Running, installing or distributing any program intended to damage or to place excessive load on a computer system or network;
- Attempting to circumvent data protection schemes through any mechanism, including unauthorized access or tampering with security;
- Electronically posting or distributing materials resulting in any violation of existing laws, regulations or university or Regental policies;
- Attempting to monitor or tamper with another person's electronic communications, or reading, copying, changing, or deleting another person's files or software without the explicit agreement of that person; and
- Providing access to computer accounts, Internet connectivity, electronic mail, or other significant services to persons not authorized for use of School of Mines facilities, resources or network services. For example, students with computers hosted on the residence hall network may not permit family or friends to use these services.

Although these guidelines cover most aspects of the policy, a full copy of the current university policy on acceptable use of computing and network resources may be found at its.sdsmt.edu/guielines.htm

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (FERPA) OF 1974 OR BUCKLEY AMENDMENT

The purpose of FERPA is to protect the privacy rights of students from the indiscriminate collection, maintenance, disclosure, and release of personally identifiable student information, including information regarding student status or performance.

Under FERPA each current and former student at School of Mines has the following fundamental rights:

- The right to review and inspect the student's education records.
- The right to request the amendment of the student's education records that the student believes are inaccurate or misleading, and the right to a hearing if the request for amendment is not granted.
- The right to consent to disclosures of personally identifiable information contained in the student's education records, except to the extent that FERPA authorizes disclosure without consent.
- The right to file a complaint with the U.S. Department of Education concerning alleged failures by School of Mines to comply with the requirements of FERPA.

Students should be aware that these rights and privileges are available to them. Formal notification regarding FERPA is provided annually in the student code of conduct brochure. An announcement covering information designated as Public or Directory Information is included in the "Tech Times" each fall term. Directory Information includes the student's name, local and permanent address, telephone listing, electronic mail address, photograph (e.g., year book photos), date and place of birth, major field of study, dates of attendance (including graduation date), grade level, enrollment status (e.g., undergraduate or graduate, full or part time), participation in officially recognized activities and sports, weight and height of members of athletic teams, degree, honors and awards received, and the most recent education agency or institution attended (previous to School of Mines). This information is critical to some obligations and services performed by the university. Directories are also distributed in print and online, such that the information is publicly accessible without password protection.

Students have the right to request that such information concerning them be withheld from the annual Campus Directory. For a full description of FERPA, information regarding the location of students' educational records, and procedures at School of Mines for compliance with the law, please contact the Office of Academic and Enrollment Services.

New US government reporting requirements have been added for international students (F and J status). As a result of the regulations that became effective on January 1, 2003, the Family Educational Rights and Privacy Act (FERPA) is waived for F and J students in respect to these specific reporting requirements. The regulations will be strictly enforced by the appropriate bureau(s) within the US Department of Homeland Security (DHS) and information will be reported electronically to DHS via Student and Exchange Visitor Information System (SEVIS). The consequences to students for non-compliance with the new regulations are severe. Contact the Director of the Ivanhoe International Center for additional information.

FINAL EXAMINATION POLICY

The South Dakota School of Mines and Technology provides a policy for the administration of final examinations.

The faculty, recognizing that courses and programs of instruction differ substantially and that methodologies of instruction and evaluation remain the province of each instructor, does not seek to impose any mandatory final examination policy upon the constituent faculty of this institution. However, each faculty member is hereby encouraged to give the last examination (comprehensive or non-comprehensive) during the final examination week.

A five-day final examination period shall be scheduled by the registration officer. No special individual or departmental requests will be honored in constructing the final examination schedule.

The instructor or instructors for each course shall indicate to their department chair whether or not they intend to give a final examination, the number of hours for the exam, and whether additional rooms are needed for alternate seating; requests for additional rooms can be honored only if rooms are available. No additions will be permitted once the schedule has been published. All final exam requests will be due from departments at the time course registry requests are due. The final version of the exam schedule will be published in the Course Listings bulletin.

Final exams in all laboratory courses and courses of one credit or less will be given during the last regularly scheduled class period of the semester. Final examinations for evening classes meeting after 4:30 p.m. will be held at the last meeting of the class during final exam week. Final examinations for all other courses are scheduled by the registration officer according to the regular class meeting time during the semester and must be given at the scheduled time; they may not be rescheduled or given prior to the start of the final examination period. Examinations will be held in the regularly scheduled classrooms unless instructors make special advance arrangements through the registration officer.

Instructors in multi-section courses may request a "common final examination" period if requests are made in advance. Rooms must be reserved with the registration officer for such exams in order to avoid conflicts.

Final exam periods will be one hour and 50 minutes each, although instructors may request a longer final exam period (two hours and 50 minutes) if needed.

If a student is scheduled for three or more examinations on any one day, the middle examination(s) of the day shall be rescheduled for this student by the instructor(s) upon the request of the student. The student will be required to make this request between the 10th and 15th day of classes.

Other than those events approved by the faculty of the South Dakota School of Mines and Technology, final examinations will be the only events scheduled during the week of final examinations. Students having conflicts arising from participation in such scheduled events must see their professors at least one week prior to the examinations week to determine an equitable alternative to taking the examination at the scheduled time.

Instructors will submit all grades not later than three working days after the last day of final examinations for the term.

Grievance Procedures for Students

Policy

Students may pursue grievances when there is cause to do so. "Grievance" means an alleged misinterpretation, misapplication, or violation of a specific term or provision of Board or Institutional policy affecting terms or conditions of enrollment or academic standing, or other agreements, contracts, policies, rules, regulations, or statutes that directly affect terms and conditions of enrollment and academic standing at the South Dakota School of Mines and Technology.

Procedures

The purpose of this grievance procedure is to provide a fast and equitable method for the resolution of grievances without discrimination, coercion, restraint, or reprisal against any student who may submit or be involved in a grievance.

1. **Step 1** — The student should first attempt to resolve the problem with the other person(s) involved in the problem. For example, a problem with an instructor should be addressed first with the instructor involved and the department chair. A problem with a campus service unit should be taken up first with the director of that unit.

2. **Step 2** — If the problem, question, or concern is not resolved by the action taken in Step 1, the grievant must present a written grievance utilizing Grievance Form A at the lowest administrative level having authority to dispose of the grievance. A copy of the grievance should be filed with the administrator at the next level who is the supervisor of the administrator receiving the grievance.

The grievance must be filed within 10 working days of the date on which the incident, situation, or circumstance occurred. The administrator upon receiving the grievance will investigate the matter in a thorough and appropriate manner and respond to the grievant within 10 working days. If the president of School of Mines represents the lowest level administrator having authority to dispose of the grievance, said grievance must be originally filed at the Step 4.

3. **Step 3** — If the grievance is not resolved at the Step 2, the grievant may formally grieve to the administrator at the executive council

level who is the supervisor of the administrator receiving the grievance at the Step 2 within 10 working days of the notification to the student as to the decision rendered in the previous step. Grievant will use Grievance Form B. That administrator will conduct an appropriate and thorough investigation of the alleged incident, situation, or circumstance, and prepare a decision on the grievance within 15 working days of the date of receipt of the Step 3 grievance. The grievant may be notified in person or by certified mail regarding this decision.

4. **Step 4** -- If the grievance is not resolved at Step 3, the grievant may formally grieve to the president of School of Mines using Grievance Form C within 10 working days of the notification to the student as to the decision rendered in the previous step. The president will conduct an appropriate and thorough investigation of the alleged incident, situation, or circumstance, including a review of the decision of the executive council administrator on the Step 3 grievance, and prepare a decision on the grievance within 20 working days of the receipt of the Step 4 grievance. The grievant may be notified in person or by certified mail regarding the decision of the president.

5. **Step 5** -- If the grievance has not been resolved in Step 4, the grievant may submit a grievance to the Board of Regents on Grievance Form D within 10 working days of the notification to the student as to the decision rendered in the previous step. This form must be filed with the executive director of Board of Regents within 10 working days following receipt of the Step 4 decision. The Board of Regents will review the grievance and render a final decision in accordance with Board procedures, policies, and guidelines.

Anti-Harassment Policy

It is the policy of South Dakota School of Mines and Technology that harassment will not be tolerated. It distracts the harasser, the victim, and others from the tasks of the workplace and academic environment; it undermines morale and the psychological well-being of the victim; and it leads to expensive litigation and to possible liability. The university has zero-tolerance for harassment, whether it occurs on or off campus, during or after normal business hours, at work-related social functions, or during business-related travel. Any employee or student violating this policy will be subject to disciplinary action including termination or dismissal.

The South Dakota School of Mines and Technology Anti-Harassment policy IV-A-20 and the South Dakota Board of Regents Human Rights Complaint Procedures 1:18 can be reviewed in their entirety at www.hpcnet.org/hr/rules, or contact the Affirmative Action Officer/Title IX-EEO Coordinator in the Human Resources Office.

Policy Governing Academic Integrity

High standards of academic honesty and intellectual integrity are essential to the success of our students and the institution. The campus community will not tolerate acts of dishonesty in any academic activities at School of Mines. Such acts jeopardize not only the individual student, but also the integrity and dignity of the institution and its members.

The South Dakota Board of Regents has clearly defined those acts that constitute violations of academic integrity (BOR Policy 3.4.2.B.1). These acts include, but are not limited to, cheating, fraud, plagiarism, or knowingly furnishing false information within the academic arena. These acts of dishonesty violate the ethical values the university works to instill in all members of the campus community.

Faculty and administrators should consistently communicate the importance of academic integrity and ethical principles to our students. In addition, all members of the campus community should take reasonable steps to anticipate, deter, and confront acts of dishonesty in all areas of academics — research, assignments, and exams. The instructor of record for each course is responsible for clarifying the academic integrity standards for that course within the course syllabus.

The penalty for any act of academic dishonesty shall be at the discretion of the instructor of record, subject to the appeals process described below. Penalties may range from requiring the student to repeat the work in question to failure in the course. To ensure fairness to all involved and to conform to South Dakota Board of Regents policies, penalties may be imposed only in accordance with the following procedure. In the following, the term "judicial officer" refers to the person appointed by the Dean of Students to consider cases of academic dishonesty, as described in BOR Policy 3:4. Among other responsibilities, the judicial officer is expected to maintain university-wide records on all actions related to student academic dishonesty.

An instructor who intends to penalize a student for an act of academic dishonesty must provide written notification to the student and the judicial officer within ten working days of the time the alleged violation becomes known to the instructor. The written notification must include a description of the alleged violation, the penalty the instructor intends to impose, a statement notifying the student that he or she may request an informal hearing with the instructor, and a statement describing the student's right to appeal the instructor's final decision.

If the student desires such a hearing, he or she must request the hearing within ten working days of receiving the notification or within the first ten working days of the following semester, whichever is appropriate. If an informal hearing is held, the judicial officer shall be present. The instructor must give the student written notification of the outcome of the hearing, including a description of any penalties to be imposed. If the student accepts the instructor's decision and penalties by signing a statement to that effect, there shall be no subsequent proceedings.

If the student chooses not to participate in an informal hearing, or if the student disagrees with the outcome of the informal hearing, the student may appeal the instructor's decision by requesting a formal hearing before the university Judicial Committee. All interested parties should refer to BOR Policy 3:4 for descriptions of how hearings are to be conducted, outcomes reported, and appeals made to an appellate board appointed by the president.

INTELLECTUAL PROPERTY STATEMENT

The South Dakota Board of Regents has developed a policy on intellectual property that sets forth the principles and procedures through which the Board will balance those interests.

South Dakota Board of Regents employees who carry out or administer such instructional, research and service activities routinely produce works or make discoveries that may be subject to legal protection as intellectual properties.

The Board recognizes and affirms the public policy principle, woven into the very fabric of the United States Constitution by its framers, that creators of intellectual properties should obtain a fair return from the fruits of their inventiveness. It also recognizes and affirms the principle that the public should have a fair return on its investment in support of such creative efforts.

For further information on intellectual property, see Board of Regents Policy 4:34. www.sdbor.edu/policy/4-Personnel/documents/4-34.pdf

SOFTWARE COPYRIGHT STATEMENT

The South Dakota School of Mines and Technology has obtained licenses from a variety of vendors to use their software on computers that are owned and controlled by the school. South Dakota School of Mines and Technology does not own this software or its related documentation and, in general, School of Mines does not have the right to reproduce such software or to permit its reproduction by others. Microsoft MSDN is the only exception. Please contact the ITS Help Desk for information regarding MSDN, helpdesk@sdsmt.edu

School of Mines students, faculty, and staff shall use all software only in accordance with applicable license agreements. Centrally managed licensing agreements are on file in the Information Technology Service Office or the Business Office. Making, acquiring or using unauthorized copies of computer software or other copyrighted materials may result in disciplinary or legal action as the circumstances warrant.

The following statement regarding intellectual property and the legal and ethical use of software was developed by EDUCOM, a nonprofit consortium of higher education institutions, which promotes the use of computing, networking and information resources in teaching, learning, scholarship, and research. School of Mines subscribes to the spirit of this statement, and strives to promote understanding and observation of it.

Software and Intellectual Rights

Respect for intellectual labor and creativity is vital to academic discourse and enterprise. This principle applies to works of all authors and publishers in all media. It encompasses respect for the right to acknowledgement, right to privacy, and right to determine the form, manner, and terms of publication and distribution.

Because electronic information is volatile and easily reproduced, respect for the work and personal expression of others is especially critical in computer environments. Violations of authorial integrity, including plagiarism, invasion of privacy, unauthorized access, and trade secret and copyright violations, may be grounds for sanctions against members of the academic community.

Mines Matters: The South Dakota School of Mines and Technology is located in Rapid City, S.D., at the foot of the beautiful Black Hills of South Dakota. School of Mines students, faculty, and staff enjoy the many shops and restaurants in Rapid City's vibrant downtown, as well as a walking/bicycling path that follows Rapid Creek all the way through town.

ACADEMIC SUPPORT SERVICES

The Office of Academic and Enrollment Services (AES) provides academic support services to School of Mines students through the coordination of academic orientation, academic advising, mentoring (advising by faculty of the first-time freshmen), peer advising, student assessment (including placement and proficiency testing and survey administration), student success publications, and tutoring to assist students achieve gateway competencies and to increase the percentage who graduate from School of Mines.

ACADEMIC ORIENTATION

School of Mines and Technology holds several registration and orientation sessions during the summer and one session each at the beginning of both the fall and spring semesters. AES is responsible for the academic component of these sessions. Placement testing is scheduled for the morning of mentoring/advising, registering, and completing of the Freshman Survey are scheduled for the afternoon.

ACADEMIC ADVISING

AES is responsible for assigning advisors/mentors to students based on departmental recommendations. AES also publishes an advisor/mentor handbook and conducts regular training to update advisors/mentors on current academic requirements and course offerings, and Board of Regents and university policies and procedures.

MENTORING

Mentors are faculty members who have been selected to work with first-time freshmen because of their special interest in and commitment to new students. In addition to being the academic advisors for these first-time students, mentors provide encouragement, personal guidance, and a bridge to university services and resources that first-time students may be reluctant to seek out on their own. School of Mines mentors build bonds with these first-time undergraduate students through summer registration mentoring sessions, through a weekly mentoring course (IS-090) that is connected to the General Engineering and Science (GES 115) academic course, through social interactions, and through individual meetings during the first year of school.

PEER ADVISING

Peer advisors are upper-class students selected by their departments to assist other students with advising and registration activities, including planning class schedules, interpreting university procedures and policies, and making referrals to other university services. Peer advisors do not take the place of faculty academic advisors/mentors but they do assist them in fulfilling their roles as academic advisors/mentors. Peer advisors assist the mentors with the fall and spring registration and the University Mentoring course.

STUDENT ASSESSMENT

AES has responsibility for administering the COMPASS mathematics and English placement tests for new students and the Collegiate Assessment of Academic Proficiency (CAAP) tests for sophomores. AES also administers the Freshman Early Alert Survey to identify students who may be experiencing academic difficulties and plans interventions when appropriate. AES also administers interest inventories to assist students in choosing a career and the Student Satisfaction Survey.

STUDENT SUCCESS PUBLICATIONS

Publication of student success newsletters is a part of academic support at School of Mines. These newsletters (“FYI: First-Year Information,” “The Commuter Connection,” and “School of Mines Family Matters”) focus on informing students about academic requirements, policies, procedures, and available services. AES also publishes a guidebook for the parents of first-time students.

TUTORING

Tutoring in all the core subjects — math, chemistry, physics, computer science, English, and more - is provided by peer tutors and is free to all School of Mines students through the Tech Learning Center, or TLC.

Located adjacent to the computer lab in the lower level of the Devereaux Library, the TLC is open seven days/evenings a week during the regular semester and on a more limited schedule during the summer sessions. The TLC also has computers, a television/video cassette recorder (VCR), textbooks, and other study aids available for student use. For more information regarding the TLC please call (605) 394-2400 or (605) 394-2428.

Mines Matters: Approximately 22 percent of School of Mines students live in residence halls. Another five percent live in the four fraternity and two sorority houses clustered near campus. The remainder lives elsewhere off campus.

EDUCATIONAL RESOURCES AND OUTREACH SERVICES

Black Hills Natural Sciences Field Station (BHNSFS)

The Black Hills Natural Sciences Field Station functions in cooperation with universities from South Dakota, North Dakota, Mississippi, and Wisconsin with the purpose of providing summer field courses in the Black Hills and nearby areas, as well as overseas. Field courses in geology and geological engineering are offered. For descriptions of all courses offered, see the listings of the Department of Geology and Geological Engineering in this catalog.

The Field Station operates from three sites: School of Mines campus, field camp sites during the summer at Ranch A in the northern Black Hills, Wyoming, and Taskesti in the country of Turkey.

Geology and Geological Engineering Field Camps:

At Ranch A, two (2) sessions are held consecutively in the first 10 weeks of summer:

GEOL 410 Field Geology -
five (5) weeks (six (6) semester hours)
GEOE 410 Engineering Field Geology
five (5) weeks (six (6) semester hours)

At Taskesti, GEOL 410 Field Geology is held during 5 weeks of the summer.

Further information may be obtained by calling (605) 394-5114 or (605) 394-2494, or go to the web site: http://www.sdsmt.edu/es/geology/bhnsfs.htm. Applications (available from the web page) should be received by January 31, and all deposit fees are non-refundable upon acceptance into the course.

Bookstore

The School of Mines Bookstore is located in the Surbeck Student Center and is owned and operated by School of Mines. All revenues generated by the Bookstore are reinvested into School of Mines. The School of Mines Bookstore serves the students, staff, and faculty of School of Mines by providing course materials, office supplies, Hardrockers apparel, computer software, etc. In addition, the Bookstore cashes personal checks, sends and receives personal faxes, and special orders books and software. Please call (605) 394-2374 for assistance. For additional information, visit the School of Mines Bookstore's website at www.sdsmtbookstore.com.

Center of Excellence for Advanced Manufacturing and Production (CAMP)

School of Mines formally initiated the Center of Excellence for Advanced Manufacturing and Production (CAMP) in October of 1997. After just three years in operation, CAMP won the prestigious Boeing Company Outstanding Educator Award for year 2000 and a year later the NSF Corporate and Foundation Alliance Award.

CAMP integrates students, faculty, and industry partners into a center whose purpose is to develop a unique approach to engineering. It teaches students how to handle large and small project organization, team management, presentation of project ideas and reports, and other important topics not taught in the classroom. CAMP teaches these concepts by involving students in the actual management of exciting projects that include intercollegiate competitions as well as industry sponsored projects. It is this first-hand involvement that makes CAMP a successful program for creating future managers and leaders.

The mission of CAMP is to provide an innovative educational program based on the concept of enterprise teams, to create an electronic community using advanced telecommunications technology to facilitate interaction between higher education and industry, and to provide a focus for manufacturing assistance.

Although all students are welcome to work on CAMP projects, students who are invited to become CAMP members must be juniors with at least a 3.0 GPA or have outstanding capabilities relevant to CAMP goals. CAMP members must complete course work on product development, electronic communication, and business administration. Members must also work on a multi-disciplinary senior design project.

Geographic Information Systems (GIS) and Remote Sensing Lab

The Geographic Information Systems (GIS) and Remote Sensing laboratory provides the campus and broader community with a facility for generating and analyzing spatially-referenced digital information, including maps and remotely-sensed data. The laboratory was developed by the Department of Geology and Geological Engineering in close cooperation with the South Dakota Space Grant Consortium and EROS Data Center in Sioux Falls, South Dakota. The lab became a NASA Center of Excellence in Remote Sensing in 1998. It became an ESRI Authorized Learning Center in 2000, and now offers many GIS workshops every year.

Undergraduate and graduate courses in GIS are offered through the Department of Geology and Geological Engineering for the benefit of campus and off-campus users of GIS. Applications have been developed in a variety of areas, including: abandoned mine inventory, archaeology, aquifer vulnerability, ecosystem classification, geology, hydrology, land cover classification, land use planning, mineral deposit modeling, mineral exploration, paleontology, wildlife habitat modeling, carbon sequestration, and remote sensing.

Additive Manufacturing Laboratory (AML)

The AML provides manufacturing research and development in the form of material addition in size scales from microns to meters. Two technologies provide this capability: Laser Powder Deposition (LPD) and Direct Write (DW).

Laser Powder Deposition (LPD) Laboratory

This laboratory houses the LPD system that is comprised of a 3 kW Nd: YAG Laser, a Fanuc M16i Robot, a 2.5 - D gantry motion system with a CAD/CAM interface, and four metal powder-feed systems with integrated CID and CCD cameras. The LPD system facilitates laser cladding, solid free-form fabrication, and graded alloy development of both metallic and non-metallic materials. This lab also supports the development of Laser Ultrasonics for in-situ defect detect during the cladding operations. Projects include component repair, development of laser cladding wear resistance materials, material property response, thermal and stress modeling of the laser clad materials and unique component direct laser fabrication.

Direct Write Laboratory (DWL)

The DWL supports the direct printing of mesoscale materials, such as metals and ceramics for conductors, dielectrics, ferroelectrics, and ferromagnetics through use of several DW techniques. The DW technologies available in the DWL include: Maskless Mesoscale Materials Deposition (M3D), Ink Jet from MicroFab, n-Scrypt from Sciperio, and micron scale laser sintering and ablation. With the materials handling capability and the precision of the DW technology, Tech researchers are able to: manufacture conformal antennas; integrate circuitry with bio-materials; perform research involving tissue engineering, integrated lightweight electronics, and support development of products that are difficult and expensive to construct with conventional technologies. The developed applications will find use in a wide range of end users from the DoD for troop support communications, improving space optics, developing new sensors for Home Land Security, providing support for cardiovascular research and aid in improving tissue growth for accelerating healing and appendage reconstitution.

Advanced Materials Processing and Joining Lab (AMP)

In 2001, the Advanced Materials Processing and Joining Center (AMP) was created under a grant from the Army Research Laboratory. Under this grant, the latest in the state of the art in Friction Stir Welding (FSW) and Processing (FSP) equipment was designed, procured and installed at School of Mines with the assistance of our industrial partner, MTS Systems Corporation of Eden Prairie, MN. This equipment provided the School of Mines AMP Laboratory with the most versatile, fully instrumented FSW/FSP research and development tools found anywhere in the world. The Laboratory is currently staffed by three full time employees (Director, Research Scientist, and an Administrative Assistant).

Since its inception, the School of Mines AMP Center has become one of the worlds leading focal points for research and development in the emerging Friction Stir Welding and Processing technologies. We are collaborating with major government laboratories, universities, and industrial companies and are training our students for positions of responsibility within these organizations.

Over the past three years, The AMP Center has developed internal research programs at School of Mines through the direct and indirect funding support for more than 40 graduate and undergraduate students and release time or summer support for many faculty members. Several of these students have taken responsible positions in the field of FSW/FSP within industry. Currently, AMP is providing Graduate Research Assistance to students from the MES, CEE, EE, ChemE, and CSE programs and is sponsoring undergraduate senior design projects in the ME and MET departments. Several sophomore, junior, and senior undergraduate students are employed on an hourly basis. Extensive collaborative outreach programs have been developed with the local Oglala Lakota College through the involvement of Native American summer student interns under the Bridges to Success Program.

AMP has an extensive government base of support for our R&D programs with current research collaborations with the Army Research Laboratory, Air Force Research Laboratory, NASA Langley Research Center, and the Pacific Northwest National Laboratory. The industrial collaboration is also extensive with partnerships existing with major aerospace companies. These partnerships include direct funding, materials and equipment contributions, and engineering consultation and support.

AMP has developed several collaborative research programs with Brigham Young University, University of South Carolina, University of Missouri-Rolla, and is currently developing programs with the Iowa State University, The University of Colorado and the Wichita State University. A major achievement during these first three years has been the establishment of the regions first National Science Foundation Research Center. This NSF Industry University Cooperative Research Center for Friction Stir Processing (CFSP) brings together SDSMT, BYU, USC, and UMR and 18 industrial sponsors from around the world to perform research and development which enhance the understanding of the science of FSP and accelerate its implementation into industrial environments. The School of Mines AMP Center has been designated as the Lead Institution for this NSF Research Center.

The Center for Accelerated Applications at the Nanoscale (CAAN)

The Center for Accelerated Applications at the Nanoscale (CAAN) focuses on the increasingly important nanotechnology field. Nanotechnology covers many areas of research dealing with objects measured in nanometers. A nanometer is a billionth of a meter, or a millionth of a millimeter. A human hair's diameter measures about 200,000 nanometers. The ultimate value of nanotechnology is quality. By building products at the molecular level, they will last longer, work better, and push their potential to new levels. Some experts predict that nanotechnology will result in a new Industrial Revolution.

The industrial impact of nanotechnology is projected to be in excess of $1 trillion annually within the next 10-15 years. Under Governor Mike Round's 2010 Initiative for Economic Development, a group of distinguished South Dakota researchers have joined together in a focused effort to conduct applied research and development relating to nano-science and engineering. The programs initiated by the Center are chosen for their strong commercialization potential and mutual interest to industrial partners. The Center is positioned to utilize student resources in these programs and is closely associated with the Ph.D. program in nano-science and engineering.

Computational Mechanics Laboratory

The Computational Mechanics Laboratory will provide much needed space for a variety of high-end computing activities. The laboratory will provide School of Mines students access to the computational mechanics hardware and software currently used by industry. New computer hardware has been procured for this state-of-the-art facility. This facility will include specialized computer laboratories, classrooms, office space, a visualization laboratory, and meeting rooms. The laboratory will be housed in an addition to the Civil/Mechanical Engineering Building and is scheduled to open in December 2005.

ENGINEERING AND MINING EXPERIMENT STATION (EMES)

The Engineering and Mining Experiment Station (EMES), has provided analytical services to the public and private sectors since 1903. Analytical methods in use include a wide variety of classical and advanced instrumental techniques for the characterization and testing of minerals, ores, raw materials, and manufactured products.

EMES currently operates, maintains, and oversees training in electron microscopy (scanning and transmission electron microscopes), X-ray diffraction, atomic absorption spectroscopy, inductively-coupled plasma mass spectrometry, visible and near infrared spectroscopy, and carbon/sulfur and hydrogen/nitrogen/oxygen analyses. EMES also works closely with other departments on campus, which house additional instruments, including a gas chromatograph-atomic emission detector, an atmospheric-pressure-ionization mass spectrometer, a proton-transfer-reaction mass spectrometer, a laser particle size analyzer, Raman and FT-IR spectrometers, and scanning tunneling and atomic force microscopes.

POLYMER TECHNOLOGY, PROCESSING, AND COMPOSITES LABORATORY (PTPCL)

The Polymer Technology, Processing, and Composites Laboratory (PTPCL) has helped School of Mines become well equipped to conduct polymer synthesis and surface modifications of reinforcing materials as well as complete characterization of composite materials on macro-, micro-, and nano-scales. Polymer composite is one of the fundamental material building blocks being considered for structural applications. In the lab, researchers also:

- Work to develop for the U.S. Army multi-utility composite materials that would have lower production costs. The researchers also are investigating the feasibility of embedding advanced sensors, such as electro-optic, radio frequency and chemical sensing devices within vehicles built from composite materials.
- Develop stronger and lighter polycarbonate for military uses. Researchers hope to create a stronger and lighter material that demonstrates better heat resistance than polycarbonates currently available. Researchers also want a material that can be injected with laser-absorbing dye to protect military personnel from laser-based weapons and tracking systems. Stronger and lighter polycarbonate would benefit the military and could be used for helmet face shields, goggles, jet canopies and other uses. The end goal is to better protect soldiers, pilots and other military personnel and equipment.

This laboratory allows School of Mines to take a leading role in this area.

ULTRA-LIGHTWEIGHT SYSTEMS LABORATORY

This unique, world-class laboratory is dedicated to revolutionary reductions in the weight of a host of applications, without compromising strength, functionality, and other characteristics of interest. Much of the work in the laboratory is directed to respond to the challenge issued by the Department of Defense. The Air Force Research Laboratory's Space Vehicles Directorate has adopted the mission to establish dominance of space for U.S. assets. Simply stated, this objective will allow the DoD to operate unimpeded in space. While numerous technology challenges will be addressed with these increased resources including improved military communication, surveillance, and weapons systems, the potential to make the most significant overall impact centers around the development of advanced space structures.

INFORMATION TECHNOLOGY SERVICES (ITS)

Information Technology Services (ITS) serves the academic technology needs of School of Mines by acquiring, supporting, and enhancing many of the technology resources available for students, faculty, and staff engaged in scholarly activity. The mission of ITS is to provide proactive, responsive, people-oriented technologies, training, and support in the areas of multimedia, computing, and networking. In partnership with faculty, ITS pioneers new learning technologies to provide quality educational experiences outside the traditional classroom or to enhance traditional learning environments.

ITS supports the network and communications server infrastructure for the entire campus. ITS operates and maintains the campus Local Area Network (LAN) and all centralized computing resources, as well as gateways to external networks. Network connections for individuals in the residence halls are also managed through ITS. Please note, there is an additional charge for in-room connections to the Residence Hall Network. See the website at its.sdsmt.edu/dormnet.htm.

ITS supports academic computing and multimedia facilities, including computing labs, presentation classrooms, distance learning facilities, video services, remote delivery mechanisms, videoconferencing, the Governor's Electronic Classroom (GEC, CB110), the Digital Dakota Network studio (DDN, CB109), and traditional and cutting-edge audiovisual resources to support classroom instruction.

The ITS Software Development Team is responsible for maintaining and updating the School of Mines Webpage while providing software development support to all departments on campus. They create specialized web software to meet the needs of our campus customers, including the Student Association, Residence Halls, Administration, special faculty projects, etc.

All ITS staff enjoy the challenge of assisting faculty in the transfer of cutting-edge instructional technology tools into the classroom, making the learning process more efficient, effective, and exciting. On request, ITS staff members are available for short class presentations on focused technology topics to complement curriculum. In 2000-2001, Technology Fellows began working with faculty in this area. ITS is working closely with the Technology Fellows to ensure coordination among services.

ITS is involved in supporting technology to enhance many School of Mines outreach efforts, including the on-campus daycare center (Kids Kastle Little Miner's Clubhouse), the West River Consortium building, the Technology Development Center, the upcoming Business Incubator and local service organizations. On request, ITS will provide reasonable services to currently registered students from any South Dakota institution of higher education who may be located permanently or temporarily in the Rapid City area. In partnership with the State Bureau of Information and Telecommunications, ITS also provides services to local state agencies.

The ITS Student Help Desk (its.sdsmt.edu) assists students with hardware and software issues as well as network account access. The Student Help Desk is located on the lower level of Surbeck. For assistance, e-mail the Help Desk at helpdesk@sdsmt.edu, call (605) 394-1295, drop by, or check the web pages (its.sdsmt.edu).

We also have a Faculty/Staff Help Desk which assists all faculty/staff on campus with all computing needs. Contact them by calling (605) 394-1234.

ITS Help Desk

The ITS Help Desk assists students, faculty, and staff with software and hardware questions and provides scheduling services for many shared resources. The Student Help Desk (605-394-1295) is located on the lower level of the Surbeck Center. The Faculty/Staff Help Desk (605-394-1234) is located on the lower floor of the EE building. For assistance, e-mail the Help Desk at helpdesk@sdsmt.edu, drop by, or check the web pages (its.sdsmt.edu).

PC Labs

All of the PCs on campus are linked to the campus network, providing access to file servers, applications software, electronic mail, and the Internet. Approximately 184 PCs are located in campus labs, accessible to all students. An additional 62 PCs and Unix workstations are located in department labs, and these are also accessible to all students upon request. Many of the campus labs are reserved for class use much of the day but can be used as open labs otherwise. Labs in residence halls are available to non-resident students during business hours only. Resident students may use these labs at any time they are open. Some labs are kept open in the evening; the Classroom Building lab is open 24 hours. PC labs are located in:

Chemistry Building: Room 208
Civil/Mechanical Building: Room 310
Classroom Building: South entrance
Devereaux Library: East lower floor and Room 109
EE/Physics Building: Room 307
Howard Peterson Hall: Room 148
McLaury Building: Room 304
Palmerton Hall: Room 11
Surbeck Center
Miner's Shack

In these labs students have access to standard office productivity software, as well as electronic mail and World Wide Web/Internet. Many of the labs are also equipped with discipline-specific software packages. See its.sdsmt.edu/labs.htm for current lab descriptions, software listings, and locations. Special-purpose labs are located in CB107 (IT system administration lab) and McLaury 215 (UNIX workstations/graphics).

ITS Software Development Team (HPC)

The ITS information services team assists faculty, staff and students by creating software solutions for unique campus needs. These services include database driven Internet applications, on-line surveys, MS Word, MS Excel, and MS Access programming solutions.

The information services team can be contacted via the Technology Help Desk at (605) 394-1234, Vickie Bender at (605) 394-1299, or by email to Vickie.Bender@sdsmt.edu.

Interactive Supplemental Materials

All faculty at School of Mines have access to Internet and electronic mail facilities. Faculty have the capability to use interactive videoconferencing technologies to meet with students. Some classes use listserves or chat groups to distribute additional material and for communication and discussion among students. Students have the option of corresponding through mail, telephone, fax, and electronic mail with faculty and instructors. The course syllabus will list options for course material delivery. Distance instructors will provide contact information (e-mail address and telephone number) that will be provided to students, along with their course materials. If students have privacy concerns regarding using Internet-based communications, please contact the Help Desk at helpdesk@sdsmt.edu or (605) 394-1234 for assistance.

Distance Education Course Delivery Systems

Distance education courses are available via DVD, Internet, and various interactive media. An increasing number of courses are being made available via Internet delivery methods. The technology of distance education is changing as fast as technology itself, and School of Mines strives to benefit students by taking advantage of cutting-edge technologies for course delivery. As technologies become available, they will be incorporated into the offerings.

Video-based courses at School of Mines usually include segments filmed in the classroom as the lecture is being presented to the on campus students during the current semester. This is especially important in the science and engineering classes because of today's rapid advances in knowledge and technology. Most distance learning classes are "semester based," *i.e.*, distance students are expected to complete each class within the semester the course is taken. This gives distance students the opportunity to meet and work with other students who are taking the class at the same time.

Information Technology Services is responsible for recording and televising the distance education courses and for distributing or mailing materials to distance learning students. To inquire about distance offerings, check the Schedule of Classes or contact Academic and Enrollment Services (394-2400). To request assistance with distance education delivery or to update tape delivery address, contact Distance Education via e-mail at itsdistance@sdsmt.edu.
Tape delivery address may be changed on line at http://its.sdsmt.edu/shipping.htm.

Distance Education Using Videoconferencing

The Digital Dakota Network (DDN, formerly called RDTN; located in CB109) and

Governor's Electronic Classroom (CB110) videoconferencing facilities link all six South Dakota universities, as well as all South Dakota K-12 school districts, and many state agencies with interactive videoconferencing capabilities. Dial-up (ISDN) participants can also be included in videoconferences through sophisticated video bridging capabilities in the state. The Governor's Electronic Classroom also includes a tightly coupled desktop computing environment.

All videoconferencing sites are fully interactive, so students at every site receiving the class can see and hear the faculty member at the originating site. Students at any participating site can ask questions of the faculty member and students at the other sites, and participate in class discussion.

Other videoconferencing applications are also supported via DDN, ISDN, and Internet2, such as student job interviews with potential employers or meetings with research sponsors.

Governor's Electronic Classroom

The Governor's Electronic Classroom facilities link all six South Dakota universities with interactive videoconferencing and a tightly coupled computing environment. Courses taught in this classroom can simultaneously involve faculty members and students at two or more sites. All participants can see and hear the other sites. The videoconferencing equipment automatically switches to the site where someone is speaking. The videoconferencing capability in this classroom can also be used to connect to compatibly equipped sites around the world via ISDN telephone lines. When not reserved for classes, this facility is available for other videoconferencing applications such as student job interviews or meetings with research sponsors.

Internet2 Videoconference Room

Another videoconferencing venue is available in Surbeck Center. This facility permits videoconferencing via Internet2 (H.323 standard) network connections, as well as with ISDN dialup connections. The room is a conference room and works best for small groups.

Institute of Atmospheric Sciences

The Institute has conducted research in the atmospheric sciences since its establishment at School of Mines in 1959. One of the Institute's principal early objectives was to develop beneficial weather modification techniques for the northern Great Plains. As convective clouds bring to the region most of its summer rainfall and all of its damaging hail, the Institute's scientists and engineers have studied these clouds intensively. Areas of scientific emphasis have developed from these objectives to include cloud and precipitation physics, small-scale atmospheric circulations, air quality, effects of pollution upon cloud physics processes, atmospheric electricity, thunderstorm electrification and lightning, climate, radiative properties of clouds, radar and satellite remote sensing, and mesoscale processes. Institute personnel have conducted or participated in numerous field experiments in cloud physics, and cloud seeding, remote sensing of aerosols, and tropical rainfall measurements by satellite beginning in the 1960's. They have also conducted an evaluation of North Dakota's state cloud modification project.

The research facilities of the Institute include a modern workstation-based weather laboratory, an instrumented aircraft, image processing systems, a tethered-balloon sampling system, a hand-held dual UV/NVIR (350-1050 nm) spectroradiometer, plant canopy instrumentation, analytical instrumentation, instrumented walk-up towers, eddy flux instrumentation, and a variety of computer resources. A network of UNIX workstations and PC systems is available for staff and student computing needs. A campus network provides access via Internet and Internet II to other computers off campus (including the supercomputer system at the National Center for Atmospheric Research). The Institute receives current weather data through the UNIDATA system and the National Weather Service Rapid City Forecast Office is collocated on the campus. A local computer network facilitates the handling of large data sets.

From 1970 through 2004, the Institute of Atmospheric Sciences operated a T-28 aircraft as a National Science Foundation storm-penetrating aircraft research facility. The T-28 collected data in thunderstorm research programs in the United States, Switzerland and Canada. Since the late 1990s the Institute has engaged the scientific and technical community and identified the A-10 “Warthog” as the best choice to serve as the next-generation airframe to continue the work of the T-28. Engineering feasibility studies have shown that the A-10 airframe can be successfully modified to penetrate severe storms, carrying instruments to measure state variables (air temperature and atmospheric pressure) and atmospheric electric fields as well as to characterize all types of hydrometeors from cloud droplets to hailstones. In addition, the aircraft will have the capacity to deploy instrumentation for atmospheric chemistry, remote sensing, and imaging. The storm-penetrating aircraft will continue to provide data to answer important questions in global climate change, nutrient cycling, atmospheric phenomena, and related areas of investigation.

The Institute has developed new data processing systems and approaches for analyzing weather radar data (including NEXRAD), and such data are used in analysis of severe storms and to develop remote sensing estimates of precipitation in support of hydrological studies.

Laboratory instrumentation including various air-pollutant monitoring devices, such as particulate samplers and gaseous analyzers, has been used to monitor air quality in the area. Research in the air pollution field has included quantitative analysis of particulate compounds and source apportionment modeling by mass balance. Chemical speciation of ambient gaseous and particulate components is of current interest.

Numerical cloud modeling studies have emphasized the dynamics of convective and stratiform clouds; chemical, electrical, and microphysical processes within them; and the comparison of model predictions with radar and aircraft observations. Current modeling studies focus on hailstorms, thunderstorm electrification (including lightning), precipitation processes, their modification by cloud seeding, winter orographic clouds, and marine boundary-layer clouds. Access to the supercomputer facilities of the National Center for Atmospheric Research at Boulder, Colorado, has been of great value in running the larger cloud models.

Mesoscale research has focused on the study of factors governing the initiation and organization of convective storms, mesoscale cloud systems, and topographic effects on airflow and precipitation. An analysis of severe wind-producing convective storms is being carried out jointly with the National Weather Service, Rapid City, to increase the understanding of these storms and to improve forecasting. Another relatively new area of emphasis is flash-flood producing storms. Numerical simulations of lake-effect snow storms are continuing and a field project, the Lake Induced Convection Experiment (Lake-ICE), was held in the winter of 1997-1998 over Lake Michigan. An area of study that also involves researchers from Civil and Environmental Engineering and Geology and Geological Engineering, is the coupling of atmospheric, surface, and subsurface hydrologic processes on the mesoscale models. In a related area, work is underway on the remote sensing of land surface processes and use of remotely sensed data to initialize mesoscale models.

Remote-sensing research in the past has emphasized novel image processing, pattern recognition, and neural network techniques useful in classifying clouds in satellite images. Global cloud and aerosol properties are being retrieved from satellite data, and their influence upon the earth’s radiation budget and climate change is under study. A new NASA-funded project uses leaf area index (LAI) and remote sensing to evaluate fire chronosequences of the Black Hills and Siberia, Russia.

In the last three years, IAS has broadened its research focus to include biogeochemistry and atmospheric chemistry. Recent research in this area has focused on the development and validation of new mobile calibration systems for the preparation and delivery of known test gas mixtures, to assess the performance characteristics of atmospheric measurement methods. This quality assurance approach was recently employed during the Gaseous Sulfur Intercomparison experiment (GASIE). Current research projects are underway to investigate the links among biology, atmospheric chemistry, and various aspects of global environmental change. IAS scientists are currently working to determine the ability of soils to sequester atmospheric CO_2. Another topic of special interest is the development of micrometeorological techniques for measuring trace gas fluxes. Fluxes of trace gases including nitrous oxide and methane from soils and terpenes and isoprene from vegetation influence the radiation balance and oxidant balance of the Earth's atmosphere. Trace gas fluxes are important because specific gases (for example methane and nitrous oxide) affect the Earth's radiation balance, while others (isoprene and terpenes) affect the cleansing capacity of the atmosphere. Facilities to conduct this research include a unique tethered-balloon atmospheric profiler, tower systems, and analytical instrumentation including gas chromoatographs, Atomic Emission Detectors, atmospheric pressure mass spectrometers, and a new proton transfer reaction mass spectrometer (PTR-MS).

Several of the Institute's scientists teach on a part-time basis in the university's Department of Atmospheric Sciences, which offers a minor in Atmospheric Sciences program through a B.S. in the Interdisciplinary Sciences program, an M.S. degree, and an interdisciplinary Ph.D. program in Atmospheric and Environmental, Science. The Institute employs a number of graduate students from Atmospheric Sciences as Graduate Research Assistants. A few undergraduate assistants are occasionally employed.

LIBRARY

The Devereaux Library, located in a four-story building on the north side of the campus along Saint Joseph St., provides a wide variety of resources and services for students, faculty, staff, and the community. During the academic year, the library is open ninety-five (95) hours each week.

The library's main level is the location of the South Dakota Reading Room, Reference Collection, Electronic Resources, Reference Desk, downtime (the popular reading area), Circulation Desk, Interlibrary Loan, Technical Services, and Administrative Offices.

The lower level of the library contains the literature collection, Government Documents Collection, movies (VHS & DVD), audiobook collection, an audiovisual listening and viewing room, study areas, and two PC laboratories. The Tech Learning Center and the Testing Center are also located on the lower level.

The second level of the library houses an extensive journal collection, the print versions of Abstracts and Indexes and study areas.

The library's top level houses the majority of the Main Book Collection, the Special Collections vault and study areas.

The library's collection supports the entire range of academic disciplines, with a primary focus on science and engineering; it contains approximately 180,000 volumes. Special collections include the South Dakota Collection, audiovisual materials, extensive documents from every branch of the federal government, and patents and trademarks. Devereaux Library is an official Patent and Trademark Depository Library, the only such designation in South Dakota, as well as a participant in the Federal Depository Library Program. The library's collection includes hundreds of CD-ROMs and a growing collection of videos, DVDs, and audiobooks.

Devereaux Library is a "library without walls," providing electronic access to many of its resources. The Library has developed its own WWW home page, providing access to other library catalogs, electronic databases, and all other resources on the Internet. Patrons may use the web page to ask reference questions, order interlibrary loans, make suggestions about the library's resources and services, search the online catalog, and renew books.

Devereaux is a teaching library, offering classes that introduce patrons to the state's on-line catalog (Aleph) and to the Internet. Individual instruction in the use of electronic resources is available weekdays at the Reference Desk.

Devereaux Library's primary mission is to support the university, but the public is also welcome to use its resources and services.

MUSEUM OF GEOLOGY

The Museum of Geology is an outstanding part of School of Mines particularly as the Museum and surrounding region is rich in fossils, rocks and minerals, many that comprise the Museum's collections and exhibits.

Approximately 350,000 specimens, pertaining to the fields of vertebrate paleontology, mineralogy, invertebrate paleontology and paleobotany are on public display or in the research collections. Museum collections form the basis for staff and student research. The Museum provides an active educational outreach program to area schools and organizations. Undergraduate paleontology education is an option within the Geology curriculum, whereas graduate education opportunities can lead to the degree of Master of Science in Paleontology or Ph.D. in Geology and Geological Engineering Department. The Museum serves as an aid to the Department as its staff provides several museum and vertebrate paleontology courses along with practical experience through summer field expeditions and participation within the laboratory or the collections. These activities support the Department's university-level educational programs. Inquiries from the public about specimens and discoveries are welcomed and often lead to partnerships with local ranchers and fossil enthusiasts. Many volunteer opportunities are available. Through partnerships with Federal and State agencies, the Museum collects, conserves, and houses these unique, often rare, resources.

Of interest to the public and the general student are exhibited skeletons from the Late Cretaceous marine and non-marine rocks to the Mid-Tertiary Big Badlands of western South Dakota, providing a vivid impression of Dakota life in ancient times. Spectacular minerals from throughout the world, arranged by the Dana System, are on exhibit. The South Dakota Hall of Minerals focuses on the diversity of Black Hills minerals, and also included are special exhibits featuring fluorescent minerals. Lapidary specimens of local agates, meteorites, and native gold complete this unique collection.

The Museum is open to the public throughout the year. Tours for groups may be scheduled with the Museum, which is located on the top floor of the O'Harra Building. The Museum may be reached at (605) 394-2467 or (800) 544-8162, ext. 2467.

SOUTH DAKOTA SPACE GRANT CONSORTIUM

The Space Grant Consortium was established March 1, 1991, under a grant from the National Aeronautics and Space Administration (NASA). Consortium members in addition to South Dakota School of Mines and Technology include Augustana College, South Dakota State University, and the USGS EROS Data Center. Horizons, Inc., SAIC, Raytheon ITSS, Honeywell, Cynetics Corp., QSS Group, Inc., Raven Industries, RESPEC, and Barrick Gold Corp., are industrial affiliates. Educational affiliates include Black Hills State University, University of South Dakota, Dakota State University, Northern State University, Lake Area Technical Institute, Oglala Lakota College, Sinte Gleska University, Si Tanka College, Lower Brule Community College, Sisseton Wahpeton Community College, Sitting Bull College, the South Dakota Discovery Center and Aquarium, Scientific Knowledge for Indian Learning and Leadership (SKILL) at School of Mines, Teaching SMART (a program of Girls Inc. of Rapid City), Kirby Science Discovery Center, The Journey Museum, Black Hills Astronomical Society, and the Badlands Observatory. The SD Department of Transportation's Office of Aeronautics and the National Weather Service are government affiliates.

A primary Consortium objective is to enhance the capability for earth science-related education and research in the state, as well as for aerospace-related research and manufacturing. The Consortium provides undergraduate scholarships and graduate fellowships in earth science and aerospace-related fields. It also provides summer fellowships tenable at NASA Centers and the USGS National Center for Earth Resource Observation and Science (EROS), to help enhance interactions among member institutions and strengthen research capabilities related to remote sensing techniques and applications. The Consortium has assisted in the development of a Geographic Information Systems laboratory on campus. Other Consortium programs include support for undergraduate research projects, NASA's KC-135 Reduced Gravity Student Flight Opportunity Program, and faculty travel to NASA Centers or elsewhere that can aid in developing enhanced research capabilities. The Consortium office on the campus is located in MI 228. The Consortium Office also maintains a K-12 Outreach function to help foster wider use of earth science and aerospace-related materials in K-12 educational programs throughout the state, and to improve education in the areas of math, science, engineering, and technology. Outreach activities include sponsorship of South Dakota Space Days, teacher workshops, Visiting Scientist programs in schools, and Aviation Careers Exploration Academy.

For more information, see the South Dakota Space Grant Consortium website located at www.sdsmt.edu/space/.

SPECIAL EVENTS AND EDUCATIONAL PROGRAMS

School of Mines is involved in coordinating and hosting special events and educational programs for students and educators. Some of the many events and programs include the AP Institute, Technology for Teaching and Learning, Engineers Week, Computer Programming Contest, West River Math Contest, Concrete Conference, High Plains Regional Science Fair, Cultural Exposition, and the Star of the West Speakers Series.

UNIVERSITY AND PUBLIC RELATIONS

The Office of University and Public Relations provides a variety of services to the campus community including: public relations, media relations, government relations, photography, graphic design, and educational outreach. Efforts and activities are designed to assist in the recruitment of students, faculty, and staff; support fundraising activities; provide recognition for the faculty, staff, and students for their many achievements; and identify opportunities for the university to work more closely with the community and state.

Educational/Summer Programs and Professional Conferences

The office of Educational Programs and Professional Conferences coordinates and organizes continuing education opportunities, workshops and conferences at School of Mines that focus on science and technology. These workshops and conferences combine the expertise of faculty with the cultural and natural resources available in the beautiful Black Hills. Classes are designed for youth, adults, K-12 math and science teachers, and for alumni and other technical professionals. Conferences will focus on both regional and national audiences. Both on-campus residential and non-residential programs are offered.

Communications and Marketing

The Office of University and Public Relations assists academic departments and campus organizations involved in outreach to elementary and secondary students throughout the region. University and Public Relations assists in organizing and publicizing events, and in recruiting participants through a variety of ways, including by making available mailing lists for K-12 teachers and school officials.

The Office of University and Public Relations acts as the hub of School of Mines overall marketing and communications efforts. Through traditional avenues such as media relations and advertising, and through campus events and other opportunities, University and Public Relations spreads the positive message about how School of Mines can help students reach their goals and achieve their dreams.

Publications

The Publications Manager coordinates the production of all major campus publications including, but not limited to, the catalog, recruitment publications, and the School of Mines and Technology Magazine. Staff members of the Office of University and Public Relations are available to edit and proof publications produced by campus departments and offices. Staff can also assist with the coordination of printing bids.

Graphic Design and Layout

University and Public Relations staff members are experienced in creating materials including advertisements, newsletters, brochures, and fliers, using industry-standard software, multiple scanning platforms, and print output formats.

Public Information and Media Relations

The Public Information Manager coordinates all media activities for the campus, including press releases, weekly tip sheets, and hometown releases. It is a goal of the university to provide faculty, students, and staff with recognition for their achievements. Hometown releases are sent for student achievements including Dean's List, Honors Convocation Awards, and Commencement. Students, faculty, and staff are encouraged to notify the Public Information Manager regarding newsworthy achievements and events.

Photography

Photography services are also provided to document campus events. Reprints of photos are available through the Public Information Manager. Photos can be made available electronically for publications or the web.

Surbeck Center Scheduling Services

As the student union for School of Mines, Surbeck Center provides more than just 71,000 square feet of space devoted to campus and community activities; it also provides information services, equipment check-out for students and scheduling services for all of campus. Surbeck Center's main office serves as a one-stop scheduling center assisting with the reservation and coordination of University resources for the various activities of the University — academic, student, departmental, community and professional. Additionally, Surbeck Center staff provide assistance for all on campus activities, events, academic and summer conference scheduling as listed below.

Summer Conference Services

From mid-May through mid-August, the campus of School of Mines provides conferencing services to a variety of guests. Surbeck Center staff is available to confirm and coordinate your reservation information and to assist with special event planning and logistical needs to ensure a successful experience for summer guests.

Academic Scheduling

The office of Academic and Enrollment Services determines the initial classroom assignments and provides this information to Surbeck Center. Fall and spring semesters are downloaded to the scheduling system managed by Surbeck staff before March 15 of the preceding academic year. Summer class schedules are downloaded by March 15 of the same year.

Reserving Facilities

All scheduling of campus resources begins with Surbeck Center. Information regarding University facilities, services, equipment, and documentation requirements are determined then information is processed and coordinated with the appropriate authorizing and resource providing departments. Campus resources are reserved by contacting Surbeck Center's scheduling and event staff. Telephone Number: 605.394.6774, Fax Number: 605.394.6998, and e-mail address: usc@sdsmt.edu.

Surbeck Center's main floor houses a large student lounge, the alumni office, the bookstore, banquet-ballroom, career planning office, conference rooms, counseling, the dean of students office, health service facilities, mail boxes for all students living on campus, student accounts and cashiering services office, the main office for residence life, and the Surbeck Center offices. The dining hall, snack bar, recreation area, student activities and leadership center, Ivanhoe International Center, the multi-cultural activities office, campus ministries, and display areas can be found in the lower level in addition to more meeting rooms and "hang-out" space for students. Surbeck Center includes an addition completed in December of 1971 and newly renovated spaces completed in 2004.

STUDENT SERVICES

The Vice President for Student Affairs and Dean of Students Office develops, manages, and directs Student Services programs at School of Mines. These programs are designed to assist students in fulfilling their academic, educational, and career objectives by developing their optimum potential intellectually, socially, and emotionally.

The Vice President of Student Affairs and Dean of Students serves as a student advocate; advises School of Mines community on student matters; supervises all units within Student Services; coordinates the academic appeals committee; conducts student-centered research; advises student organizations; develops student-related policies; produces the campus safety and student code of conduct brochure, and is co-chair of the Campuses Community Prevention Coalition.

CAMPUS MINISTRY

Various campus ministries are available for students seeking to grow in their faith, as well as for those looking to explore faith for the first time. Activities include worship, Bible study, fellowship meals, and volunteering activities. These ministries also help maintain a food pantry for students in need, and offer pastoral help to students in crisis. Campus ministries can be reached by calling (605) 355-3073.

CAREER PLANNING, PLACEMENT, AND COOPERATIVE EDUCATION

Career Planning

The Career Planning Office assists students with their career development and their searches for full-time, summer internship, and co-op opportunities. For additional information, call (605) 394-2667 or visit www.hpcnet.org/sdsmt/careerplanning. Services offered by Career Planning include:

Job Search and Career Information: The office helps students develop their resumes, cover letters, and interviewing skills, as well as providing information about career opportunities related to School of Mines degree programs. Career resources available to students include employer materials, placement and salary data, interest inventory programs, Career Guides, publications, and other information that can help students make career decisions, search for jobs, and prepare for interviews.

On-Campus Interviews: Each year many companies visit the campus to recruit School of Mines students for full-time, summer, or co-op positions. Career Planning coordinates the scheduling of campus interviews through an e-recruiting system, which can be accessed at www.sdsmtcareers.com. This system also allows electronic posting of resumes by students and jobs by employers. In addition to electronic postings, Career Planning also posts jobs on its office bulletin boards from employers not interviewing on campus.

Career Fairs: Career Planning organizes Fall and Spring Career Fairs that are held on campus each September and February. A wide range of employers-including Fortune 500, regional companies and government agencies-participate in these events, which are attended by several hundred students from freshman to graduate levels.

Summer Internships: Many companies hire School of Mines students for summer internships that can help students obtain valuable work experience in their career field and confirm their career choice. Students should start their search in the fall semester for internships the following summer. Summer job opportunities are posted on Career Planning's online e-recruiting system, as well as a designated bulletin board in the office.

Alumni Placement Assistance: Career Planning offers School of Mines alumni free access to its online resume and job posting system. Visit www.sdsmtcareers.com for more details.

Career Counseling: Individuals interested in information on career choices or changing majors are encouraged to contact the Director of Career Planning (605) 394-2667.

Interest Inventory: The Choices Interest Inventory can be accessed free of charge by School of Mines students in the campus computer labs or through an online version. For further information, contact the Director of Career Planning (605) 394-2667 or the Director of Retention & Testing (605) 394-2400.

Cooperative Education Program: A partnership with business, industry, and government agencies, School of Mines' Cooperative Education Program provides students with opportunities to apply their classroom learning to "real world" work experiences in industry. Co-op students are hired by employers to work in positions related to their major. Minimum GPA and other co-op eligibility requirements vary among companies. Interested students should contact their department's Cooperative Education Coordinator. Students are responsible for securing their own co-op positions and are encouraged to register with Career Planning for assistance with identifying and applying for co-op opportunities.

Academic Credit: One (1) to three (3) credits. Prerequisite: Permission of instructor. Credit is available for each semester or summer work experience upon approval by the departmental Cooperative Education Coordinator. After accepting a co-op offer, students should notify Career Planning of their co-op employer, location, and dates of employment.

Students will be expected to apply knowledge learned in the classroom and to develop human relations skills and maturity in a work environment relevant to their career field. Students must satisfy departmental requirements in order to earn credit for the course. Requirements include a written report of the work experience and an employer's evaluation of work performance. Because the work performed by a student working full-time while on co-op is equivalent to the workload of a full-time student, a student on co-op who is registered for CP credit shall be considered to have full-time status.

Administration: School of Mines' Cooperative Education Steering Committee is comprised of the departmental Cooperative Education Coordinators, the Vice President for Academic Affairs, and the Director of Career Planning, Placement, and Cooperative Education. The committee is responsible for developing cooperative education industrial or business experiences; assisting students with identifying co-op opportunities; maintaining contact with cooperative education employers; and conducting an on-going evaluation of the program. For additional information, contact the Director of Career Planning (394-2667) or visit www.hpcnet.org/sdsmt/careerplanning.

Child-Care Services

The Kids Kastle Little Miner's Clubhouse provides campus-based, quality licensed child care for School of Mines students, faculty, staff, and community parents. Part-time and full-time programs are available. The Clubhouse is open year-round; contact the Kids Kastle Little Miner's Clubhouse at (605) 394-2586.

Counseling and Student Americans with Disabilities Act (ADA) Services

Professional counseling and student ADA services are offered free of charge to all School of Mines students. The office is located in Surbeck Center. Individual, group, and couples counseling, as well as wellness programming, is available. Students may receive counseling on stress, family problems, depression, substance abuse, or other personal concerns and on school related problems. Students with medical, psychiatric and learning disabilities who are seeking accommodations should contact the university counselor. The Assistive Technologies Lab, funded through a Department of Education Title III Strengthening Institutions grant, this lab is equipped with state-of-the-art computers, scanners, and software to facilitate learning for students with ADA certified disabilities such as visual or auditory impairments, dyslexia, ambulatory impairments, etc. Students wishing to use the Assistive Technologies Lab must be ADA certified through the campus counselor and ADA coordinator. The office is open 8:30 a.m.- 4:30 p.m. weekdays with evening hours on request. Walk-ins are welcome. Call (605) 394-2416 for information or an appointment.

Dining Services

School of Mines Dining Services would like to invite students, faculty and staff to dine on campus in the Hardrocker Dining Hall or the Miner's Shack Snack Bar. They are both located in the lower level of the Surbeck Student Center.

Use your all-you-care-to-eat meal plans, Plus Dollars, or pay by cash in the Hardrocker Dining Hall. You'll find an abundant variety of fresh foods, prepared from scratch every day. Many foods are prepared right before your eyes — only moments before serving. Daily features include traditional homestyle meals, fresh-cooked pastas and simmering sauces. Also enjoy hot and hearty traditional and vegetarian soups, bisques and chowders as well as a taste-tempting salad bar and our make-to-order grill.

Hours:
Open Monday-Friday

Breakfast:	7:00 am - 9:30 am
Lunch:	11:00 am - 1:30 pm
Dinner:	5:00 pm - 7:00 pm
Friday Dinner:	5:00 pm - 6:30 pm

Saturday and Sunday

Brunch:	11:00 am - 1:00 pm

Miner's Shack Snack Bar:
Looking for a quick bite to eat or a leisurely meal with friends? The Miner's Shack Snack Bar is a great place to eat using your Plus Dollars. You may also pay by cash or credit card. This retail dining location features hamburgers, chicken sandwiches, deli sandwiches, made-to-order pizza and much more.

Hours:
Open Monday-Friday:7:00 am - 11:00 pm
Saturday and Sunday:11:00 am - 11:00 pm

HEALTH SERVICES

The Student Health Service is a two-part program that provides undergraduate and graduate students the best medical care possible at reasonable cost.

Part I - Clinical Service
Each student (graduate and undergraduate) must have a complete Proof of Immunization and Medical History-Physical Examination Form, signed by a physician. Forms are to be submitted to the Dean of Students Office; once processed, the form will be on file in the Student Health Office. Failure to provide the completed Immunization Form will result in denial of registration. Meningitis vaccinations are strongly recommended. Those graduate students who are enrolled exclusively in distance education courses, and who do not attend on-campus classes, do not need to meet the immunization requirements.

A Medical Examination Form, signed by a physician, must be on file in the Student Health Office before medical service will be offered. International students entering the country may submit as evidence the physical examination taken in partial fulfillment of the requirements for entry into the United States. However, since the official government copy is left frequently at the port of entry, it is suggested that the student request the examining physician to complete the official school copy at the time that the physical examination is given.

An on-campus nurse and other health personnel are available during the hours posted. Student Health staff provide routine medical treatment on campus. When deemed necessary, the campus health provider will refer the patient for or will provide pathological, laboratory, and diagnostic X-ray services. Recommended or required vaccinations are provided at minimum cost. Procedures for emergency care are listed in the campus safety brochure. Student health fees are included in the mandatory general activities fee that all students pay at registration.

Part II - Optional Hospital-Surgical Medical Policy for Those Students Not Covered by Any Other Insurance Plan
Optional student health insurance is available through a hospital-surgical medical plan for purchase to supplement on-campus clinical service. This coverage is mandatory for all international students in order to provide protection from serious financial hardship. The plan covers 12-month hospital care, emergency room, and surgical benefits at any location. Since this is a group policy for students enrolled in SD Board of Regents institutions, the cost has been held to a minimum to cover most of the normal hospitalization and surgical charges. Additional coverage may be purchased for student's spouse and dependents. For complete information on this Hospital-Surgical Medical Policy, contact the School of Mines Business Office, Student Health Services, or the Vice President for Student Affairs and Dean of Students.

Ivanhoe International Center

The Ivanhoe International Center (IIC) was established through the generosity of alumnus Lytton F. "Buster" Ivanhoe, in the fall semester, 1994. The Center is located in the Surbeck Center and is the center of international activities on campus. A broad program of services is provided to international students. The IIC coordinates orientation sessions, the English as a Second Language joint program, social activities, computer facilities and services, community and campus outreach, and the provision of newspapers and literature from native countries. The director is available to assist students with: US Citizenship & Immigration Service (USCIS, formerly known as the INS) student matters; advocacy with all campus offices, organizations, and the surrounding community; housing inquiry referrals; federal income tax requirements; and the international student list serve. The IIC also works with students who may wish to study abroad. The Ivanhoe International Center is a department in the Division of Student Affairs.

The IIC also serves as a resource for various community groups and individuals, and collaborates with area universities and organizations on a number of activities. The physical facility of the IIC offers a relaxed setting for students to work on computers, collaborate on projects, read a native publication, or just "hang out" with friends.

The IIC welcomes everyone who wishes to become involved in any of their programs.

Multicultural Affairs

The Office of the Multicultural Affairs/Study Center is located on the third floor of the Old Gym. Staff is committed to the recruitment and retention of students of color. The office provides the following services: identifies, motivates and prepares School of Mines and K-12 students at the college and pre-college level to enter and successfully progress through science, technology, engineering and mathematics educational pathways, provides supplemental tutoring, mentoring and other academic enrichment programs, administers scholarship programs and identifies supplemental sources of financial assistance and scholarship, housing inquiry referrals, assists in coop/internship/employment placement, sponsors social and cultural enrichment events and activities to nurture cross-cultural understanding and inclusion, hosts time management/test taking workshops, coordinates service projects and outreach opportunities to sustain cultural identity in the larger Rapid City community, and maintains a reference library of cross-cultural and diversity literature. Part of the recruitment efforts focus on involvement with provides prospective students, K-12 teachers, and professional staff with multiple opportunities. An effective program through the years is SKILL (Scientific Knowledge for Indian Learning and Leadership), founded in 1989, that addresses the commitment to providing every opportunity for women, minority, and disadvantaged individuals to enter science and mathematics-based careers.

The Multicultural Activities Office Coordinator, located in the Surbeck Center, provides educational information and programming for all students so they are more aware of multiple cultural customs, traditions and issues. Both offices are committed to work with, support efforts, and provide leadership in the quest for a multicultural environment at School of Mines. To this end, Multicultural Affairs has a dynamic definition of multiculturalism: the interweaving of culture, race/ethnicity, social class, religion, geographic location, age, and gender. Through this definition they embrace similarities, respect the differences among groups, and discourage assumptions based on stereotypical notions about someone's culture.

The office personnel work closely with the campus wide university Multicultural Affairs Committee. The committee is developing an institutional work plan to continually foster a welcoming and safe environment; recruitment and retention; and campus networking connections.

The Director of Multicultural Affairs is the advisor to the School of Mines American Indian Science and Engineering Society (AISES) chapter. This campus organization nurtures the building of community by bridging science and technology with traditional Native values. AISES also provides activities/programs that offer students camaraderie, support, and encouragement.

<u>RESIDENCE LIFE</u>

Living Accommodations at School of Mines

Living on campus in one of the three School of Mines residence halls is a unique and valuable part of the educational experience. Residence Life contributes in a positive manner to the academic achievement of students and to the educational atmosphere of the university while assisting underclassmen in adjusting to the overall university experience. All students are encouraged to take advantage of the opportunity to live, learn and lead in the residence halls at School of Mines. Most first and second year students are required to live on-campus. The South Dakota Board of Regents policy # 3:6 on housing states the following: "during the first two (2) years from the time they were or would have been graduated from high school, all unmarried students who enroll in courses delivered on a main campus for six credit hours or more are required to enter into a housing agreement with the institution unless special permission to room elsewhere is received from the institution. Permission ordinarily shall be granted to students with dependent children or to students who reside full time during the academic year with parents or legal guardians. Students who have enrolled for twelve (12) or more credits for four semesters may be exempted from this agreement at the discretion of the institution." http://www.sdbor.edu/policy/3-Student_Affairs/3-6.doc.

Residence Hall Applications and Housing Agreements

The Housing Application and Exemption Request form are included with the School of Mines View Book. The forms are also on-line and available all year. During the spring semester, currently enrolled students will have the opportunity to reserve specific rooms as coordinated by the Residence Life Office. Applicants for a residence hall assignment must submit a $100.00 advance housing payment, which will be applied to room rental charges. The advance payment will be refunded if the application is withdrawn before August 1 and December 15 for fall and spring semesters respectively. If the application is withdrawn after these dates, the advance payment is forfeit.

Upon check-in, each student will sign a Housing Agreement for the entire academic year (or the portion remaining). Signed contracts ensure room assignment for these periods and obligate the resident to comply with policies, regulations, and guidelines as stated in the Residence Life Handbook. If the student is released from this contract (contract release is at the discretion of the university), the following charges may be assessed (a) $50 charge for contract release for spring semester, if notification of notification/request for release is made before December 15; (b) $75 charge for contract release for spring semester, if notification/request of contract release is made after December 15 and before the first day of the spring semester; or (c) $100 charge for contract release, if notification/request for release occurs after the first day of the semester and before the earned room rent is greater than $100.00.

Per university policy, all residents are required to purchase a meal plan each semester.

On-Campus Living

Connolly Hall, completed in 1948, Palmerton Hall, completed in 1969, and Howard Peterson Hall, completed in 2004, provide comfortable living accommodations for approximately 570 students on campus. All students who live in a residence hall are required to abide by the policies, regulations, and guidelines of the residence halls. The Residence Life Handbook, provided to each resident, covers all such policies, regulations, and guidelines. Resident Assistants, students employed by Residence Life, live and work with students to ensure the residence hall communities are environments conducive to academic success.

High-speed internet connections are available in all residence hall rooms; internet service is available for an additional fee. Local telephone and expanded basic cable TV plus HBO services are available and included in rent. Rooms are furnished with a bed (frame with mattress), a desk, and a study chair for each resident. Additionally, closet space, wastebasket, and dressers are also provided. Telephones, TVs, and computers are not provided. Rooms in Howard Peterson Hall have air-conditioning and in-room sinks. Quads in Howard Peterson Hall have in-room bathrooms.

Residence Hall Exemptions

In practice, School of Mines supports the South Dakota Board of Regents housing policy previously stated and, at its discretion, will approve exemptions to those students who

(a) are two (2) or more years past high school graduation as of registration day; or
(b) will live for the full academic year with parent(s) or legal guardian(s); or
(c) have a dependent child; or
(d) are active members of, and living in, a college recognized fraternity or sorority; or
(e) have completed four semesters of institutional enrollment with 12 or more credits; or
(f) are 21 years of age or older as of registration day; or
(g) are married; or
(h) are military veterans with one or more years of active service; or
(i) are classified as special students (enrolled, but not admitted/non-degree seeking); or
(j) are taking less than six credit hours.

Exemptions are initiated by completing the Residence Hall Exemption form (available on-line). When a student signs the Residence Hall Exemption form, he or she is certifying that the conditions of an approved exemption as described in (a) through (j) above exist. Any exceptions to the above policy must be supported by full written documentation of the individual circumstance(s) and are subject to the approval of the Director of Residence Life.

Graduate Housing

In general, campus housing availability is limited for graduate students because of undergraduate demands. No married student housing is available. Residence hall applications and information are not automatically provided to graduate students; therefore, if students want such application/information, please contact the Residence Life Office. Students who contract for on-campus housing for the upcoming academic year or term may be assigned in available rooms upon early arrival.

Off-Campus Housing

New students who require off-campus housing are encouraged to arrive in Rapid City at least one month prior to registration in order to get settled. Temporary summer housing is available at the end of the spring term through August 15. The Residence Life Office posts notices about private rooms, apartments, motels, houses, etc., available in the Rapid City area. Students interested in living off campus are welcome to review these notices posted in Surbeck Center. Information on accommodations in the Rapid City area may also be obtained from area realtors, local newspapers, current students, or the Ivanhoe International Center.

STUDENT ACTIVITIES

STUDENT ACTIVITIES AND LEADERSHIP CENTER

The mission of the Student Activities and Leadership Center is to enhance student involvement through educational and social activities while promoting leadership development through empowering students. In 2004, the center adopted a motto of: "Connecting you to the campus, preparing you for the world." The center provides organizations support for a diverse range of programming ideas, new member recruitment, and teambuilding activities. Organizations can also use several office resources as needed. The center creates and implements new student orientation sessions, leadership development programs, student organizations and programs, and advises the homecoming committee. The Student Activities and Leadership Center also provides advisors for a variety of student organizations including student government, student programming board, and the campus Greek council, among others.

Student Organizations

Involvement in student organizations is strongly encouraged at South Dakota School of Mines and Technology. Through co-curricular involvement, students develop their leadership skills, and gain real-life experiences in collaboration, critical thinking, and time management. There are more than 80 organizations at School of Mines, with new ones being created throughout the year. To find out how to get involved in any of these organizations, or to get information about starting an organization, contact the Student Activities and Leadership Center.

Academic Organizations:

American Chemical Society
American Institute of Chemical Engineers
American Society of Civil Engineers
American Society of Mechanical Engineers
Association of Computing Machinery
Association of Engineering Geologists (AEG)
Materials Advantage
Drill and Crucible Club
Human Powered Vehicle
Institute of Electrical and Electronics Engineers
Institute of Industrial Engineers
Linux User Group
SDSM&T AeroHeads
SDSM&T Robotics Team
Society of Automotive Engineers
Society of Economic Geologists
Society of Women Engineers
South Dakota Solar Motion Team

Athletic Organizations:

Fellowship of Christian Athletes
Hardrocker Climbing Club
School of Mines Judo Club
SDSM&T Hot Rockers Dance Team
SDSM&T Cycling Club
Society of Rhythm Engineers
SDSM&T Ski and Snowboard Club
Tech Soccer Club
Ultimate Frisbee Club

Greek Organizations:

Alpha Chi Sigma
Alpha Delta Pi
Alpha Omega Epsilon
Delta Sigma Phi
Interfraternity Council
Theta Tau
Triangle

Honor Societies:

Alpha Sigma Lambda
Eta Kappa Nu Association
Order of Omega
Phi Eta Sigma
Pi Tau Sigma
Tau Beta Pi

Multicultural Organizations:

Association of Norwegian Student Abroad
Chinese Student & Scholar Association
Cultural Expo Committee
India Club
American Indian Science and Engineering Society
Mongolian Student Association

Religious Organizations:

International Christian Fellowship
InterVarsity Christian Fellowship
Latter-Day Saint Student Association
Lutheran Campus Ministry
Muslim Student Association
Newman Club

United Campus Ministry

Special Interest Organizations:
Circle K
Habitat for Humanity
Students Against Destructive Decisions
College Democrats
College Republicans
Drama Club
Hardrocker College Bowl Club
Hardrocker Flying Club, Inc.
Leadership Development Team
M Week
Non-Trad Student Forum
Pershing Rifles
Ranger Challenge
Scabbard & Blade
Student Alumni Connection
Tech Association of Role Players
TAP (Tech Activities and Programs)

Student Government Organizations:
Connolly Hall Council
Howard Peterson Hall Council
Palmerton Hall Council
Residence Hall Association
Student Association

Student Media:
KTEQ 91.3 FM Radio
The Raver (Student Newspaper)
School of Mines Amateur Radio Club

Student Association

All regularly enrolled students at School of Mines are eligible for active membership in the Student Association upon registration and payment of the required activity fees. The purpose of the Student Association is to administer and coordinate student activities; to provide a means for representing student ideas and opinions to faculty, administration, and the community; and to improve and clarify academic, cultural, recreational, and social aspects of the academic community. The student senate conducts the affairs of the Student Association.

Elections for Class Representatives and Senators occur in spring semester, with the exception of the Freshman class, which occurs in the fall semester. The President of the Student Body appoints additional Representatives.

Tech Activities and Programs (TAP)

Tech Activities and Programs (TAP) is the campus-wide programming board. The mission of TAP is to provide a comprehensive program for the cultural, educational, recreational, and social interests of the students, staff, faculty, alumni, and guests of School of Mines. TAP also provides an opportunity for students to develop their leadership skills and to interact with faculty outside of the classroom. Membership is open to all School of Mines students.

VISUAL AND PERFORMING ARTS

APEX Gallery

The APEX Gallery was established in 1989 and is housed in the Classroom Building. It offers challenging educational and science exhibitions for enjoyment and enrichment of people of all ages. Contemporary works of artists and scientists, many of who are nationally and internationally recognized, are exhibited. These exhibitions are designed to reflect a cross section of cultural expressions and perspectives. In addition to providing on-campus students and staff with opportunities to view the exhibits, the APEX Gallery has an active community outreach, component.

Music Program

The Music Program (http://music.sdsmt.edu), a division of the Department of Humanities, is housed in the King Center. Included are an ensemble rehearsal area of more than 1,600 square feet with adjoining music offices, music library, and storage, and two smaller rehearsal areas of more than 1,000 square feet; one of which doubles as an applied music teaching studio/jazz band rehearsal area and the other which provides space for an electronic music laboratory and individual practice. Cultural and educational enrichment opportunities include:

- Academic course offerings - see the courses listed under MUS, MUEN, or MUAP elsewhere in this catalog or on the Music Activities website.
- Ensembles - Symphonic Band, Concert Choir, Jazz Band, Master Chorale, Pep Band, Alumni & Friends Choir, and other instrumental and vocal ensembles. School of

Mines music ensembles vary in type from academic laboratory courses in aesthetics to student-led recreational groups.

- Music performances - School of Mines ensembles perform at area and regional schools, at professional conferences and organized music festivals, and through concert tours. A sample of these include:
- School of Mines Concerts are presented by the major ensembles every semester at venues around Rapid City and the Black Hills.
- School of Mines Recitals are presented by faculty and students throughout the academic year in the Rapid City area.
- Appearances throughout South Dakota and neighboring states at various venues such as the Grand Teton Choral Festival in Jackson Hole, Wyoming, at which the Master Chorale took first place in the college division, and state choral directors association conventions.
- Appearances at nationally recognized events such as the Music Educators National Conference in California and the Washington (DC) National Cathedral dedication.
- Foreign tours resulting in critical acclaim and invitations to perform in such venues as the New Years Eve Mass in Vienna's Karlskirche in 1990, Lindenholzhausen Harmonie-Festival in 1993, Florence's Palazzo Vecchio in 1996, Vieste (Italy) cathedral in 2001, and the Konstanz (Germany) Münster in 2003.

For more information and current concert listings, visit the Music Activities website at: http://music.sdsmt.edu

Drama Program

Opportunities are available to students in the dramatic arts through participation in the Drama Club, a division of the Department of Humanities. Two full dramatic productions are presented each year with student involvement in all aspects-acting, producing, stage, set, and technical design. Recent productions have run the gamut from Shakespeare to modern drama and comedy. In addition, student-directed one-act play productions are presented each spring semester.

INTERCOLLEGIATE ATHLETICS

The athletic program has always been considered a major extracurricular activity on the campus of School of Mines. It is believed that a student's participation in athletics fosters well-rounded development. The intercollegiate sports scheduled throughout the year include football, cross country, basketball, volleyball, golf, and track.

The university is a member of the DAC-10 Conference and is NAIA affiliated. The DAC-10 awards championships in all conference sports each season. A double round robin in basketball plus post-season conference tournament and a single round robin in football are scheduled each year and determine the conference championship. The championships in cross country, golf, and track are awarded on the basis of a conference championship meet. The conference volleyball champions are determined by a double round robin schedule and a tournament. There is a high degree of success even at the national level by our conference representatives.

Eligibility for Intercollegiate Athletics

To be eligible for intercollegiate competition at the South Dakota School of Mines and Technology, a student must:

1. Be making normal progress toward a recognized degree and maintain the GPA required to remain in good standing as set forth by this catalog.
2. Be enrolled in a minimum of twelve (12) semester credit hours at the time of participation, or if the participation takes place between terms, the student must have been enrolled in the term immediately preceding the date of participation. Students become ineligible upon dropping below twelve (12) credit hours of enrollment.
3. Pass 24 credit hours (or equivalent) in the two terms of attendance immediately preceding the term of participation. A second-term freshman must pass nine (9) credit hours (or equivalent) in the first term.
4. Be eligible in the appropriate conference.
5. Transfer students from a four-year institution must have eligibility remaining at the institution they are transferring from to be eligible for further intercollegiate competition. Junior college transfers or graduates need to check with the athletic director about their status.

INTRAMURAL SPORTS

All students are encouraged to participate in the intramural program, which provides organized athletic contests and wholesome recreation. In the past several years, approximately 70% of the student body has participated in the intramural program. It provides for individual and team competition and fosters a spirit of fair play and sportsmanship. Among the activities are co-ed water polo, wallyball, indoor and outdoor soccer, basketball, dodge ball, volleyball, swimming, racquetball, and flag football. A Director of Intramural Activities is responsible for directing the Intramural Program.

Mines Matters: The trek up M-Hill to whitewash the M and lay the senior plaque, freshmen in green beanies, and mud volleyball are only some of the traditions of M-Week, School of Mines annual homecoming celebration held each fall. Other activities include the coronation of the homecoming royalty, the dance, and the M-Day parade and football game.

Chemical Engineering

CONTACT INFORMATION

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FACULTY

Professor Winter, Chair; Professors Dixon; Pillay, and Puszynski; Assistant Professors Gilcrease and Menkhaus; Emeritus Professors Bauer, Munro, and Sandvig.

CHEMICAL AND BIOLOGICAL ENGINEERING

The 21st century brings with it many exciting opportunities and careers for chemical engineers. Chemical engineering professionals are found throughout the entire structure of industry and commerce, and as such, the profession offers many interesting and challenging opportunities. These opportunities are in areas such as research and development, manufacturing, production, plant or process design, technical sales or service, and management.

Chemical engineers with a B.S. degree from School of Mines will obtain a solid foundation for their engineering degree in the science of chemistry, in mathematics, and in applied technology. Chemical engineers are able to help solve the problems affecting the people of the world and to efficiently use the world's resources. These needs or problems might be related to the environment, electronics, traditional and alternative energy sources, food, fibers, biotechnology, petroleum, pharmaceuticals, and new engineering materials (nano-materials, ceramics, polymer composites). The Chemical Engineering program is designed to prepare students to become practicing chemical engineers, ready to enter the workforce and make immediate contributions. As a part of this program, students will receive training and guidance so that they will:

- Be proficient in their chosen field as reflected in part by their successful entry into the engineering job market or graduate school, and by their successful performance in these endeavors.
- Be proficient in their chosen field as reflected in part by their successful entry into the engineering job market or graduate school, and by their successful performance in these endeavors.
- Be able to analyze chemical processes, both as entire processes and as separate components, through the effective use of critical thinking skills.
- Be proficient in the use of computers, including process simulation software, for solving chemical engineering problems and for communicating their solutions to others.
- Be proficient in the oral and written communication of their work and ideas.
- Have the ability to learn independently, but also be able to participate effectively in groups.
- Be able to conduct themselves with the highest ethical standards and to understand the safety, environmental, and societal consequences of their work as chemical engineers.

Chemical and physical changes of matter are of primary concern to chemical engineers in their effort to solve real world problems. Some of the physical changes of interest to the chemical engineer are distillation, extraction, crystallization, evaporation, filtration, gas absorption, industrial waste reduction, absorption, ion exchange, and recycling. Chemical changes of interest include turning raw materials such as corn or petroleum into value added and much needed products. These products could be such things as new plastics or fuel-ethanol from corn, new processes for nano-reinforced plastics, novel functionally graded thin films for aerospace and deep space applications, human insulin from recombinant E. coli cells, intermetallic nano-powders created to store hydrogen more safely for fuel cell applications, or novel ion-conducting polymers for improved fuel cell efficiency. Chemical engineers are concerned with chemical reactions of petroleum under conditions of high pressure and temperature, but are also concerned with bioreactors, where milder conditions must be optimized for the growth of specialized microbes to produce desired metabolites.

The chemical engineering curriculum is designed to allow students to prepare themselves to enter the workforce within the traditional four-year time frame. Opportunities also exist for students to participate in on-the-job training in the form of cooperative education (co-ops) and summer internships. These employment opportunities may be included as an integral part of the student's studies.

The chemical engineering faculty is actively engaged in research and development and welcomes the participation of undergraduates in these efforts. The department is currently operating one of only a handful of summer Chemical Engineering Research Experiences for Undergraduates (REU) sites in the nation. This unique opportunity allows undergraduates to accomplish research first hand in a university setting, while working under the guidance of a faculty member. For example, During the summer of 2004, School of Mines Chemical Engineering students worked on diverse research projects including novel energetic materials for the Navy, new adhesive architectures using nano-reinforcements, unique polymer membranes for the Army, innovative biotechnology to reclaim mine tailings, new chemistry to create highly structured molecules, and advanced experiments for the Chemical Engineering undergraduate laboratory. Chemical Engineering students may find an opportunity to work with professors on various research projects during the school year as well. More information about this exciting experience may be found on the web at: http://reu.sdsmt.edu. Additionally, students are encouraged to apply at other REU sites.

The courses listed in the curriculum have been chosen to develop a well-rounded education, beginning with the foundations of mathematics, physics, and chemistry, and culminating with a capstone process design course at the senior level. Along the way, students develop competencies in fluid dynamics, heat transfer, mass transfer, computer solutions to complex engineering problems, process control, kinetics, and reactor design. Students can tailor their education to better meet their personal goals by taking directed electives in the environmental, biochemical, or advanced materials areas. Students in the Environmental Engineering program may elect Chemical Engineering as their specialty emphasis. With the increased national emphasis on the environment, the unique opportunity exists at School of Mines for one to earn dual degrees in Chemical Engineering and Environmental Engineering, thus coupling a focus on the environment with complementary chemical processing and design skills.

The chemical engineering faculty at the School of Mines strives to keep the curriculum current and dynamic. As a part of this evolution, the faculty has developed an innovative and unique approach to teaching chemical engineering laboratories. (M.A.P.S., see below) Additionally, to give our students an edge in the job market, the faculty has been working on a multi-year project that integrates advanced process simulation through four years of their education. Time and again, Chemical Engineering graduates report back how this experience was a key aspect of their training, which ultimately lead to their current position.

The Chemical Engineering program has laboratory facilities that supplement the basic information presented in the classroom. These facilities include the main laboratory that houses mini-plant equipment such as a distillation column, evaporators, heat exchangers, fluid piping, and pumping systems and gas absorbers. Other laboratories include a process dynamics laboratory, which is used to study the dynamics and control of process variables such as temperature, pressure, flow rate, and liquid level; a personal computer laboratory for students to use for addressing the solution of laboratory and classroom problems, and several research laboratories.

The department has been awarded substantial grants from the National Science Foundation, industrial foundations and companies to enhance the laboratory facilities as well as the biochemical engineering curriculum. The Dow Corning Foundation Enhanced Materials, Automation, Processing, and Simulation (M.A.P.S.) Laboratory is the foundation for a unique laboratory experience. This multi-year project integrates process design and simulation throughout the chemical engineering laboratory experiences. Sophisticated process design simulators (such as the commercial software, AspenPlus and Pipe-Flo), are co-integrated with the process design project. Students are exposed to the real-world challenge of effectively applying process design skills in a pilot plant environment. This is coupled with state-of-the-art Camile process controllers.

The Chemical Engineering program is expanding in the growth area of biochemical engineering. Students may pursue an emphasis in Biochemical Engineering through elective courses in biochemistry, microbiology, and biochemical engineering. Additional biochemical engineering topics are integrated into the core chemical engineering courses. Students can gain hands-on experiences in our state-of-the-art biochemical engineering laboratory, which is substantially funded by the Cargill Company. Check out the latest developments at www.sdsmt.edu/mse/chem-che/chemE/bioche.html.

Areas of Special Emphasis

Although a minor in Chemical Engineering is not available, one can obtain special emphasis in areas such as Biochemical Engineering, Environmental Engineering, Chemical Engineering, or Advanced Materials areas by tailoring their elective courses.

Co-op Opportunities

A number of industrial partners offer cooperative education opportunities for students majoring in chemical engineering. Students are encouraged to apply for these opportunities as they provide a valuable exposure to the practice of chemical engineering. For each semester or summer term spent in a co-op position, students register for two (2) credits of a Cooperative Education (CP) course. Students wishing to register for a co-op course should visit with their advisor prior to accepting a co-op position to ensure that departmental procedures are followed and to optimize the sequencing of co-op courses with other required courses.

Professional Development Opportunities

Students in chemical engineering have many chances to enrich their formal engineering education. The department has very active professional and fraternal organizations, such as an American Institute of Chemical Engineers (AIChE) Student Chapter, an American Chemical Society (ACS) Student Chapter, and an Alpha Chi Sigma (AXE) Co-ed Fraternity. In these chapters, students learn more about their chosen professions, do community service, and participate in regional and national meetings. Each spring, students enrolled in the Fundamentals of Biochemical Engineering course participate in a field trip to industrial fermentation facilities. The AIChE Student Chapter arranges similar trips to other industries.

At the regional and national AIChE meetings, chemical engineering students from School of Mines compete against chemical engineering students from other universities in such things as research paper presentations, process designs, and a Chem-E Car Competition. School of Mines students compete, and win, these competitions. For example, the team in 2000 received 1st place in the car competition and 3rd in the poster competition. In 2003, the fuel cell-powered "ChemE-Car" car they designed won first place in the AIChE Rocky Mountain Regional competition. In 2004, the team received 4th in the car competition and 2nd in the poster competition, and in 2005, the team received 1st in the poster competition and the Golden Tire Award. In all cases, beating teams from Colorado, Utah, New Mexico, and Arizona. The School of Mines ChemE-Car teams have had tremendous success at the AIChE Student Chapter National Conference held in conjunction with the Annual Meeting for Chemical Engineering professionals. The 2002 ChemE-Car team received the Golden Tire Award; the 2003 team received 2nd place in the poster presentation and 4th place in the car competition. The 2004 team received 4th place in the poster presentation. In all years they were competing with the best teams in the world. Highlights of the AIChE student chapter activities may be found at http://aiche.sdsmt.edu/.

Chemical Engineering Curriculum/Checklist

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
GES 115	Professionalism in Engr. & Sci	2
ENGL 101	Composition I	3
Humanities or Social Sciences Elective(s)		5
TOTAL		**18**

Second Semester

MATH 125	Calculus II	4
CHEM 114	General Chemistry II	3
CHEM 114L	General Chemistry II Lab	1
PHYS 211	University Physics I	3
CHE 111	Intro. Eng. Modeling	1
CHE 117	Prof. Pract. in Chem. Eng.	2
Humanities or Social Sciences Elective(s)		4
TOTAL		**18**

Sophomore Year

First Semester

CHE 217	Chemical Engineering I	3
MATH 225	Calculus III	4
ENGL 279	Technical Communications I	3
CHEM 326	Organic Chemistry I	3
CHEM 220	Exp. Organic Chem. IA	1
PHYS 213	University Physics II	3
TOTAL		**17**

Second Semester

CHE 218	Chemical Engineering II	3
CHE 222	Chem. Engr. Thermo I	3
CHEM 328	Organic Chemistry II	3
Humanities or Social Sciences Elective(s)		3
CHE 250	Computer App. in Chem. Eng.	2
MATH 321	Differential Equations	4
TOTAL		**18**

Junior Year

First Semester

CHE 317	Chemical Engr. III	3
CHE 321	Chemical Engr. Thermo II	3
CHE 333	Process Measure and Control	1
CHE 361	Chemical Engr Lab II	2

CHEM 230	Analytical Chem for Engr	2
CHEM 332L	Analytical Chem Lab	1
CHEM 341	Physical Chem for Engr I	2
ENGL 289	Technical Communications II	3
TOTAL		**17**

Second Semester

CHE 318	Chemical Engineering IV	3
CHE 362	Chemical Engineering Lab III	1
CHE 343	Chem Kinetics/Reactor Dsgn	3
CHEM 343	Physical Chem for Engr II	2
CHEM 345	Physical Chem I and II Lab	1
Engineering Elective		3
Department Approved Elective		3
TOTAL		**16**

Senior Year

First Semester

CHE 417	Chemical Engineering V	2
CHE 461	Chemical Engineering Lab IV	1
CHE 464	Chemical Engr Design I	4
Chemical Engineering Elective		3
Biology Elective		3
Humanities or Social Sciences Elective(s)		3
TOTAL		**16**

Second Semester

CHE 433	Process Control	3
CHE 465	Chemical Engr Design II	3
CHE 487	Global and Contemporary Issues in Chemical Engineering	1
Chemical Engineering Elective		2
Chemical Engineering Lab Elective		1
Department Approved Elective		1
Humanities or Social Sciences Elective(s)		3
PE	Physical Education/MUEN	2
TOTAL		**16**

136 credits required for graduation

Curriculum Notes

The following optional areas for emphasis are available. The academic advisor recommends and approves courses to take if students are interested in an emphasis in one of these areas: Biochemical engineering, Environmental engineering, or Advanced Materials (nano materials, polymers, ceramics, materials processing, corrosion, or solid state/semi-conductors).

BIOL elective: BIOL 231, 341 or other approved by advisor.

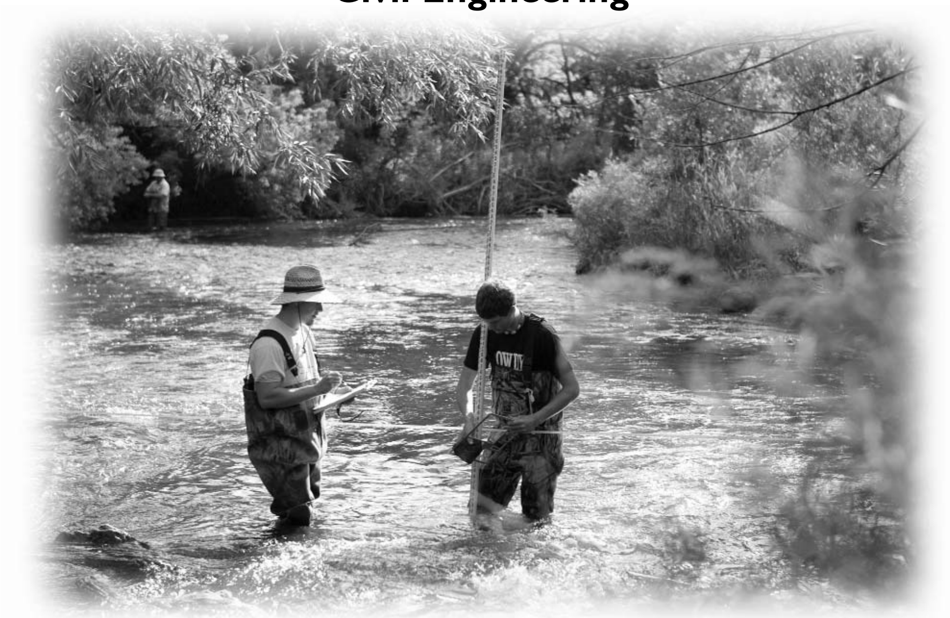
CHE elective: 5 credits from CHE 434, 444, 450, 455, 474, 474L, 484, 484L, 491, 492, 498 or others approved by advisor.

CHE lab elective: one (1) credit from CHE 474L, 484L, 498 or other approved by advisor.

Engineering Elective: An engineering course other than CHE prefix; requires advisor approval.

Department approved elective: Select from the following: CHE, CHEM, or other approved courses to fulfill emphasis electives. May include up to three (3) credits of advanced Military Science and up to six (6) credits of cooperative education.

Civil Engineering



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Faculty

Associate Professor Kenner, Chair; Professors Sangchul Bang, Hansen, Mott, and Preber; Associate Professors Fontaine and Klasi; Assistant Professors Maleck (Surovek), Patnaik, and Stone; Instructor Arneson-Meyer.

Civil Engineering Program Mission

The mission of the civil engineering program supports the mission of the institution and was developed in parallel with it. The civil engineering program's mission is:

1. To prepare men and women for an enhanced quality of life by providing an educational experience that leads to baccalaureate and post-baccalaureate degrees in civil engineering.
2. To contribute to the expansion of knowledge of civil engineering through programs of basic and applied research, scholarship, and other creative endeavors.
3. To use the special capabilities and expertise of the program's faculty to address regional, national, and international needs in civil engineering, including the areas of environmental, geotechnical, structural and water resources.
4. To serve the State of South Dakota and the nation by providing training and education that will benefit the planning, design, construction and maintenance of facilities essential to civilization.

The principal goals in support of the civil engineering program's mission are:

1. To enhance our state and national recognition as an outstanding civil engineering program that provides well prepared employees to the civil engineering profession.
2. To develop centers of excellence in research and graduate education, using faculty expertise to further develop interdisciplinary research.
3. To create and maintain an environment that ensures growth of the intellect, character, and spirit of students as well as faculty and staff members.

4. To build mutually beneficial partnerships with the broader community.
5. To increase the resources available to the department and the civil engineering program.

Civil Engineering Program Objectives

The objectives of the Civil and Environmental Engineering Program with regard to undergraduate education is to produce graduates with capabilities to

1. engage in the professional practice of civil engineering within the region working in the public or private sector,
2. actively participate in professional organizations that promote civil engineering and provide continuing self-development, and
3. pursue advanced studies in civil engineering or a related professional discipline.

The objectives presented here are modified from the most recent catalog based on faculty review and interaction with the CEE Professional Advisory Board. These program objectives can also be found on the CEE website http://cee.sdsmt.edu/ and are stated in departmental informational materials.

Graduates of the civil engineering program are expected to be competent for entry-level professional practice in four major areas of civil engineering 1) environmental, 2) geotechnical, 3) structural, and 4) water resources. In the senior year, students have two civil engineering focus electives and three department-approved electives. Focus electives can be in one or two of the four major areas. Department approved electives can be in one or more of the four major civil engineering focus areas or can be courses outside the department that support the students focus area. This provides the student the option of keeping breadth in their study program or emphasizing in one focus area. Studies in these areas culminate in major engineering design experiences to help bridge the gap between education and professional practice.

Civil Engineering Program Outcomes

Program outcomes as stated here define what students are expected to know or be able to do by the time of graduation. The civil engineering program has adopted the program outcomes established by ABET, outcome requirements of Criterion 3. By achieving these outcomes establishes the foundation for achieving program objectives. The specific program outcomes are listed below.

Students completing the civil engineering program will be able to demonstrate:

a. an ability to apply knowledge of mathematics, science, and engineering
b. an ability to design and conduct experiments, as well as to analyze and interpret data
c. an ability to design a system, component, or process to meet desired needs
d. an ability to function on multi-disciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Civil Engineering Education

An undergraduate education in civil engineering is founded on a broad knowledge of engineering sciences and selected courses in mathematics, physical sciences, social sciences, technical communication, and computer methods. Required civil engineering courses address the emphasis areas of environmental, geotechnical, hydraulic, structural, materials, and water resource engineering. Each student is asked to choose one or more of these areas as an emphasis from which elective courses are selected at the senior level. Or, they may take one course in each of the areas for a broad-based Civil Engineering emphasis. The graduate program affords an opportunity for qualified students to pursue their academic training to a more specialized and advanced level for higher professional attainment.

INTEGRATION OF DESIGN INTO THE CIVIL ENGINEERING CURRICULUM

The curriculum in the civil engineering program begins by giving the student a thorough knowledge in mathematics and basic sciences. Courses in the engineering sciences begin the transition from theory to creative application. During their junior year, students take required courses in four major areas of Civil Engineering: environmental engineering, geotechnical engineering, structural engineering, and water resources engineering. In each of these courses students learn to apply mathematics, science, and engineering science to the solution of civil engineering problems, with students learning the fundamental elements of engineering design. During their senior year, students choose one of the Civil Engineering emphasis areas and take a sequence of two (2) required courses in that area. The low enrollments in these courses allow for good interaction between students and faculty. Seniors also select two (2) courses related to their chosen course sequence from a list of department approved courses. As seniors, students get an even more intense design experience, learning about alternative solutions, feasibility, economics, and detailed design descriptions. In their last semester, students take a capstone design course, working, either in groups or alone, with the guidance of a faculty member on a meaningful major engineering design project that draws upon previous course work. The capstone design experience culminates with a formal final report and a presentation to the faculty and the students' peers.

LABORATORIES

The Department of Civil and Environmental Engineering has separate laboratories equipped for materials testing, study of fluid flow and hydraulic systems, geotechnical engineering, environmental engineering, structural engineering design, engineering graphics, and computer-aided instruction. The comparatively rugged terrain on and near the campus offers excellent opportunity for a variety of practice in surveying methods and techniques.

PROFESSIONALISM

Students in civil engineering are encouraged to participate in the technical and professional activities of the Student Chapter of American Society of Civil Engineers for promotion of professional and cultural ethics, and specialties in the profession. Students are encouraged to take the Fundamentals of Engineering Examination as the first step in becoming a Registered Professional Engineer. Because there is a human side to engineering, students are required to take courses in the humanities and social sciences. Students also take required sophomore and senior courses that directly address professionalism and engineering ethics. They are also exposed to these ideas throughout the engineering curriculum.

A minor in civil engineering is not available.

CIVIL ENGINEERING CURRICULUM/CHECKLIST

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

FRESHMAN YEAR

First Semester

ENGL 101	Composition I	3
CHEM 112	General Chemistry I	3
MATH 123	Calculus I	4
GES 115	Professionalism/Engr and Sci	2
PE	Physical Education	1
Humanities or Social Sciences Elective(s)		3
TOTAL		**16**

Second Semester

CHEM 112L	General Chem I Lab	1
CHEM 114	General Chem II	3
PHYS 211	University Physics I	3
MATH 125	Calculus II	4
CEE 117	Computer Aided Design and Interpretation in CEE	2
PE	Physical Education	1
Humanities or Social Sciences Elective(s)		3
TOTAL		**17**

Sophomore Year

First Semester

MATH 225	Calculus III	4
EM 214	Statics	3
CEE 284	Digital Computation in CEE	4
CEE 206	CEE Pract and Eng Surveys I	4
Humanities or Social Sciences Elective(s)		3
TOTAL		**18**

Second Semester

ENGL 279	Technical Communications I	3
MATH 321	Differential Equations	4
EM 331	Fluid Mechanics	3
EM 321	Mechanics of Materials	3
Humanities or Social Sciences Elective(s)		3
TOTAL		**16**

Junior Year[1]

First Semester

ENGL 289	Technical Communications II	3
CEE 316	Engr and Construct Materials	3
CEE 326	Envr Engr Process Fundament	3
CEE 336	Hydraulic Systems Design	3
CEE 346	Geotechnical Engineering I	3
CEE 353	Structural Theory	3
TOTAL		**18**

Second Semester

PHYS 213	University Physics II	3
Science Elective		3
CEE 327	Intro to Environ Engr Design	3
CEE 337	Engineering Hydrology	3
CEE 347	Geotechnical Engr II	3
One of the following courses:		3
CEE 357	Theory and Design of Metal Structures I[2]	
CEE 358	Applied Structural Design[2]	
TOTAL		**18**

Senior Year

First Semester

IENG 301	Basic Engineering Economics	2
Department Approved Elective[4]		3
CEE 474	Engr Project Management	3
CEE	Track Elective[3]	3
CEE	Approved Elective[4]	3
EM 215	Dynamics **OR**	
ME 221	Dynamics of Mechanisms	3
CEE 464	Civil Engr Capstone Design I	1
TOTAL		**18**

Second Semester

CEE 463	CEE Profession	1
ME 211	Intro to Thermodynamics	3
CEE 465	Civil Engr Capstone DesignII	2
CEE	Track Elective[3]	3
CEE	Approved Elective[4]	3
Humanities or Social Sciences Elective(s)		3
TOTAL		**15**

136 credits required for graduation

Curriculum Notes

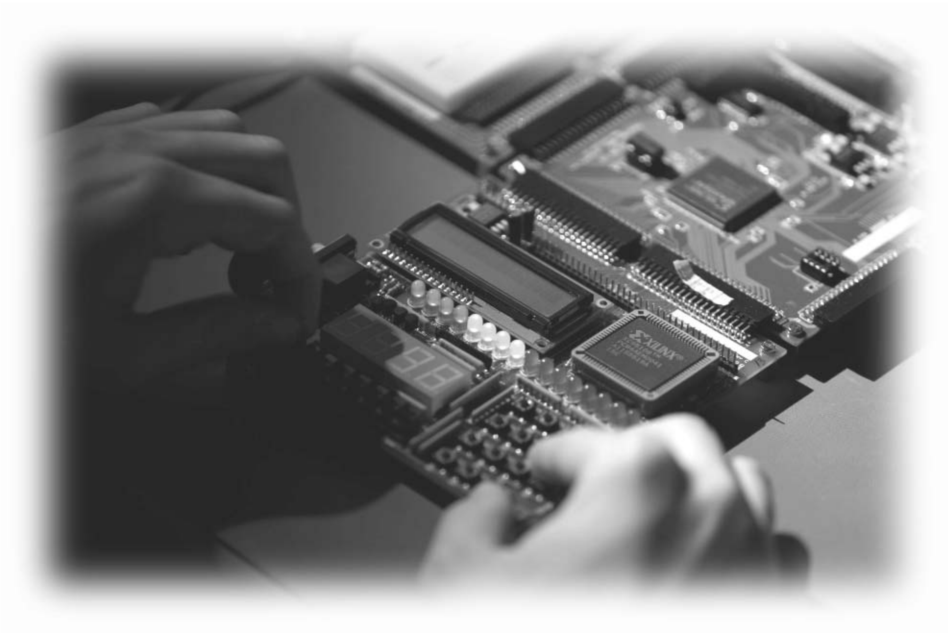
[1] In order to enroll in the CEE Junior courses, the student must have at least a C in EM 214 and EM 321.

[2] Structural Engineering emphasis students must choose CEE 357 while students of other emphasis areas may choose CEE 358.

[3] Students have the option of emphasizing in one area selected from either Environmental Engineering, Geotechnical Engineering, Structural Engineering, or Water Resources Engineering where two (2) or more approved courses can be selected. The student can also chose a general engineering option thus selecting a mix of approved elective courses. Track electives for the four focus areas are CEE 426 and CEE 427, CEE 447 and CEE 448, CEE 456 and CEE 457, CEE 433 and CEE 437, respectively

[4] Approved elective courses must be approved by the Department of Civil and Environmental Engineering. Only one approved elective can be taken at the graduate level.

Computer Engineering



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COMPUTER ENGINEERING

The Computer Engineering curriculum prepares students for a career by providing them with the engineering and technical education appropriate to meet modern technological challenges. The basic curriculum includes required course work in mathematics, basic sciences, humanities, social sciences, and fundamental engineering topics in circuit analysis, electronics, electrical systems, digital systems, assembly language, data structures, operating systems, and software engineering. Computer Engineering students are required to select three (3) senior elective courses from a wide variety of subject areas to fit their particular interests. Elective subject areas include digital signal processing, microprocessor-based system design, computer networks, computer architecture, and VLSI design.

MISSION

The mission of the Computer Engineering Program, in support of the mission of School of Mines, is to provide Computer Engineering students with an education that is broadly based in the fundamentals of the profession so that graduates will be able to maintain a high degree of adaptability throughout their professional career. It is also intended that the students will develop a dedication to the profession and an ability to maintain professional competency through a program of life-long learning.

Objectives

1. Graduates will be able to successfully practice computer engineering and related fields regionally and nationally.

2. Graduates will be well-educated in the fundamental concepts of computer engineering and able to continue their professional development throughout their careers.

3. Graduates will be skilled in clear communications and teamwork and capable of functioning responsibly in diverse environments.

Program Strengths

A two-semester capstone design experience requires Computer Engineering students to conduct their own design project in a simulated industrial environment. They are encouraged to work on team projects. Often the team projects are multidisciplinary. This foundation provides students with a broad base of understanding that allows them to apply their knowledge of scientific and engineering principles to the practical and innovative solutions of existing and future problems.

Students are required to develop a high level of written and oral communication skills and to work well as a member of a team. They must develop a social and ethical awareness so they understand their responsibility to protect both the occupational and public health and safety and to implement these factors in their professional activities. Students are encouraged to participate in the activities of professional societies, such as the Institute of Electrical and Electronics Engineers and Eta Kappa Nu, to enhance their educational and social life while on campus and to gain professional contacts for their careers. Students have opportunities to participate in cooperative education and summer intern programs whereby they elect to seek employment to experience engineering work before they complete their degree requirements. Students gain insight into future opportunities and are often hired by their intern companies after graduation.

Integration of Design Concepts

One of the key elements of the undergraduate Computer Engineering education experience is to integrate design throughout the curriculum. Students experience various design concepts in a variety of settings:

- Hands-on laboratory projects (including team projects);
- Effective integration of computer applications;
- Development of effective communication skills;
- Senior elective course;
- Senior capstone experience; and
- Participation in competitive team projects such as the Robotics team, the Alternative Fuel Vehicle Team, the Unmanned Aerial Vehicle team, and the Formula SAE Mini-Indy team.

Graduate School Opportunities

Since the undergraduate curriculum is broad based, it is impossible to study areas of interest in very much depth. Qualified students may specialize further by pursuing a graduate program at School of Mines or any of the nation's major universities.

Laboratories

The Electrical and Computer Engineering Department houses well-equipped laboratories designed to give students easy access to experimental support for their theoretical studies. Junior and senior laboratory projects are conducted on an open laboratory basis that allows students to schedule experimental work at their own convenience. Laboratory facilities are open to students and are supervised until 10 p.m. on most weeknights with additional weekend hours.

Four general-purpose laboratories are fully equipped to provide facilities for experiments in such diverse areas as communication systems, control systems, electromechanics, energy conversion, digital circuits, and electronics. These laboratories can also be used to provide hands-on experience under the direct supervision of Electrical and Computer Engineering faculty. In addition, there are special-purpose laboratories serving the fields of power systems, optoelectronics, thin-film electronic materials, solid state devices, analog and digital systems, mechatronics, real-time embedded systems, computer instrumentation, microprocessor development and fabrication, reconfigurable logic, and parallel processing and cluster computing (in conjunction with the Mathematics and Computer Science Department).

A project room has recently been completed. Seniors and graduate students have access to this facility to work on senior design and graduate thesis projects. The work area allows students a convenient place in which to work for the duration of their project.

NOTES ON COMPUTER ENGINEERING COURSES

Classes that are typically offered every semester include CENG 244, CENG 314, CENG 464, and CENG 465.

Classes that are typically offered every fall semester include CENG 440 and CENG 444.

Classes that are typically offered every spring semester include CENG 342, CENG 442, and CENG 446.

CENG 420 is typically offered in the spring semester of even numbered years, for example spring 2004. CENG 447 is typically offered in the spring semester of odd numbered years, for example spring 2007.

COMPUTER ENGINEERING CURRICULUM/CHECKLIST

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

FRESHMAN YEAR

First Semester

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
ENGL 101	Composition I	3
CHEM 112L	General Chemistry I Lab	1
GES 115	Professionalism/Engr & Sci	2
PE	Physical Education[1]	1
Humanities or Social Sciences Elective(s)		3
TOTAL		**17**

Second Semester

MATH 125	Calculus II	4
CENG 244	Intro to Digital Systems	4
CSC 150	Computer Science I	3
PHYS 211	University Physics I	3
PE	Physical Education[1]	1
Humanities or Social Sciences Elective(s)		3
TOTAL		**18**

SOPHOMORE YEAR

First Semester

EE 220	Circuits I	4
MATH 321	Differential Equations	4
CSC 250	Computer Science II	4
CSC 251	Finite Structures	4
TOTAL		**16**

Second Semester

ENGL 279	Tech Communications I	3
EE 221	Circuits II	4
CENG 314	Assembly Language	3
Humanities or Social Sciences Elective(s)		6
TOTAL		**16**

JUNIOR YEAR

First Semester

ENGL 289	Tech Communications II	3
EE 320	Electronics I	4
EE 351	Mechatronics and Measurement Systems	4
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
MATH 225	Calculus III	4
TOTAL		**19**

Second Semester

EE 312	Signals	3.5
CSC 300	Data Structures	4
CENG 342	Digital Systems	4
MATH 381	Intro to Prob Theory/Stats	3
EM 216	Statics and Dynamics	4
TOTAL		**18.5**

SENIOR YEAR

First Semester

EE 311	Systems	3.5
CSC 470	Software Engineering	3
CENG 464	Senior Design I	2
CENG	Elective(s)[2]	4
IENG 301	Basic Engr Economics	2
TOTAL		**14.5**

Second Semester

CENG 465	Senior Design II	2
CSC 456	Operating Systems	4
CENG	Elective(s)[2]	3
CENG	Elective(s)[2]	4
Humanities or Social Sciences Elective(s)		4
TOTAL		**17**

136 credits required for graduation

Curriculum Notes

[1] Music Ensemble courses, (MUEN 101, 121, 122) may be substituted for Physical Education courses for qualified students. Any other substitution must be approved in advance by the Physical Education Department Chair.

[2] Eleven (11) CENG elective credits are required. Total design content of CENG electives must be a minimum of six (6) hours.

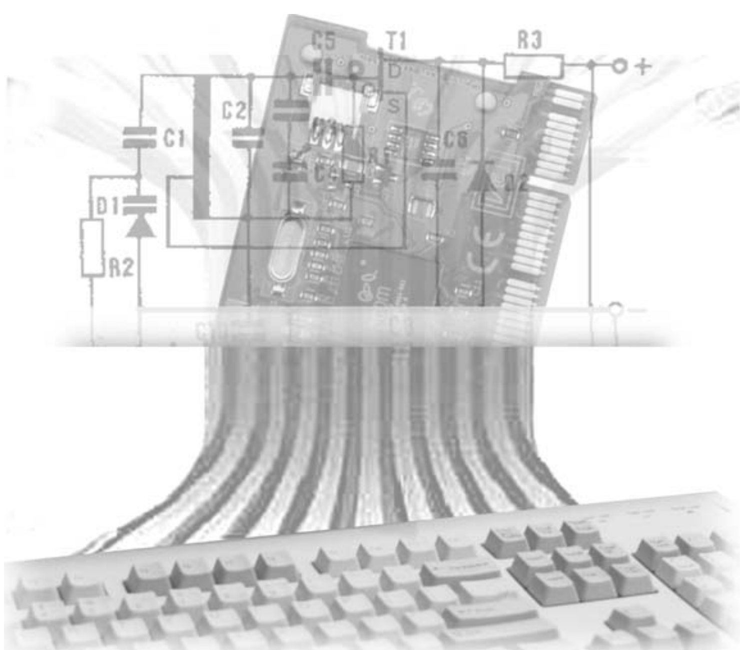
Half of the credits in each of the CENG electives listed below are design credits.

CENG Electives

EE 322	Electronics II	4
EE 421	Communications Systems	4
EE 451	Control Systems	4
CENG 420	Design of Digital Signal Processing Systems	4
CENG 440	VLSI Design	4
CENG 442	Microprocessor Design	4
CENG 444	Computer Networks	4
(credit for only one of CENG 444 or CSC 463 may be used)		
CENG 446	Advanced Computer Architectures	4
(credit for only one of CENG 446 or CSC 440 may be used)		
CENG 447	Embedded and Real-Time Computer Systems	4
CSC 433	Computer Graphics	3
CSC 440	Advanced Digital Systems	4
CSC 463	Data Communications	4
CSC 447	Artificial Intelligence	3
CSC 464	Intro to Digital Image Processing and Computer Vision	3
CSC 476	Theory of Compilers	3

A maximum of four (4) co-op credits may be used towards the CENG elective requirement if a written request presented by the student is approved by the CENG faculty. The student request must justify that the CENG design credit requirement is met.

Computer Engineering students are required to take the Fundamentals of Engineering (FE) exam prior to graduation.



Computer Science

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Professors Carda, Corwin, Logar, and Penaloza; Associate Professors McGough, Weiss; Assistant Professor Hansen; Instructors Manes and Schrader; Emeritus Professor Op.

General Information

The Department of Mathematics and Computer Science offers a Bachelor of Science Degree in Computer Science and a Master of Science Degree in Computer Science. The Bachelor of Science degree in Computer Science is accredited by the Computing Sciences Accreditation Board (CSAB).

Students who desire to major in one of these programs should announce their intention to the Department of Mathematics and Computer Science as early as possible. Students should consult advisors in the department at each registration period before selecting electives to round out the courses of study outlined in the departmental curriculum.

Any student who is pursuing a double major and whose designated advisor is in another department should consult an advisor in the Mathematics and Computer Science Department at each registration.

Laboratories

School of Mines has a variety of computing platforms available. Resources include an extensive PC network, a Linux lab, and a lab equipped with SunRays tied to three Sun Enterprise 450 servers. Other computing resources may be accessed via the Internet. The institution encourages its students to use the computer facilities in the creative and efficient solution of scientific and engineering problems.

COMPUTER SCIENCE MAJOR

The primary goal of the Computer Science program is to prepare the graduate to enter a dynamic and rapidly changing field as a competent computer scientist. We expect our graduates to be capable in all phases of software development including design, development, and testing. We expect our graduates to have a firm understanding of hardware technologies. These capabilities require the graduate to possess good communication skills, both oral and written, and the ability to work effectively as a team member. The graduate must be able to read and comprehend the literature of the discipline and be sufficiently well versed in general theory to allow growth within the discipline as it advances. We expect most of our graduates to pursue careers as software engineers within the computer industry. Some may choose careers as entrepreneurs and others will pursue advanced degrees and careers in research.

Students majoring in Computer Science will use the Computer Science curriculum on the following page. The sample schedule on the following page lists all required classes for the Bachelor's degree in their proper prerequisite sequence. Students should consult course listings for prerequisites and should consult their advisors at each registration.

A Computer Science major must complete thirty (30) total hours in Humanities, Social Science, or other nontechnical disciplines that serve to broaden the background of the student. Within that requirement, the student must complete a minimum of sixteen (16) credits in Humanities and Social Science with at least six (6) credit hours in Humanities and at least six (6) credit hours in Social Science. Refer to the Humanities and Social Sciences section of this catalog for a list of courses satisfying these requirements. It is also important to refer to the General Education Core Requirements under Bachelor of Science Graduation Requirements for further information. Students must complete the General Education Core Requirements within the first sixty-four (64) credits.

Any Computer Science major desiring a minor in another field should consult his or her advisor in the Department of Mathematics and Computer Science as early in his or her program of study as possible. Academic and Enrollment Services has a form that must be signed by the student and the Department Chairs of both departments involved.

MINOR IN COMPUTER SCIENCE

A minor in the Department of Mathematics and Computer Science must be approved by the student's major department. Academic and Enrollment Services has forms that should be completed and signed by the department chairs from both departments involved in this minor. The requirements for a minor in Computer Science are CSC 150, CSC 250, CSC 251, CSC 314, CSC 300, and CENG 244.

COMPUTER SCIENCE AND MATHEMATICS DOUBLE MAJOR

Due to the large number of courses common to the Computer Science major and the Mathematics major, many students find it attractive to pursue a double major in these two areas. Students seeking the double major should consult their advisors for details about this option.

COMPUTER SCIENCE CURRICULUM/CHECKLIST

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

ENGL 101	Composition I	3
CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
MATH 123	Calculus I	4
CSC 150	Computer Science I	3
Humanities or Social Sciences Elective(s)1		3
TOTAL		**17**

Second Semester

MATH 125	Calculus II	4
CHEM 114	General Chemistry II	3
CSC 250	Computer Science II	4
CSC 251	Finite Structures	4
PE	Physical Education	1
TOTAL		**16**

Sophomore Year

First Semester

MATH 225	Calculus III	4
CSC 314	Assembly Language	4
CENG 244	Intro to Digital Systems	4
PE	Physical Education	1
Humanities or Social Sciences Elective(s)[1]		3
TOTAL		**16**

Second Semester

ENGL 279	Technical Communications I	3
CSC 317	Computer Organization and Architecture	4
CSC 300	Data Structures	4
Humanities or Social Sciences Elective(s)[1]		6
TOTAL		**17**

Junior Year

First Semester

ENGL 289	Technical Communications II	3
MATH 321	Differential Equations	4
PHYS 211	University Physics I	3
CSC 372	Analysis of Algorithms	3
Elective or CSC Elective[1]		3
TOTAL		**16**

Second Semester

MATH 315	Linear Algebra	4
MATH 441	Engineering Statistics I	2
MATH 442	Engineering Statistics II	2
CSC 461	Programming Language	3
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
TOTAL		**15**

Senior Year

First Semester

CSC 470	Software Engineering	3
CSC 440	Advanced Digital Systems	4
CSC 484	Database Mgmt Systems	3
Electives or CSC Electives1		6
TOTAL		**16**

Second Semester

CSC 456	Operating Systems	4
CSC 465	Senior Design Project	3
HUM 375	Computers in Society[1]	3
Electives or CSC Electives[1]		5
TOTAL		**15**

128 credits required for graduation

Curriculum Notes

- CSC 470 and CSC 465 form a two-course sequence. It is expected that they will be taken in successive semesters.
- An exit exam, such as the Major Field Achievement Test in Computer Science, will be given as part of CSC 465. The overall results of this exam will be used to assess the Computer Science program.
- CSC 105 may not be counted toward any mathematics, computer science, or engineering degree. Other majors should consult their departments on policy regarding these courses.

[1]Elective courses must be chosen to satisfy all of the following requirements:

1. Sixteen (16) semester hours in Humanities or Social Science. At least six (6) hours must be in Humanities and at least six (6) hours must be in Social Sciences.
2. Six (6) credit hours of Humanities and six (6) credit hours of Social Science must be completed within the first sixty-four (64) hours. It is important to refer to the General Education Requirements under Bachelor of Science Graduation Requirements for further information.
3. Thirty (30) total hours in Humanities, Social Science, or other nontechnical disciplines that serve to broaden the background of the student. This may include all English classes, two (2) credits of Physical Education, and those courses used to meet requirement (1) above.
4. A minimum of three (3) Computer Science elective courses numbered 400 or above must be taken. MATH 471 also counts as a Computer Science elective. A three (3)-credit Co-op may be substituted for one Computer Science elective. Special topics and independent study courses may not be used to satisfy the Computer Science

elective requirement.

Course Offering Schedule

In an attempt to help students plan their future semesters, the following information is presented. This reflects the best available knowledge at the time of the preparation of this document. This is not meant as a guarantee of when classes will be offered. Students concerned about when classes will be offered should contact the Department Chair for any changes to the following. Courses not listed below have no defined rotation and will be offered contingent on demand and staff. Most Computer Science courses are not suitable to offering in an eight-week Summer session. Students should not expect Computer Science offerings in the summer.

Classes that are typically offered every semester include CSC 105, CSC 150, CSC 250, CSC 251, CSC 314, CSC 300, and CSC 456.

Classes that are typically offered every fall semester include CSC 372, CSC 440, CSC 484, and CSC 470.

Classes that are typically offered every spring semester include CSC 317, CSC 461, and CSC 465.

Classes that are typically offered in the fall semester of even numbered years, for example fall 2006, include CSC 421/521, CSC 447/547, and CSC 772.

Classes that are typically offered in the spring semester of odd numbered years, for example spring 2005, include CSC 445/545, CSC 410/510, CSC 761, and MATH 471.

Classes that are typically offered in the fall semester of odd numbered years, for example fall 2007, include CSC 464/564, CSC 476, and CSC 784.

Classes that are typically offered in the spring semester of even numbered years, for example spring 2006, include CSC 433/533, CSC 463/563, and CSC 762.

Electrical Engineering

CONTACT INFORMATION

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FACULTY

Professor Hasan, Chair; William J. Hoffert Professor Simonson; Steven P. Miller Endowed Chair and Professor Whites; Professors and Batchelder; Associate Professor Hemmelman; Assistant Professors Chen, Montoya, and Zhang; and Instructors Jensen and Linde.

ELECTRICAL ENGINEERING

The Electrical Engineering curriculum is principally oriented toward preparing students for a career by providing them with the engineering and technical education appropriate to meet modern technological challenges. The basic curriculum includes required course work in mathematics, basic sciences, humanities, social sciences, and fundamental engineering topics in circuit analysis, electronics, electrical systems, electromagnetics, energy systems, and properties of materials. Electrical Engineering students are required to select three (3) senior elective courses from a wide variety of subject areas to fit their particular interests. Elective subject areas include communication systems, power systems, control systems, optoelectronics, and computer systems.

The undergraduate curriculum is designed to provide Electrical Engineering students with an education that is broadly based in the fundamentals of the profession so that they will be able to maintain a high degree of adaptability throughout their professional career. It is also intended that the student will develop a dedication to the profession and an ability to maintain professional competency through a program of life-long learning.

Mission

The mission of the Electrical Engineering Program, in support of the mission of School of Mines, is to provide Electrical Engineering students with an education that is broadly based in the fundamentals of the profession so that graduates will be able to maintain a high degree of adaptability throughout their professional career. It is also intended that the students will develop a dedication to the profession and an ability to maintain professional competency through a program of lifelong learning.

Objectives

1. Graduates will be able to successfully practice electrical engineering and related fields regionally and nationally.

2. Graduates will be well-educated in the fundamental concepts of electrical engineering and able to continue their professional development throughout their careers.

3. Graduates will be skilled in clear communications and teamwork and capable of functioning responsibly in diverse environments.

Program Strengths

A two-semester capstone design experience requires Electrical Engineering students to conduct their own design project in a simulated industrial environment. They are encouraged to work on team projects and often the team projects are multidisciplinary. This foundation provides students with a broad base of understanding that allows them to apply their knowledge of scientific and engineering principles to the practical and innovative solutions of existing and future problems.

Students are required to develop a high level of written and oral communication skills and to work well as a member of a team. They must develop a social and ethical awareness so they understand their responsibility to protect both the occupational and public health and safety and to implement these factors in their professional activities. Students are encouraged to participate in the activities of professional societies, such as the Institute of Electrical and Electronics Engineers and Eta Kappa Nu, to enhance their educational and social life while on campus and to gain professional contacts for their careers. Students have opportunities to participate in cooperative education and summer intern programs whereby they elect to seek employment to experience engineering work before they complete their degree requirements. Students gain insight into future opportunities and are often hired by their intern companies after graduation.

Integration of Design Concepts

One of the key elements of the undergraduate Electrical Engineering education experience is to integrate design throughout the curriculum. Students experience various design concepts in a variety of settings:

- Hands-on laboratory projects (including team projects);
- Effective integration of computer applications;
- Development of effective communication skills;
- Senior elective course;
- Senior capstone experience; and
- Participation in competitive team projects such as the Robotics team, the Solar Car Team, the Unmanned Aerial Vehicle team, and the Formula SAE Mini-Indy team.

Graduate School Opportunities

Since the undergraduate curriculum is broad based, it is impossible to study areas of interest in very much depth. Qualified students may specialize further by pursuing a graduate program at School of Mines or any of the nation's major universities.

Laboratories

The Electrical and Computer Engineering Department houses well-equipped laboratories designed to give students easy access to experimental support for their theoretical studies. Junior and senior laboratory projects are conducted on an open laboratory basis that allows students to schedule experimental work at their own convenience. Laboratory facilities are open to students and are supervised until 10 p.m. on most weeknights.

Four general-purpose laboratories are fully equipped to provide facilities for experiments in such diverse areas as communication systems, control systems, electromechanics, energy conversion, digital circuits, and electronics. These laboratories can also be used to provide hands-on experience under the direct supervision of Electrical and Computer Engineering faculty. In addition, there are special-purpose laboratories serving the fields of power systems, optoelectronics, thin-film electronic materials, solid state devices, analog and digital systems, mechatronics, real-time embedded systems, computer instrumentation, microprocessor development and fabrication, reconfigurable logic, and parallel processing and cluster computing (in conjunction with the Mathematics and Computer Science Department).

A project room has recently been completed. Seniors and graduate students have access to this facility to work on senior design and graduate thesis projects. The work area allows them a convenient place in which to work for the duration of their project.

NOTES ON ELECTRICAL ENGINEERING COURSES

Classes that are typically offered every semester include EE 220, EE 221, EE 301, EE 351, EE 464, and EE 465.

Classes that are typically offered every fall semester include EE 311, EE 320, EE 381, EE 421, EE 431, EE 461, and EE 481.

Classes that are typically offered every spring semester include EE 312, EE 322, EE 330, EE 362, EE 451, and EE 382.

Classes that are typically offered in the fall semester of even numbered years, for example fall 2004, include EE 482.

Classes that are typically offered in the fall semester of odd numbered years, for example fall 2005, include EE 432.

ELECTRICAL ENGINEERING CURRICULUM/CHECKLIST

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

FRESHMAN YEAR

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
ENGL 101	Composition I	3
CHEM 112L	General Chemistry I Lab	1
GES 115	Professionalism/Engr & Sci	2
Humanities or Social Sciences Elective(s)		3
PE	Physical Education[1]	1
TOTAL		**17**

Second Semester

MATH 125	Calculus II	4
PHYS 211	University Physics I	3
PE	Physical Education[1]	1
CSC 150	Computer Science I	3
CENG 244	Intro to Digital Systems	4
Humanities or Social Sciences Elective(s)		3
TOTAL		**18**

SOPHOMORE YEAR

First Semester

EE 220	Circuits I	4
MATH 321	Differential Equations	4
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
Humanities or Social Sciences Elective(s)		3
TOTAL		**15**

Second Semester

ENGL 279	Technical Communications I	3
EE 221	Circuits II	4
EM 216	Statics and Dynamics	4
MATH 225	Calculus III	4
EE 351	Mechatronics and Measurement Systems	4
Humanities or Social Sciences Elective(s)		3
TOTAL		**18**

JUNIOR YEAR

First Semester

ENGL 289	Tech Communications II	3
EE 311	Systems	3.5
EE 320	Electronics I	4
EE 381	Electric and Magnetic Fields	3
EM 216	Statics and Dynamics	4
TOTAL		**17.5**

Second Semester

EE 312	Signals	3.5
EE 322	Electronics II	4
EE 330	Energy Systems	4
EE 362	Electric and Magnetic Properties of Materials	3
Approved Math Elective[2]		3
TOTAL		**17.5**

SENIOR YEAR

First Semester

IENG 301	Basic Engr Economics	2
PHYS 341	Thermodynamics	3
EE 464	Senior Design I	2
EE	Electrical Engr Elective[3]	4
EE	Electrical Engr Elective[3]	4
Free Elective[4]		3
TOTAL		**18**

Second Semester

EE 382	Applied Electromagnetics	3
EE 465	Electrical Engr Design II	2
EE	Electrical Engr Elective[3]	3
Technical Elective[5]		3
Humanities or Social Sciences Elective(s)		4
TOTAL		**15**

136 credits required for graduation

Curriculum Notes

[1] Music Ensemble courses, (MUEN 101, 121, 122) may be substituted for Physical Education courses for qualified students. Any other substitutions must be approved in advance by the Physical Education Department Chair.

[2] MATH 315, 373, 381, and 441/442 are approved electives.

[3] Total design content of electrical engineering electives must be a minimum of six (6) hours. CENG 342, 420, 442, 444, 446, and 447 each have two (2) design credits and are acceptable EE electives. A maximum of four (4) co-op credits may be used towards the EE elective requirement if a written request presented by the student is approved by the ECE faculty. The student request must justify that the EE design credit requirement is met.

[4] A free elective is any college level course 100 level or above that is acceptable toward an engineering or science degree. Military Science courses, 100 level and above, apply as free electives only; substitution for departmental, humanities, or social science electives is not permitted.

[5] A technical elective is any 200 level or above science or engineering course that does not duplicate the content of any other course required for graduation. Co-op credits may be used for technical elective credit. A maximum of six (6) co-op credits may be used for the EE degree.

Electrical Engineering students are required to take the FE (Fundamentals of Engineering) exam prior to graduation.

Environmental Engineering

CONTACT INFORMATION

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STEERING COMMITTEE

Professor Mott, Program Coordinator; Professors Davis, Kellar, Kliche, and Winter; Assistant Professor Stone.

ENVIRONMENTAL ENGINEERING

Environmental engineers serve our society at the most fundamental level in caring for the air we breathe, the water we drink, and the soil in which we grow our food. Environmental engineers solve existing and prevent future environmental problems. Students in the B.S. Environmental Engineering program will be educated in higher mathematics, basic sciences, engineering sciences, and engineering design. The experience will be augmented by "hands-on" laboratory courses at the freshman through senior levels. Students will use computers in virtually all engineering course work. Fundamental environmental engineering course work will involve heat and mass transfer, classical and chemical thermodynamics, ground-water and surface-water hydrology, and environmental systems analysis. Each student will participate in a two-semester capstone design experience that will involve work with a multidisciplinary team on the solution to a significant environmental problem. In order to develop a technical link with one of five disciplines closely related to environmental engineering, each student will opt for an emphasis consisting of four (4) to five (5) required and elective courses, delivered by the respective discipline. This course work prepares the student to cooperatively work alongside engineers of the emphasis discipline in solution of environmental problems. Emphasis areas include:

1. Chemical Engineering - The application of chemical, chemical engineering, and environmental engineering principles to the environmentally safe production of a wide range of products including pharmaceuticals for human consumption, materials for electronic applications, and energy to power our society.
2. Civil Engineering - Engineering of our society's infrastructure through treatment of water for potable use, renovation of waste waters generated by domestic and industrial users, safe handling (both disposal and recycling) of solid and hazardous wastes generated by society, clean-up of existing environmental pollution, and general stewardship of the Earth's land and water resources.
3. Geological Engineering - Engineering for the environmentally sound use and conservation of the Earth's natural resources including development of ground-water supplies, cleanup of

contaminated aquifers, isolation of hazardous wastes, and exploration for and development of mineral or petroleum resources.
4. Materials and Metallurgical Engineering - Development and implementation of environmentally sound processes for producing the metals, ceramics, and composite materials used by our society, and leadership in the area of recycling of materials for re-use by society.
5. Mining Engineering - The development of mining and reclamation plans that ensure environmentally sound mining operations and that the Earth and oceans are returned to environmentally acceptable conditions upon the completion of mining activities.

The objective of the Environmental Engineering Program with regard to undergraduate education is to provide graduates with an educational foundation that will enable them to engage in the professional practice of environmental engineering within the public or private sector, or complete advanced studies either in environmental engineering or a related professional discipline.

Graduates of this program are expected to:
1. Ethically apply principles from mathematics, science, engineering, humanities, and social sciences, as appropriate in applicable global and contemporary societal contexts, to the definition, formulation, and solution of both existing and potential environmental problems.
2. Develop, interpret, and utilize appropriate laboratory process data; think critically; and use modern engineering skills, techniques, and tools in the iterative decision-making process associated with environmental engineering design.
3. Work and learn, on a lifelong basis, both independently and cooperatively with peers.
4. Communicate the results of their work and their ideas effectively, both orally and in written form, to peers and to non-technical audiences.

A minor is not available in Environmental Engineering.

COOPERATIVE EDUCATION PROGRAM

Students may participate in the Cooperative Education Internship Program. Within the limits specified by each emphasis, these credits may be applied toward elective requirements.

LABORATORIES

Laboratories maintained by the Chemical, Civil and Environmental, Geological, Materials and Metallurgical, and Mining Engineering programs are equipped with up-to-date analytical instrumentation. Descriptions of these laboratories are given elsewhere in respective sections of this catalog. These laboratories are utilized both in graduate and undergraduate research and in association with undergraduate courses to enhance student understanding of critical phenomena. Computational laboratories maintained by all five (5) programs are equipped with up-to-date personal and workstation computing equipment. These computers are networked with the university's file server.

ENVIRONMENTAL ENGINEERING CURRICULUM/CHECKLIST

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

FRESHMAN YEAR

First Semester

ENGL 101	Composition I	3
CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
MATH 123	Calculus I	4
GES 115	Professionalism in Engineering and Science	2
Humanities or Social Sciences Elective(s)		3
PE	Physical Education[8]	1
TOTAL		**17**

Second Semester

CHE 111	Intro. Engr Modeling	1
CHEM 114	General Chemistry II	3
CHEM 114L	General Chemistry II Lab	1
CHE 117	Prof Pract in ChE[6]	2
MATH 125	Calculus II	4

PHYS 211 University Physics I 3
Gen Ed Humanities or Social Sci. elective 3
PE Physical Education[8] 1
TOTAL 18

SOPHOMORE YEAR

First Semester

ENVE 217 Chem Engr. I 3
MATH 225 Calculus III 4
CHEM 230 Analytical Chemistry I 2
ENGL 279 Tech. Communications I 3
BIOL 341 Microbial Processes in Engineering and Nat. Science 3
Humanities or Social Sciences Elective(s) 3
TOTAL 18

Second Semester

PHYS 213 University Physics II 3
GEOE 221 Geology for Engineers 3
Engineering Mechanics[1] 4
MATH 321 Differential Equations 4
Gen Ed Humanities or Social Sci. elective 3
Laboratory Elective[7] 1
ENVE 290 Seminar 0.25
TOTAL 18.25

JUNIOR YEAR

First Semester

ENGL 289 Tech. Communications II 3
IENG 301 Basic Engr. Economics 2
CHEM 316 Fund. of Org. Chem. 3
ENVE 315 Fund. of Heat Transfer[2] 2
ENVE 320 Thermodynamics[3] 4
ENVE 326 Environmental Engineering Process Fund 3
TOTAL 17

Second Semester

CHE 250 Computer Applications in Chemical Engineering[6] 2
ENVE 318 Chemical Engr. IV[2] 3
EnvE 327/327L Intro Env. Eng. Design 3
EM 328 Applied Fluid Mechanics[4] 3
Statistics[9] 2
EnvE 290 Seminar 0.25
Emphasis elective(s)[5] 3
TOTAL 16.25

SENIOR YEAR

First Semester

ENVE 421 Environ Systems Analysis 3
EnvE 429L Land Systems Laboratory 1
ENVE 475 Ground Water 3
ENVE 464 Envr Engr Design I 2
Emphasis elective(s)[5] 7
TOTAL 16

Second Semester

ENVE 337 Engineering Hydrology 3
ATM 405 Air Quality 3
ENVE 465 Envr Engr Design II 2
EnvE 490 Seminar 0.5
Emphasis elective(s) (5) 3
Humanities or Social Sciences Elective 4
TOTAL 15.5

136 credits are required for graduation

Curriculum Notes

[1] EM 217 or EM 216, or a combination of EM 214/321, EM 214/215, or EM 214/ME 221 will satisfy the engineering mechanics requirements.

[2] MET 422 will satisfy the requirements for transport phenomena for the materials and metallurgical emphasis only.

[3] CHE 222 and CHE 321 will satisfy the thermodynamics requirement.

[4] CHE 218, EM 331, or ME 331 will also satisfy fluid mechanics requirements.

[5] Each student must select preparatory and upper division specialty course work totaling seventeen (17) credits. (See emphasis areas below).

[6] CEE 284 (4 cr.) would meet the combined requirement for ChE 117-ChE 250, four (4) credits total. Math 373 three (3) credits could be substituted for ChE 250 two (2) credits.

[7] Biol 231L, or Chem 332L will satisfy this requirement.

[8] Music Ensemble courses may be substituted for Physical Education courses for qualified students. Any other substitutions must be approved in advance by the Physical Education Department Chair.

[9] A minimum of two (2) credits algebra-based appllied statistics must be completed.

ENVIRONMENTAL ENGINEERING EMPHASIS AREAS

Chemical Engineering

Required course work

Sub CHE 222 & ChE 321 for ENVE 320 2
BIOL 232 General Microbiology Lab *and*

CHEM 332L	Analytical Chemistry I Lab[1]	1
ENVE 455	Pollution/Phenonema/Process Design	3
CHEM 480	Toxicology **OR**	3
CHEM 482	Environmental Chemistry	3
CHE 492[2]	Special Topics in ChE Lab(1 or 2)	
CHE 343[2]	Chemical Kinetics and Reactor Design **OR**	3
CHE 417[2]	Chemical Engineering V	2

[1] The combination of these two (2) courses also satisfies the laboratory elective requirement.

[2] Election of ChE 343 would require a minimum of one (1) credit of Special Topics in ChE Lab; election of ChE 417 would require a minimum of two (2) credits of Special Topics in ChE Lab.

Civil Engineering

Required course work

ENVE 426	EnvE Phys/Chem Proc Des	3
ENVE 426L	EnvE Phys/Chem Proc Lab	1
ENVE 427	EnvE Bio. Proc. Des.	3
ENVE 427L	EnvE Bio. Proc. Des. Lab	1
ENVE 428	Adv Treatment Plant Design	3

A minimum of two (2) credits from the following:

CEE 433	Open Channel Flow	3
CEE 435	Water Res Sys Mgmt	3
CEE 437	Watershed/Floodplain Mod	3
CEE 474	Engr Project Management	3
CHE 417	Chemical Engineering V	2
CHE 443	Chem Kinetics/Reactor Des	3
ENVE 498	Undergraduate Research	var.
ENVE 455	Pollution Phenom/Process	3
ENVE 491	Indep Study	var.
CHEM 480	Toxicology	3
CHEM 482	Environmental Chemistry	3
GEOE 324	Engineering Geophysics	3
GEOE 466	Engr and Env Geology	3
ENVE 220	Mineral Processing and Resource Recovery	4
ENVE 310	Aqueous Extrac/Conc/Recy	3
ENVE 310L	Aq Extrac/Conc/Recy Lab	1
ENVE 433	Comp App in Geosci Mod	4
ENVE 440	Env/Recl Prac in Min Ind	3
ENVE 491	Indep Studies in Envr Engr	var.

Geological Engineering

Required course work

GEOL 212	Min. & Crystallography	3
GEOE 322	Structural Geology	3
GEOL 341	Elem. Petrology	3

Four (4) credits from the following:

GEOE 324	Engineering Geophysics	3
CEE 437	Watershed/Floodplain Mod	3
GEOE 466	Engr and Env Geology	3
GEOE 482	Applied Geomorphology	3
ENVE 498	Undergraduate Research	1 or 2
GEOE 498	Undergraduate Research	1 or 2

Materials and Metallurgical Engineering

Required course work

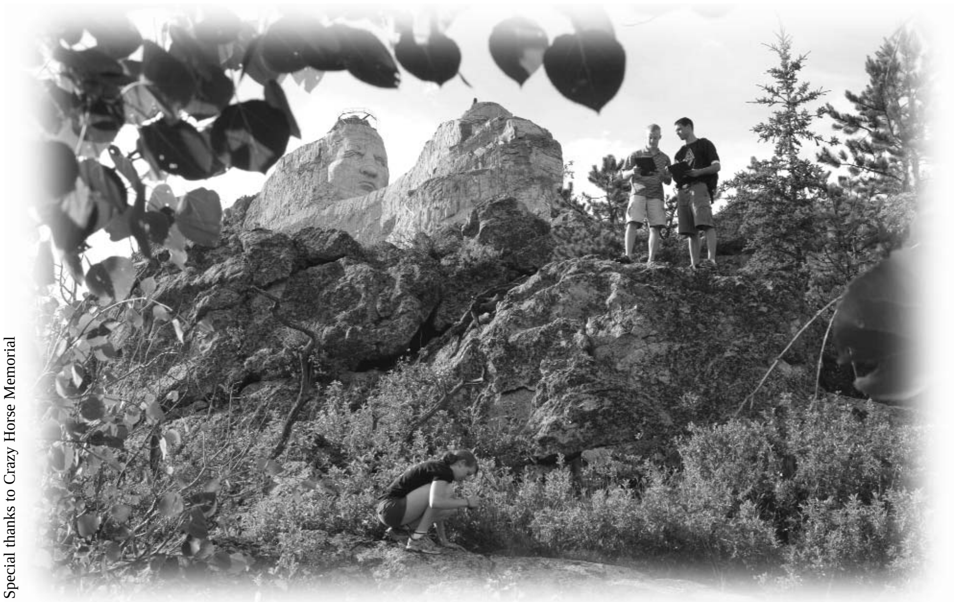
sub. MET 422 for ENVE 315 and ENVE 318[1]		1
ENVE 220	Mineral Processing and Resource Recovery	4
ENVE 310	Aq Extrac/Conc/Recy	3
ENVE 310L	Aq Extrac/Conc/Recy Lab	1
ENVE 321	High Temp Extrac/Conc/Recy	4
ENVE 445	Oxid and Corr of Metals	3

[1] ENVE 315 and ENVE 318 (five (5) credits total) are the typical required courses. For the Materials and Metallurgical Engr. emphasis substitute MET 422 (four (4) credits).

Mining Engineering

MEM 120	Intro to Mining & Sustainable Development	2
MEM 204	Surface Mining Methods and Equipment	3
MEM 304	Mineral Economics and Finance	3
MEM 307	Mineral Exploration and Geostatistics	2
MEM 405	Mine Permitting and Reclamation	3

Geological Engineering



Special thanks to Crazy Horse Memorial

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Faculty

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Supporting Faculty

Professors Duke, Fox, Hladysz, Lisenbee, and Paterson; Associate Professor Price; Adjunct Professor Long.

Geological Engineering

Geological engineering is the development and conservation of natural resources in ways useful to mankind. It encompasses diverse fields such as ground-water resources, subsurface contamination, slope stability, environmental site investigations, petroleum exploration and production, and minerals. The instruction in geological engineering provides training at both the undergraduate and graduate levels through the Ph.D.

Geological Engineering Program Objectives

The objectives of the program in geological engineering are to provide students with: 1) an understanding of the fundamental principles of geological engineering, basic engineering, and geology, and 2) academic training and design experiences to prepare them for practice in the geological engineering profession. This education also prepares them to continue with graduate studies, if they desire.

Graduates of the geological engineering program are expected to be competent for entry-level professional practice in the areas of 1) ground water, 2) environmental site planning and natural hazards, 3) geomechanics and geotechnics, and 4) exploration for and development of fuels or minerals. In the senior year, students select two of these four main areas of emphasis, depending on their interests and career objectives. Studies in these areas culminate in major engineering design experiences to help bridge the gap between education and professional practice. Graduates of the program who obtain employment in their area of expertise are expected to advance more rapidly than their peers who do not have similar specialized training.

GEOLOGICAL ENGINEERING EDUCATION

An integral part of the educational experience is development of the ability to design solutions for meeting desired needs in geological engineering work. The design component of the curriculum is developed within geological engineering courses that integrate basic science (including geology, chemistry, and physics) and engineering science (including statics, mechanics of materials, fluid mechanics, soil mechanics, and thermodynamics). This engineering design experience includes a two-semester capstone design sequence. The capstone engineering design courses build upon and integrate previous course work in helping to prepare graduates for the professional practice of geological engineering.

The nature of geological engineering is continually evolving as the needs of employers change in response to advances in technology and economic forces. To prepare adequately for careers in geological engineering, students must be willing to engage in lifelong learning in order to embrace new technologies and to stay current within the engineering profession. Graduates with a broad range of skills, flexibility in learning new technologies, and sound training in fundamental principles can expect a competitive advantage in the job market and workplace.

The Bachelor of Science program in geological engineering is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

A minor in geological engineering is not available.

PROFESSIONAL DEVELOPMENT

Students in geological engineering are encouraged to participate in the Student Chapter of the Association of Engineering Geologists as well as to become student members of the National Ground Water Association, the Society for Mining, Metallurgy, and Exploration (SME), and the Society of Petroleum Engineers (SPE). Students are strongly encouraged to take the Fundamentals of Engineering examination, as the first step in becoming a registered professional engineer.

GEOLOGICAL ENGINEERING LABORATORIES

The Department of Geology and Geological Engineering has laboratory facilities that include a digital and analytical modeling laboratory, a Geographic Information Systems (GIS) laboratory, a ground-water laboratory, a wind engineering laboratory, a geotechnics laboratory, a drilling fluids laboratory, and an operational well field with data loggers and transducers. Instrumentation includes ground-probing radar, a hydrologic analysis system, a portable wind tunnel, a mobile drilling rig, and petroleum engineering equipment. The computer laboratory is continually updated and contains high-speed computers with GIS and other analytical capabilities. Programs are available for digital modeling of ground-water flow and contaminant migration, petroleum engineering, slope stability, geophysical applications, geochemical modeling, and spreadsheet applications.

GEOLOGICAL ENGINEERING CURRICULUM/CHECKLIST

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

FRESHMAN YEAR

First Semester

CHEM 112	General Chemistry I	3
MATH 123	Calculus I	4
ENGL 101	Composition I	3
GES 115	Professionalism/Engr and Sci	2
Humanities or Social Sciences Elective(s)		6
TOTAL		**18**

Second Semester

CHEM 112L	General Chem I Lab	1
CHEM 114	General Chemistry II	3

MATH 125	Calculus II	4
PHYS 211	University Physics I	3
GEOE 221	Geology for Engineers	3
CEE 117	Computer Aided Design and Interpretation in Civil Engr.	2
TOTAL		**16**

Sophomore Year

First Semester

EM 214	Statics	3
MATH 225	Calculus III	4
MEM 201	Mine Surveying	2
PE	Physical Education	1
PHYS 213	University Physics II	3
Humanities or Social Sciences Elective(s)		3
TOTAL		**16**

Second Semester

ENGL 279	Technical Communications I	3
EM 321	Mechanics of Materials	3
GEOL 212	Mineralogy/Crystallography	3
MATH 321	Differential Equations	4
PE	Physical Education	1
Humanities or Social Sciences Elective(s)		3
TOTAL		**17**

Junior Year

First Semester

ENGL 289	Technical Communications II	3
GEOL 331	Stratigraphy & Sedimentation	3
GEOL 341	Elementary Petrology	3
CEE 346	Geotechnical Engineering	3
MET 320	Met Thermodynamics	4
TOTAL		**16**

Second Semester

GEOE 322	Structural Geology	3
GEOE 324	Engineering Geophysics I	3
EM 328	Applied Fluid Mechanics	3
Approved Elective[1]		3
MINE 302	Mineral Economics and Finance	3
Humanities or Social Sciences Elective(s)		1
TOTAL		**16**

Summer

GEOE 410	Engineering Field Geology	6
TOTAL		**6**

Senior Year

First Semester

GEOE 466	Engr and Envr Geology	3
GEOE 475	Ground Water	3
GEOE 461	Petroleum Production[2]	3
GEOE 464	Geol Engr Design Project I	3
GEOL 416	GIS I: Intro to GIS	3
TOTAL		**15**

Second Semester

MINE 411	Rock Mechanics I	4
Professional Electives[3]		6
GEOE 465	Geol Engr Design Project II	3
Humanities or Social Sciences Elective(s)		3
TOTAL		**16**

136 credits required for graduation

Curriculum Notes

[1] Approved Elective. Must be a course approved by the Department of Geology and Geological Engineering.

[2] Students interested in mineral exploration may substitute GEOE 451 for GEOE 461.

[3] Professional Electives. Students may choose two of the following courses:

GEOE 451	Economic Geology
GEOE 425	Engineering Geophysics II
GEOE 462	Drilling Engineering
GEOE 482	Applied Geomorphology
ENVE 326	Environmental Engineering Process Fundamentals
ENVE 421	Environmental Systems Analysis
CEE 337	Engineering Hydrology
CEE 347	Geotechnical Engineering II
CEE 437	Watershed and Floodplain Modeling
CEE 447	Foundation Engineering
CEE 474	Engineering Project Management
ME 351	Mechatronics and Measurement Systems (cross-listed with EE 351)
MEM 433	Computer Applications in Geoscience Modeling
MINE 440	Environmental and Reclamation Practices in the Mining Industry
MINE 450	Rock Slope Engineering
MINE 471	Theory and Application of Explosives

Additional course work in mathematics and statistics is encouraged. MATH 381 and MATH 382 are recommended statistics courses; MATH 432 is recommended for students interested in numerical modeling of partial differential equations.

Industrial Engineering

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Faculty

Ervin Pietz Professor Kellogg, Chair; Associate Professors Kerk and Matejcik; Assistant Professor Karlin.

The Bachelor of Science program in Industrial Engineering is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

Industrial Engineering

Industrial Engineering is concerned with the design, improvement, and installation of integrated systems of people, material, and equipment. The Industrial Engineer employs a set of skills that includes mathematical modeling, probability and statistics, computer science, human factors, and interpersonal skills. Thus, Industrial Engineering may be thought of as applied problem solving, from inception to implementation.

Industrial Engineering Program Objectives

The objectives of the Industrial Engineering program are to produce graduates who:

• contribute to the success of companies through effective problem solving.
• design, develop, implement, and improve integrated systems that include people.
• materials, information, equipment, and environments.
• effectively manage business operations and project management teams.
• continue to develop the personal and professional skills necessary to adapt to our changing societal, technological, and global environments.

Graduates of the Industrial Engineering program are expected to be competent for entry

level professional practice and will:
- possess basic scientific and mathematical competence.
- be able to conduct experiments and analyze data.
- have technical and computer competence.
- be able to communicate effectively.
- be able to work effectively on a professional team.
- understand business and management functions.
- be able to design a system.
- have an understanding of professional and ethical responsibility.

INDUSTRIAL ENGINEERING EDUCATION

The curriculum in the Industrial Engineering Department is designed to give the student a thorough knowledge in the fundamental principles within the four primary stems of Industrial Engineering: operations research and optimization, manufacturing, statistical processes, and human factors.

Throughout the program of studies, special emphasis is placed upon application of systems principles in engineering design to assure proper integration of the individual (or individuals), procedures, materials, and equipment. Concepts of systems oriented design are integrated throughout the curriculum through:

- An effective integration of computer applications and technology;
- Development of effective communication skills and teaming;
- Improved understanding of engineering design and theory through hands-on laboratory experience and team projects; and
- An emphasis on business and managerial aspects of design through development of an entrepreneurial business plan.

Students may participate in the Cooperative Education Internship Program. The co-op credits may count as approved engineering elective courses.

INDUSTRIAL ENGINEERING LABORATORIES

Laboratories are utilized for courses in work methods and measurements, and in human factors, and in Computer Controlled Manufacturing. The major amount of laboratory activity, however, is involved in the senior design courses. Insofar as possible, these design projects utilize the facilities of local industries, service organizations, governmental agencies, and other types of business. In addition, modern computer facilities, including "workstations," are used for many of the courses.

INDUSTRIAL ENGINEERING CURRICULUM/CHECKLIST

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

FRESHMAN YEAR

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
Humanities or Social Sciences Elective(s)		3
PE	Physical Education[1]	1
ENGL 101	Composition I	3
CHEM 112L	General Chemistry I Lab	1
GES 115	Professionalism/Engr and Sci	2
TOTAL		**17**

Second Semester

MATH 125	Calculus II	4
PHYS 211	University Physics I	3
PE	Physical Education[1]	1
ME 110	Intro to Mechanical Engr	2
PSYC 101	General Psychology	3
Humanities or Social Sciences Elective(s)		3
TOTAL		**16**

SOPHOMORE YEAR

First Semester

EM 216	Statics and Dynamics	4
ENGL 279	Technical Communications I	3
MATH 225	Calculus III	4
IENG 381	Intro to Probability and Stats	3
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
TOTAL		**18**

Second Semester

IENG 382	Probability Theory and Stats II	3
MATH 321	Differential Equations	4
ACCT 211	Principles of Accounting II	3
IENG 302	Engineering Economics	3

Math/Science Elective		3
Humanities or Social Sciences Elective(s)		3
TOTAL		**19**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II	3
IENG 311	Work Methods and Measurement	3
IENG 486	Statistical Quality and Process Control	3
IENG 345	Entrepreneurship	4
IENG 362	Stochastic Models	3
Humanities or Social Sciences Elective(s)		2
TOTAL		**18**

Second Semester

IENG 441	Simulation	3
MATH 353	Linear Optimization	3
IENG 321	Human Factors Engineering	3
EE 301	Intro Circuits, Machines, Syst	4
MET 232	Properties of Materials	3
TOTAL		**16**

SENIOR YEAR

First Semester

IENG 425	Production and Operation	3
IENG 331	Safety Engineering	3
IENG 471	Facilities Planning	3
IENG 464	Senior Design Project I	3
Dept. Approved Electives		6
TOTAL		**18**

Second Semester

IENG 366	Management Processes	3
IENG 465	Senior Design Project II	3
IENG 475	Computer Controlled Manuf	3
Humanities or Social Sciences Elective(s)		2
Department Elective		3
TOTAL		**14**

136 credits required for graduation

Curriculum Notes

[1] Music Ensemble courses may be substituted for Physical Education courses for qualified students. Any other substitutions must be approved in advance by the Physical Education Department Chair.

Elective courses must be chosen to satisfy all of the following requirements:

1. Sixteen (16) semester hours in Humanities or Social Science. At least six (6) hours must be in Humanities and at least six (6) hours must be in Social Sciences. This may include PSYC 101, which is required.
2. Six (6) hours of Humanities or Social Science must be included in the list of approved Cultural Diversity courses.
3. At least three (3) hours of Humanities or Social Science must be at the 300 or 400 level.

Mines Matters: During Engineers Week held annually at the School of Mines, more than 100 children use interlocking blocks to construct buildings of all shapes and uses during the Kids' Block Contest.

Mechanical Engineering

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Mechanical Engineering

Mechanical Engineering is a very broad field that provides opportunities for interesting and challenging work in every phase of modern technology. The curriculum in the Mechanical Engineering Department is designed to give the student a thorough knowledge of the fundamental principles of engineering and science within the major areas of mechanical engineering: manufacturing, mechanical systems, and thermal science and energy. Beyond this basic foundation, the curriculum also develops:

1. The various aspects of engineering design including design theory and teamwork;
2. An effective integration of computer technology;
3. Communication skills and effective presentations; and
4. Improved understanding of engineering theory through hands-on laboratory experience.

In the senior year, the students select from course electives that best reflect their interests and career objectives. Students may select courses from one or more of the following general areas:

1. Manufacturing, *e.g.*, control, design, development, and manufacture of diverse equipment and processes;
2. Mechanical Systems/Design, *e.g.*, design of machines and structures; and
3. Thermal Science/Energy, *e.g.*, heating/air conditioning and power systems design

Mission

The mission of the Mechanical Engineering program is to prepare our graduates for a lifetime of success in the mechanical engineering profession by:

- Providing a quality engineering education, primarily to regional residents, emphasizing individual development and concluding with entry into graduate school or a broad spectrum of engineering positions predominately within the manufacturing industry.

- Providing a curriculum committed to the philosophy of teamwork and collaboration in a diverse, multidisciplinary, global society, while promoting the merits of lifelong learning.

Objectives

We realize that building upon traditions of excellence requires continual development of active partnerships among the faculty, the students, and our constituents. In keeping with these objectives, the mechanical engineering program produces graduates who are able to perform at a level that meets or exceeds industry expectations. Our students will be able to achieve the objectives listed below within a few years of graduation through attainment of the outcomes listed below at the time of graduation.

Objective (1) Work effectively in an evolving engineering environment by:
Outcomes
- Possessing a solid foundation in engineering science and mathematics;
- Adapting to changing needs of management and society;
- Effectively managing multi-task assignments and working on multi-disciplinary teams.

Objective (2) Understand, learn, and apply evolving technology by:
Outcomes
- Applying modern engineering software and computational tools;
- Applying modern communication software;
- Applying modern data acquisition software and hardware.

Objective (3) Communicate effectively in inter-disciplinary environments by:
Outcomes
- Applying effective written and oral communication skills;
- Understanding the dynamics of multi-disciplinary groups;
- Being aware of societal norms and engineering ethics.

Students may participate in the Cooperative Education Internship Program. In some instances, credits earned during the co-op may be applied toward department elective requirements.

In the graduate program, the department directs study in the same three (3) fields of emphasis described above. A thesis or a non-thesis program may be selected. A "fast-track" program for the Master of Science degree is available, which streamlines the advanced degree process for undergraduates wherein undergraduates may take graduate courses for eventual graduate school credit. (See details in the graduate section of this catalog.)

The Mechanical Engineering department does not offer a minor.

Mechanical Engineering Laboratories

There are several undergraduate laboratories in the Department, including mechanical systems and instrumentation, thermal and fluid systems, manufacturing, robotic systems, and vibrations. Laboratories are updated with personal computers, peripherals, and data acquisition equipment.

Graduate research laboratories and resources include: advanced workstation computer facilities, equipment for modern digital controls, machine vision systems, image analysis equipment, structural testing and analysis equipment, compliant structures and computational solid mechanics, fluid mechanics, and heat transfer codes on the workstation facilities.

Mechanical Engineering Curriculum/Checklist

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

Freshman Year[1]

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
GES 115	Professionalism/Engr and Sci	2
ENGL 101	Composition I	3
PE	Physical Education[2]	1
Humanities or Social Sciences Elective(s)		3
TOTAL		**17**

Second Semester

MATH 125	Calculus II	4
PHYS 211	University Physics I	3
ME 110	Intro to Mechanical Engr.	2
PE	Physical Education[2]	1
Humanities or Social Sciences Elective(s)		6
TOTAL		**16**

Sophomore Year

First Semester

EM 214	Statics	3
ENGL 279	Technical Communications I	3
ME 262	Product Development	4
MATH 321	Differential Equations	4
Humanities or Social Sciences Elective(s)		3
TOTAL		**17**

Second Semester

ME 221	Dynamics of Mechanisms	3
ME 211	Intro to Thermodynamics	3
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
MET 231	Properties of Materials Lab	1
MET 232	Properties of Materials	3
EM 321	Mechanics of Materials	3
TOTAL		**17**

Junior Year

First Semester

MATH 225	Calculus III	4
ENGL 289	Technical Communications II	3
ME 316	Solid Mechanics	3
EE 301	Introductory Circuits, Machines, and Systems	4
CSC 150	Computer Science I	3
TOTAL		**17**

Second Semester

ME 313	Heat Transfer	3
ME 352	Intro to Dynamic Systems	3
MATH 373	Intro to Numerical Methods	3
ME 322	Machine Design I	3
ME 351	Mechatronics and Meas Syst	4
Technical Elective		3
TOTAL		**19**

Senior Year[3]

First Semester

ME 331	Thermo Fluid Dynamics	3
ME 477	Mechanical Engr Design I	2
IENG 302	Engineering Economics	3
MATH 381	Probability/Statistics	3
ME 4XX	Mechanical Engr Elective #1	4
ME 481	Advanced Prod. Dev. Lab I	1
TOTAL		**16**

Second Semester

ME 312	Thermodynamics II	3
ME 479	Mechanical Syst Design II	2
ME 482	Advanced Prod. Dev. Lab II	2
ME 4XX	Mech Engr Elective #2	3
ME 4XX	Mechanical Engr Elective #3	3
Humanities or Social Sciences Elective(s)		4
TOTAL		**17**

136 credits required for graduation

Curriculum Notes

[1] Many courses are prerequisites for other courses, and their sequencing is important. A faculty advisor should be consulted for any deviation from the above schedule.

[2] Music Ensemble courses may be substituted for Physical Education courses for qualified students. Any other substitutions must be approved in advance by the Physical Education Department Chair.

[3] Total design content of senior year mechanical engineering electives must be a minimum of three (3) hours.

Metallurgical Engineering

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FACULTY

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MATERIALS AND METALLURGICAL ENGINEERING

Materials and Metallurgical Engineering is the branch of engineering that develops and supplies the materials for virtually every other engineering field. Three-fourths of all chemical elements are metals, so metals play a vital role in nearly every aspect of modern life. Metallurgical Engineers transform the Earth's mineral resources into finished products by extracting metals from ores, producing ceramics from metal compounds, and fabricating composite structures.

Today's materials are exotic and so are the methods of producing them. Metallurgy is based upon the principles of chemistry, physics, and mathematics. These sciences provide an understanding of the methods of metal production processes and the behavior of materials. In addition to familiar materials such as steel, aluminum, copper, glass, gold, and silver, Metallurgical Engineers produce many exotic materials such as metals with shape memories, ultrahigh-purity materials for integrated circuits, materials for surgical implants, ceramics for space vehicles, nano-scale metal particles and superconductors.

There are three (3) areas of specialization in Metallurgical Engineering: mineral processing, extractive metallurgy, and materials engineering. Mineral processors concentrate ores and recycle materials so that extractive metallurgists can produce pure, high-quality metals and non-metallics for use by materials engineers who transform these materials into the marvels of our advanced civilization, ranging from space craft to thin diamond films. Metallurgical Engineers are actively involved in nanotechnology and production and utilization of nano-scale materials.

Advances made by Metallurgical and Material Engineers make possible advances in other engineering fields. This happens because virtually every engineering field is in constant search of higher-performance materials. Metallurgical engineers are responsible for the production of materials and also for the evaluation of metals, ceramics, and polymer-based composites. The evaluation of materials includes tests to determine strength, hardness, toughness, corrosion behavior, and many others. It is the role of the Metallurgical Engineer to develop processing methods to create materials with specific and exacting properties for every conceivable application.

The primary source for materials continues to be the Earth in forms such as ores, minerals from sea water, and petroleum. However, recycled materials are an increasingly important material source for Metallurgical Engineers.

Materials and Metallurgical Engineers are employed throughout the nation and the world.

THE OBJECTIVES OF THE B.S. METALLURGICAL ENGINEERING DEGREE PROGRAM

The program graduates will:

- Successfully apply metallurgical engineering principles in their employment
- Meet societal needs through science and technology
- Grow professionally and personally
- Serve their profession and community

MATERIALS AND METALLURGICAL ENGINEERING LABORATORIES

Laboratory facilities in metallurgical engineering are equipped for instruction in mineral processing, chemical metallurgy, physical metallurgy, and mechanical metallurgy. Sample preparation facilities, gravitational and magnetic separators, froth flotation equipment, BET surface area measurement equipment, Zeta Meter, and Coulter counter are available for mineral and materials processing. Induction melting and vacuum furnaces, fluidized-bed reactors, corrosion potentiostat, contact angle goniometer, and high pressure autoclaves are available for chemical metallurgy, while x-ray diffraction units, Fourier transform infrared spectrometer, Raman Spectrometer, Langmuir-Blodgett trough, metallographs, atomic force microscope, controlled atmosphere furnaces, quantitative image analyzer, scanning and transmission electron microscopes, and equipment for measuring the physical and mechanical properties of materials including a universal testing machine (MTS), Charpy impact testing machine, and microhardness, Rockwell and Vickers hardness testers are available.

MINOR IN MATERIALS SCIENCE - METALS

The requirements for a minor in Materials Science — Metals are MET 232, 330, 332, 443, 445 and one of MET 430 or 440, for a total of 18 credits. MET 330, MET 332 and MET 440 are offered in alternate years, so plans for a Materials Science-Metals minor should be made early. This minor is designed for students in the engineering and science disciplines that desire focused training in the field of Materials Science with special emphasis on metals. Students completing the minor in Materials Science-Metals will demonstrate the following outcomes:

1. a proficiency in Materials Science concepts covering metals and alloys;
2. the ability to develop new metals/alloys, and improve metals/alloys;
3. the ability to predict and evaluate the performance of metals and alloys.

Given the redundancy in the B.S. Metallurgical Engineering core curriculum, the Minor in Materials Science-Metals is not available to those students who receive a B.S.

degree in Metallurgical Engineering. A minor in Materials Science-Metals must be approved by the student's major department. Academic and Enrollment Services has forms that should be completed and signed by the Department Chairs from both departments involved in this minor.

METALLURGICAL ENGINEERING CURRICULUM/CHECKLIST

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

FRESHMAN YEAR

First Semester

MATH 123	Calculus I[5]	4
CHEM 112	General Chemistry I[6]	3
ENGL 101	Composition I[1]	3
GES 115	Professionalism/Engr and Sci	2
PE	Physical Education	1
Humanities or Social Sciences Elective(s)[3, 4]		3
TOTAL		**16**

Second Semester

MATH 125	Calculus II	4
BIOL 153	General Biology II[6] OR	3
BIOL 151	General Biology I[6] OR	3
CHEM 114	General Chemistry II[6]	3
PHYS 211	University Physics I	3
CHEM 112L	General Chem Lab OR	1
BIOL 151L	General Biology I Lab OR	1
BIOL 153L	General Biology II Lab	1
PE	Physical Education	1
Humanities or Social Sciences Elective(s)[3, 4]		3
Humanities or Social Sciences Elective(s)[3, 4]		3
TOTAL		**18**

SOPHOMORE YEAR

First Semester

MET 232	Properties of Materials	3
MET 231	Structures and Properties of Materials Lab	1
MATH 321	Differential Equations	4
PHYS 213	University Physics II	3
CHEM 114L	General Chem II Lab OR	1
BIOL 151L	General Biology I Lab OR	1
BIOL 153L	General Biology II Lab	1
ENGL 279	Technical Communications I[1]	3
EM 214	Statics	3
TOTAL		**18**

Second Semester

MATH 225	Calculus III	4
EM 321	Mechanics of Materials	3
PHYS 213L	University Physics II Lab	1
MET 220	Min Proc and Resource Recov	4
Humanities or Social Sciences Elective(s)[3, 4]		4
TOTAL		**16**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II[2]	3
MET 320	Metallurg Thermodynamics	4
MET 351	Engineering Design I	2
Set A or C		7
TOTAL		**16**

Second Semester

MET 352	Engineering Design II	1
MATH 373	Intro to Numerical Analysis	3
Free Elective		2
Set B or D		11
TOTAL		**17**

SENIOR YEAR

First Semester

MET 464	Engineering Design III	2
IENG 301	Basic Engineering Economics	2
Science Elective		3
Humanities or Social Sciences Elective(s)		3
Set A or C		7
TOTAL		**17**

Second Semester

MET 433	Process Control	3
MET 465	Engineering Design IV	1
Science Elective		3
Set B or D		11
TOTAL		**18**

136 credits required for graduation

Curriculum Notes

[1] Satisfies General Education Goal #1
[2] Satisfies General Education Goal #2
[3] Satisfies General Education Goal #3
[4] Satisfies General Education Goal #4
[5] Satisfies General Education Goal #5
[6] Satisfies General Education Goal #6

Set A

MET 422	Transport Phenomena	4
Free Elective		3

	Set B	
MET 321	High Temp Extract/Conc/Rec	4
Directed Met Elective		3
EE 301	Intro Circuits, Machines, Syst	4
	Set C	
MET 330	Physics of Metals	3
MET 330L	Physics of Metals Lab	1
MET 332	Thermomechanical Treatment	3
	Set D	
MET 440	Mechanical Metallurgy	3
MET 440L	Mechanical Metallurgy Lab	1
MET 443	Composite Materials	3
MET 310	Aqueous Extract/Conc/Rec	3
MET 310L	Aq Extract/Conc/Rec Lab	1

Mining Engineering and Management

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FACULTY

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SUPPORTING FACULTY

Mr. Shashi Kanth, Chair; Mr. Charles Layton, Professors Hansen and Preber; Associate Professor Klasi.

MINING ENGINEERING AND MANAGEMENT

The Mining Engineering and Management degree program replaces the Mining Engineering degree program.

The Mining Engineering and Management program was designed to better meet the needs of the mining industry. It combines the traditional mining engineering education with selected management-related concepts in order to better prepare the graduates for the modern mining industry.

Mining Engineering is the application of engineering and scientific principles to the discovery, appraisal, and extraction of minerals from the Earth and sea. Mining Engineering and Management takes traditional mining engineering education one step farther by including management-related education in the curriculum.

The curriculum provides the student with fundamental training in the basic sciences, engineering sciences, engineering design, geology, the humanities, and mining engineering. Principles of mine operation, mine planning, mining technology, rock mechanics, and computer applications receive special emphasis. Key management-related concepts are introduced at all levels of the curriculum.

Significant design experience is built into the curriculum and is enhanced by the use of sophisticated design software in many of the mining courses. In this, teamwork is stressed. The students work together in small, specialized teams during many of the laboratory exercises and to complete the final capstone design project. The students will present their final design project both orally and in written form.

The Mining Engineering and Management program will come up for accreditation review by the Engineering Accreditation Commission of the Accreditation Board for Engineering and

Technology (ABET) during their next general review in 2010.

A minor in Mining Engineering and Management is not available.

Mining Engineering and Management Program Objectives

The program in Mining Engineering and Management is designed to meet the changing needs of the mining industry in South Dakota, the nation and the world. The program concept is a result of discussions between the School of Mines Mining Engineering Industrial Advisory Board and the School of Mines administration.

The objective of creating this new degree at School of Mines is to provide the modern mining industry with graduates who are technically sound in mining engineering, but who can progress quickly through supervision and into management.

The curriculum has been designed to meet accreditation requirements in both mining engineering and engineering management. The core mining engineering curriculum provides technical training in areas such as rock mechanics, mine ventilation, ore reserve evaluation, mine design, mining equipment selection, mining method selection, and mineland reclamation. The curriculum also includes a strong emphasis on management-related topics: health and safety, economics and finance, labor relations, project management, environmental management, international business, and communication skills.

Professional Development

Students in the program are encouraged to become student members of their primary professional organization-the Society for Mining, Metallurgy, and Exploration (SME). Upon graduation, they are further encouraged to continue professional membership of SME. Additionally, the students can become student members of the International Society of Explosives Engineers (ISEE). Both SME and ISEE have local chapter meetings, which the students are encouraged to attend.

During their senior year, students in the Mining Engineering and Management program are encouraged to take the Fundamentals of Engineering (FE) examination. Passing the FE examination is the first step in the process of registration as a Professional Engineer (PE). The second, and final, step in the registration process is the successful completion of the Professional Engineering examination, which is normally taken at least four (4) years after graduation.

The Mining Engineering and Management program participates in a cooperative education program that provides an opportunity for students to combine school work with a meaningful work experience in industry. Participating companies in the program provide jobs for students during semesters scheduled for work. A student in the cooperative program should plan on five (5) years to graduate.

Mining Engineering Laboratories

Laboratory facilities exist in the department for rock mechanics, ventilation, and computer-aided mine design. Laboratory equipment available for student use includes: equipment for rock specimen preparation, uniaxial and triaxial rock strength testing machine, direct shear machine, computerized data acquisition system, ventilation network model, and surveying equipment.

The computer laboratory consists of personal computers used independently or linked to the campus fileservers through the network. Available software packages are routinely used by undergraduate and graduate students for the solution of problems in rock mechanics, geostatistics, management, mineral economics, ventilation, blasting, mapping, and mine design. State-of-the-art geoscience modeling and mine planning software is used by students for surface and underground mine design.

Mining Engineering and Management Curriculum/Checklist

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
MATH 123	Calculus I	4
Humanities or Social Sciences Elective(s)		3
GES 115	Professionalism/Engr and Sci	2
ENGL 101	Composition I	3
PE	Physical Education	1
TOTAL		**17**

Second Semester

CHEM 114	General Chemistry II	3
MATH 125	Calculus II	4
PHYS 211	University Physics I	3
MEM 120	Introduction to Mining and Sustainable Development	2
PE	Physical Education	1
Humanities or Social Sciences Elective(s)		3
TOTAL		**16**

Sophomore Year

First Semester

MATH 225	Calculus III	2
PHYS 213	University Physics II	3
EM 216	Engineering Mechanics (Statics and Dynamics)	4
MEM 201	Surveying for Mineral Engineers	2
MEM 203	Introduction to Mine Health and Safety	1
ENGL 279	Technical Communications I	3
ECON 201	Microeconomics	3
TOTAL		**18**

Second Semester

MATH 321	Differential Equations	3
GEOE 221/221L	Geology for Engineers	3
ENGL 289	Technical Communications II	3
Humanities/Social Science Course		3
MEM 202	Materials Handling and Transportation	2
MEM 204	Surface Mining Methods and Equipment for Coal, Metal and Quarrying Operations	3
TOTAL		**17**

Junior Year

First Semester

MEM 301	Computer Applications in Mining	2
MEM 303	Underground Mining Methods and Equipment for Coal, Metal and Stone Operations	3
MEM 305	Mine Excavation and Explosives	3
EM 328	Applied Fluid Mechanics	3
BADM 360	Organization and Management	3
MEM 307	Mineral Exploration and Geostatistics	3
TOTAL		**17**

Second Semester

XXX XXX	Mineralogy and Petrology	4
MEM 302	Mineral Economics and Finance	3
MEM 304	Theoretical and Applied Rock Mechanics	4
MEM 306	Mine Power and Pumping Systems	3
GEOE 322/322L	Structural Geology	3
TOTAL		**17**

Senior Year

First Semester

HRM 417	Human Resource Management	3
MEM 401	Theoretical and Applied Ventilation Engineering	4
MET 220	Coal and Minerals Processing	3
MEM 405	Mine Permitting and Reclamation	3
Hum/SSCourse (Language)		4
TOTAL		**17**

Second Semester

MEM 464	Mine Design and Feasibility Study	4
Free Elective		2
XXX XXX	Managerial Economics and Finance	3
MEM 466	Mine Management	2
MEM 4XX	Mining Technical Elective[1]	3
BADM 407	International Business	3
TOTAL		**17**

136 credits required for graduation

Curriculum Notes

[1]Elective chosen from a list of approved mining or business courses.

Courses marked with an "X" are pending until Fall 2006.

Associate of Arts Degree

The Associate of Arts Degree in General Studies is a two-year degree program that provides a student the opportunity to complete a curriculum of study in traditional fields of study. The curriculum offers a broad and varied background in general education as well as opportunities to explore a number of disciplines as a basis for entrance into a four-year degree program. Completion of the AA Degree will fulfill the general education requirements for a baccalaureate degree at the state universities of South Dakota. Approved general education courses from other state universities may be used to satisfy the School of Mines general education requirements. The program of studies is as follows:

ASSOCIATE OF ARTS DEGREE GENERAL EDUCATION REQUIREMENTS

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

Written and Oral Communication

A minimum of nine (9) semester hours is required. This requirement can be met by taking one of two (2) sequences of courses.

Either:

ENGL 101	Composition I	3
ENGL 279	Technical Communications I	3
ENGL 289	Technical Communications II	3

Or:

ENGL 101	Composition I	3
ENGL 201	Composition II	3
SPCM 101	Fundamentals of Speech	3

If planning to pursue a baccalaureate degree from School of Mines the first sequence should be selected.

Humanities

Courses in History, Literature, Philosophy, Religion, non-English languages, Art, Music, and Theatre may be used. A minimum of six (6) semester hours in two (2) disciplines, *i.e.* two (2) different course prefixes or a two-semester sequence in a foreign language, is required.

ART 111/112	Drawing and Perception I and II	3/3
ARTH 211	History of World Art I[1]	3
ARTH 251	American Indian Art History[2]	3
ENGL 221/222	British Literature I[1] and II[1]	3/3
ENGL 241/242	American Lit I[1] and II[1]	3/3
ENGL 250	Science Fiction	3
FREN 101/102	Intro French I[1] and II[1]	4/4
GER 101/102	Intro German I[1] and II[1]	4/4
HIST 121/122	Western Civilization I[1] and II[1]	3/3
HUM 100	Introduction to Humanities[1]	3
HUM 200	Connections: Humanities and Technology[1]	3
JAPN 101/102	Japanese Culture and Language I[1] and II[1]	3/3
LAKL 101/102	Intro Lakota I[1] and II[1]	3/3
MUS 100	Music Appreciation[1]	3
MUS 110	Basic Music Theory I[1]	3
PHIL 100	Introduction to Philosophy	3
PHIL 200	Introduction to Logic	3
PHIL 220	Introduction to Ethics[1]	3
PHIL 233	Philosophy and Literature	3
REL 230	Introduction to the Bible	2
REL 250	World Religions[1]	2
SPAN 101/102	Intro Spanish I[1] and II[1]	4/4

Social Sciences

Courses in Anthropology, Economics, Geography, History, Political Science, Psychology, and Sociology may be used. A minimum of six semester hours in two (2) disciplines, *i.e.* two (2) different course prefixes, is required.

ANTH 210	Cultural Anthropology[1]	3
ECON 201	Prin of Microeconomics[1]	3
ECON 202	Prin of Macroeconomics[1]	3
GEOG 101	Introduction to Geography[1]	3
GEOG 212	Geography of North America	3
HIST 151/152	US History I[1] & II[1]	3/3
POLS 100	American Government	3
POLS 210	State & Local Government	3
PSYC 101	General Psychology	3
PSYC 261	The Psychology of Being	3
SOC 100	Introduction to Sociology[1]	3
SOC 150	Social Problems[1]	3
SOC 251	Marriage and the Family	3

[1] Course meets Cultural Diversity requirement.

[2] Courses are part of the cooperative agreement between School of Mines and Oglala Lakota College.

with his or her advisor in the Atmospheric Sciences department for any course offering or other program modifications that may occur after the publication of this catalog. Most courses are offered only every other year. Attention must be paid to this two-year cycle in planning a program of study.

Master of Science Graduate Degree Program

A Master of Science graduate program in the atmospheric sciences is offered to students with undergraduate degrees in atmospheric sciences or meteorology, physics, mathematical sciences, biology, chemistry, or engineering. A resident undergraduate student in any of these fields may take as electives upper-division courses in meteorology, either as part of the minor or otherwise, and proceed directly to graduate work in meteorology upon receipt of the Bachelor's degree. In addition to meeting the goals listed above for undergraduate minor and IS atmospheric science graduates, the Master of Science graduate will be able to review the literature; devise strategies for attacking a problem in atmospheric sciences; acquire, organize, and interpret data; and prepare results for both oral and written presentation. He or she is expected to be able to carry out such original investigations both individually and as a member of a team.

A Master of Science degree requires twenty-four (24) credit hours of course work, with an additional six (6) semester hours of research credit for completing a thesis. There are two specializations in the program, meteorology and earth systems, with a common core of three courses shared by both specializations. See pp. 202 - 204 for more details. A properly-prepared undergraduate science or engineering graduate with minimal meteorological background may use the M.S. program to complete sufficient coursework to satisfy the federal civil service requirements for employment as a meteorologist. The M.S. program can be a stepping-stone to Ph.D. work in the atmospheric and environmental sciences, as well as a terminal degree leading to employment in private industry or government.

Atmospheric and Environmental Sciences Interdisciplinary Ph.D. Graduate Program

In addition to the M.S. program in atmospheric sciences, the Atmospheric Sciences Department participates in the Atmospheric and Environmental Sciences (AES) Ph.D. program. Faculty in several departments are involved in delivering the program, including Chemistry and Chemical Engineering, Civil and Environmental Engineering, Mining and Engineering Management, Geology and Geological Engineering, and Atmospheric Sciences. Degree candidates are expected to complete courses in a broad range of topics selected from these disciplines. For complete information on the AES program, please refer to the AES section of this catalog beginning on p. 198.

Mathematics

A minimum of three (3) semester hours of College Algebra or a math course with College Algebra as a prerequisite is required.

MATH 102	College Algebra	3

Natural Sciences

A minimum of six (6) semester hours in the natural sciences is required including one semester hour of laboratory. Courses in Biology, Chemistry, Earth Science, and Physics may be used.

BIOL 151/151L	General Biology I and Laboratory	3/1
BIOL 153/153L	General Biology II and Laboratory	3/1
CHEM 106/106L	Chemistry/Laboratory	3/1
CHEM 108/108L	Organic and Bio Chemistry/Laboratory	4/1
CHEM 112/112L	General Chemistry I and Laboratory	3/1
CHEM 114/114L	General Chemistry II and Laboratory	3/1
GEOL 201/201L	Physical Geology/ Laboratory	3/1
PHYS 111/111L	Introduction to Physics I and Laboratory	3/1
PHYS 113/113L	Introduction to Physics II and Laboratory	3/1
PHYS 211	University Physics I	3
PHYS 213/213L	University Physics II and Laboratory	3/1

Cultural Diversity

A minimum of six (6) semester hours is required. Courses must be selected from those marked with a one ([1]) in the Humanities and Social Sciences sections above. If non-marked courses are selected to fulfill the Humanities and Social Science requirements, additional marked courses must be selected to fulfill this requirement.

Information Technology

A minimum of two (2) semester hours is required.

CEE 284	Digital Computation Applications in CEE	4
CHEM 182	Chemical Computations	2
CSC 105	Introduction to Computers	3
CSC 150	Computer Science I	3
GE 113	Introduction to Personal Computer and Workstation Programming	3
GE 115	Professionalism in Engineering & Science	2
GEOE 211	Earth Systems Engineering and Analysis	3

Electives

Total semester hours required to graduate is sixty-four (64). The number of elective credits will vary from a minimum of twenty-four to thirty (24-30) semester hours, depending on the courses selected in Humanities, Social Sciences, Cultural Diversity, and Natural Sciences. All elective courses must be approved by the student's academic advisor.

Other Degree Requirements

Students are required to pass the CAAP proficiency examination and the Information Technology examination. For additional information on these examinations contact the Office of Academic and Enrollment Services at (605) 394-2400.

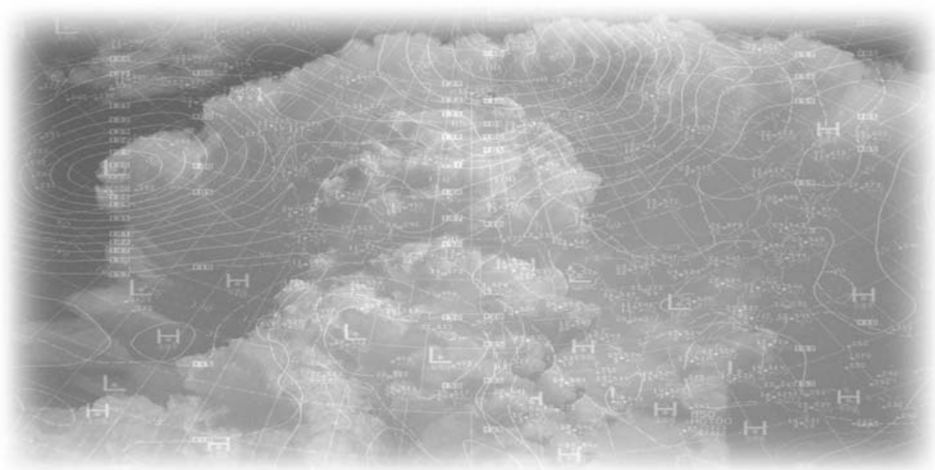
Students must have achieved a minimum cumulative grade point average of 2.00 in order to graduate with this degree.

After completion of forty-eight (48) credit hours, students may register for up to nine hours of 300 level courses.

If planning to pursue a baccalaureate degree from School of Mines, students should consider taking two (2) credits of approved physical education courses.

This information may be found at www.hpcnet.org/is

Atmospheric Sciences



CONTACT INFORMATION

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FACULTY

Professor Hjelmfelt, Chair; Professors Detwiler, Helsdon, and Zimmerman; Associate Professor Capehart; Assistant Professor Sundareshwar; Adjunct Professors Campbell, and Dorn.

The purpose of the atmospheric sciences curriculum is to educate students to the level of scientists and engineers who are capable of developing and applying knowledge concerning physical, dynamical, and chemical processes in the atmosphere.

UNDERGRADUATE MINOR IN ATMOSPHERIC SCIENCES

A minor in atmospheric sciences is offered to any student enrolled in any undergraduate degree program that allows minors at School of Mines. For some majors this would require an additional semester or more of study beyond the normal four years. A minimum of eighteen (18) credits in atmospheric science coursework must be earned. Three courses, Introduction to Atmospheric Sciences (ATM 301), Atmospheric Physics (ATM 401), and Global Environmental Change (ATM 406) are required for the minor.

Specialization in Atmospheric Sciences within the Bachelor of Science in Interdisciplinary Sciences degree program

Students in the Bachelor of Science in Interdisciplinary Sciences (IS) degree program may choose a specialization in Atmospheric Sciences. The successful student is expected to be capable of independent and critical thinking in the areas of physical, synoptic, and dynamic meteorology; remote sensing; and global atmospheric change. As such, he or she should be qualified for employment where expertise in atmospheric sciences is a primary requirement, though need not necessarily qualify as a meteorologist by the federal government's criteria. The curriculum also is suitable for preparation towards graduate study at the MS and PhD level.

The Interdisciplinary Sciences Bachelor of Science degree program offers a specialization in Atmospheric Sciences. General requirements for a B.S. in Interdisciplinary Sciences are described on pp.155 - 163. Required coursework for the Atmospheric Sciences specialization includes the following:

Degree: Meteorology, atmospheric science, or other natural science major that includes:
1) All courses and other curriculum requirements for the general Interdisciplinary Sciences degree requirement.

2) The Atmospheric Sciences undergraduate core: ATM 301, ATM 402, ATM 406, ATM 450, ATM 450L

3) The following mathematics and science courses (which may require additional prerequisites): CHEM 114, CHEM 114L, CSC 150, PHYS 213, PHYS 213L, MATH 225, BIOL 311

4) 12 hours of additional ATM or ATM-directed cooperative education (CP) credits

5) 12 Hours of additional professional development credits from ATM, BIOL, CHEM, CEE, CSC, CP, ENVE, GEOE, GEOL, MATH, or PHYS, within the requirements of the IS program. (Engineering course credits cannot be counted towards IS degree requirements but can be counted as general electives.)

Federal Certifications as a Meteorologist

Students in the undergraduate minor or IS programs desiring to be qualified for federal employment as meteorologists (with the National Weather Service or other federal government agencies employing meteorologists) should contact a Department of Atmospheric Sciences advisor to ensure that their plan of study meets the strictly enforced civil service requirements. The basic requirements for federal civil service qualification as a meteorologist (as dictated by the United States Office of Personnel Management) are listed below:

Degree: Meteorology, atmospheric science, or other natural science major that includes:

A. At least twenty-four (24) semester hours (36 quarters) of credit in atmospheric science/meteorology including a minimum of:
   1. Six (6) semester hours of atmospheric dynamics and thermodynamics
   2. Six (6) semester hours of analysis and prediction of weather systems (synoptic/mesoscale
   3. Three (3) semester hours of physical meteorology and
   4. Two (2) semester hours of remote sensing of atmosphere and/or instrumentation
B. Six (6) semester hours of physics, with at least one course that includes laboratory sessions
C. Three (3) semester hours of ordinary differential equations
D. At least nine (9) semester hours of course work appropriate for a physical science major in any combination of three or more of the following: physical hydrology, statistics, chemistry, physical oceanography, physical climatology, radiative transfer, aeronomy, advanced thermodynamics, advanced electricity and magnetism, light and optics, and computer science.

OR: Combination of education and experience-course work as shown in A above, plus appropriate experience or additional education.

Note: There is a prerequisite or corequisite of calculus, physics, and differential equations for course work in atmospheric dynamics and thermodynamics. Calculus courses must be appropriate for a physical science major.

Atmospheric Sciences undergraduate curriculum scheduling

It is the student's responsibility to check

Biology

<u>CONTACT INFORMATION</u>

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<u>FACULTY</u>

Professor Winter, Chair; Professor Sookie Bang.

<u>BIOLOGY</u>

Many students need a knowledge of biology as part of their background. The biology courses are offered for students in science, engineering, and general studies. Students are advised to take laboratory courses whenever possible.

Minimum enrollments, as established by administration policy, are necessary to teach a course. A minor in Biology is not available. However, for students considering medical, dental, veterinary, or graduate school in a biology field, the department recommends students and advisors consider one of three biology sequences for study rather than selecting courses at random. Record of successful completion of an approved sequence can be made a part of a student's permanent record. A minimum of eighteen (18) credits is recommended with eight (8) of those credits being BIOL 151/151L; BIOL 153/153L; or equivalent. At least six (6) credits should be at the 300 level or above.

Recommended Options

A. General Biology Sequence
Eight (8) core credits:
BIOL 151, 151L, 153, 153L
Ten (10) additional credits from:

BIOL 231	General Microbiology	3
BIOL 231L	General Microbiology Lab	1
BIOL 341	Microbial Processes in Engineering and Nat. Sciences	3
BIOL 371	Genetics	3
BIOL 491	Independent Study	1/4

B. Health Science Sequence

Eight (8) core credits:
BIOL 151, 151L, 153, 153L
Ten (10) additional credits from:

BIOL 121	Basic Anatomy	3
BIOL 121L	Basic Anatomy Lab	1
BIOL 123	Basic Physiology	3
BIOL 123L	Basic Physiology Lab	1
BIOL 231	General Microbiology	3
BIOL 231L	General Microbiology Lab	1
BIOL 371	Genetics	3
BIOL 423	Pathogenesis	3
BIOL 423L	Pathogenesis Lab	1
BIOL 492	Topics	1/5

C. Environmental Science Sequence

Eight (8) core credits:
BIOL 151, 151L, 153, 153L
Ten (10) additional credits from:

BIOL 311	Principles of Ecology	3
BIOL 330	Environmental Science	3
BIOL 341	Microbial Processes in Engineering and Nat. Sciences	3
BIOL 371	Genetics	3
BIOL 431	Industrial Microbiology	3
BIOL 431L	Industrial Microbiology Lab	1
BIOL 403	Global Environmental Change	3
BIOL 492	Topics	1/5

BIOLOGICAL LABORATORIES

These laboratories, located on the ground floor of the McLaury Building, are equipped for the preparation and study of biological materials, both macroscopic and microscopic. For some courses field trips add significant experience.

Mines Matters: In 2004-2005, School of Mines awarded more than three hundred degrees. The School of Mines offers commencement in December and May.

Chemistry

CONTACT INFORMATION

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FACULTY

Associate Professor Heglund, Chair; Professors Arrington and Boyles; Assistant Professor Fong; Instructor Warren.

CHEMISTRY

The Department of Chemistry offers undergraduate chemistry courses, that meet the requirements for the degree Bachelor of Science and for other programs on campus. The Chemistry program offers two (2) degree options at the baccalaureate level: the ACS-certified degree, which meets the national requirements of the American Chemical Society, and the Applied Chemistry Option. Both degrees require one hundred twenty-eight (128) semester credits.

Upon graduation with a bachelor's degree in chemistry, students have knowledge of chemical and physical phenomena at the molecular level. They are expected to possess the skills of critical thinking in chemical problem-solving, such as instrumental data interpretation for molecular structure characterization. Students are expected to have a command of the four major subdisciplines of chemistry, namely, analytical, inorganic, organic, and physical chemistry, as well as to be familiar with the chemical literature.

Chemistry graduates of the department distinguish themselves in that the chemistry curriculum gives them ample opportunity to supplement their chemical knowledge with a breadth of other courses, which may be elected from diverse offerings on campus including the humanities, social sciences, biological and physical sciences, mathematics, engineering, and others. This unique latitude inherent within the chemistry curriculum allows students to develop as well-rounded individuals who are able to face and meet the challenges they may anticipate in their chosen careers.

Chemistry, by its very nature, is the central science in today's world, and many graduates use their degrees as a solid foundation for advanced study in chemistry as well as for study in medicine, pharmacy, veterinary medicine, forensic science, materials science, environmental science, medical technology, physical therapy, patent or environmental law, education - all are possibilities for students with a chemistry education. Likewise, students who opt not to further their education beyond their B.S. degrees in chemistry are also prepared for a wide variety of employment opportunities. Among former chemistry graduates these have included research and quality assurance positions in academic, industrial, governmental, and private sectors of the economy.

The department also participates in the Master of Science in Materials and Engineering Science, and the Doctor of Philosophy degrees in Materials and Engineering Science (MES) and Atmospheric, Environmental, and Water Resources (AEWR). Students seeking these degrees may choose to emphasize any of the representative subdisciplines of chemistry in addition to interdisciplinary research specialties as an integral part of their graduate program of study.

The department prides itself in having state-of-the-art instrumentation available not only for research but as an integral part of undergraduate education. The instrumentation within the department currently includes an FT-IR spectrometer, a 300 MHz superconducting heteronuclear nuclear magnetic resonance spectrometer, a spectrofluorometer, diode-ray electronic spectrophotometers, voltammograph, atomic absorption spectrometer, as well as gas, liquid, and ion chromatographs.

In order to ensure that chemistry majors will complete all degree requirements in a timely manner, will meet prerequisites for further education such as medical school, and will be knowledgeable about post-graduation options and employment opportunities, advisors work closely with their assigned students.

*Minor in Materials Science - Polymers

The requirements for a minor in Materials Science - Polymers are Met 232, Chem 220, 326, 328, 332, 340 and 426, for a total of nineteen (19) credits. This minor is designed for students in the engineering and science disciplines that desire focused training in the field of Materials Science with special emphasis on polymers. Students completing the minor in Materials Science-Polymers will demonstrate the following outcomes:

1. a proficiency in Materials Science concepts covering polymers;
2. the ability to develop new polymeric materials, and improve traditional polymeric materials;
3. the ability to predict and evaluate the performance of polymeric materials.
   Given the redundancy in the B.S. Chemistry and Chemical Engineering core curricula, the minor in Materials Science-Polymers is not available to those students who receive a B.S. degree in Chemistry or Chemical Engineering.

*Minor is pending Board of Regents Approval.

Bachelor of Science in Chemistry, ACS Certified

The ACS-certified curriculum provides an excellent foundation in science and mathematics for professional preparation in chemistry, meeting the nationally recognized high standards established by the American Chemical Society. This curriculum opens the way for a variety of careers in research and development in the chemical industry or the government, and gives the student an excellent foundation for graduate study in chemistry.

Students desiring to meet the minimum requirements for certification by the American Chemical Society should follow the curriculum outlined below.

Chemistry Curriculum, ACS Certified

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
ENGL 101	Composition I	3
MATH 123	Calculus I	4
Humanities or Social Sciences Elective(s)		6
CHEM 290	Seminar	0.5
TOTAL		**17.5**

Second Semester

CHEM 114	General Chemistry II	3
CHEM 114L	General Chemistry II Lab	1
MATH 125	Calculus II	4
PHYS 211	University Physics I	3
Humanities or Social Sciences Elective(s)		6
CHEM 290	Seminar	0.5
TOTAL		**17.5**

Sophomore Year

First Semester

CHEM 332	Analytical Chemistry	3
CHEM 332L	Analytical Chemistry Lab	1
CHEM 326	Organic Chemistry I	3
CHEM 326L	Organic Chem I Lab	2
MATH 225	Calculus III	4
CHEM 252	Systematic Inorganic Chemistry	3
PE	Physical Education	1
CHEM 290	Seminar	0.5
TOTAL		**17.5**

Second Semester

CHEM 182	Chemical Computations	2
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
CHEM 328	Organic Chemistry II	3
CHEM 328L	Organic Chem II Lab	2
ENGL 279	Technical Comm I	3
Humanities or Social Sciences Elective(s)		3
CHEM 290	Seminar	0.5
TOTAL		**14.5**

Junior Year

First Semester

ENGL 289	Technical Comm II	3
CHEM 342	Physical Chemistry I	3
Elective(s)		9
PE	Physical Education	1
CHEM 490	Seminar	0.5
TOTAL		**15.5**

Second Semester

CHEM 346	Physical Chem I and II Lab	2
CHEM 344	Physical Chemistry II	3
CHEM 370	Chemical Literature	1
Advanced Chemistry Requirement[2]		6
CHEM 490	Seminar	0.5
Advanced Chemistry Elective(s)[3]		3
TOTAL		**15.5**

Senior Year

First Semester

First Semester Elective(s)		8
CHEM 490	Seminar	0.5
Humanities or Social Sciences Elective(s)		4
CHEM 446	Industrial Organic Chemistry	3
TOTAL		**15.5**

Second Semester

Electives		7
Adv Chemistry Requirement[2]		6
CHEM 490	Seminar	0.5
TOTAL		**13.5**

128 credits required for graduation

Curriculum Notes

[1] A minimum of sixteen (16) credit hours of university-approved humanities and social sciences are required, with a minimum of six (6) hours in humanities and six (6) hours in social sciences.

[2] Twelve (12) credits of advanced chemistry courses are required: Chem. 434, 434L, 452, 452L, and 460.

[3] Three (3) credits of advanced chemistry electives are required. Take any one of the following courses: 420, 421, 426, 448, 455, and 482.

Bachelor of Science in Chemistry, Applied Chemistry Option

The curriculum below, although not certified by the American Chemical Society, fully meets the entrance requirements for medical, dental, pharmacy, veterinary, law, and other anticipated careers specialties.

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

ENGL 101	Composition I	3
CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
PE	Physical Education	1
MATH	Math Elective (Math 102 or higher)	3
Humanities or Social Sciences Elective(s)		6
CHEM 290	Seminar	0.5
TOTAL		**17.5**

Second Semester

CHEM 114	General Chemistry II	3
CHEM 114L	General Chemistry II Lab	1
PE	Physical Education	1
MATH	Math Elective	3
Humanities or Social Sciences Elective(s)[1]		6
CHEM 290	Seminar	0.5
TOTAL		**14.5**

Sophomore Year

First Semester

CHEM 332	Analytical Chemistry	3
CHEM 332L	Analytical Chem Lab	1
CHEM 326	Organic Chemistry I	3
CHEM 326L	Organic Chem I Lab	2
PHYS 111	Introduction to Physics I	3
PHYS 111L	Intro to Physics I Lab	1
CHEM 252	Systematic Inorganic Chem	3
CHEM 290	Seminar	0.5
TOTAL		**16.5**

Second Semester

CHEM 182	Chemical Computations	2
ENGL 279	Technical Comm I	3
CHEM 328	Organic Chemistry II	3
CHEM 328L	Organic Chem II Lab	2
PHYS 113	Introduction to Physics II	3
PHYS 113	Intro to Physics II Lab	1
CHEM 290	Seminar	0.5
TOTAL		**14.5**

Junior Year

First Semester

ENGL 289	Technical Comm II	3
Elective(s)		6
Advanced Elective(s)[3]		3
Humanities or Social Sciences Elective(s)[1]		4
CHEM 490	Seminar	0.5
TOTAL		**16.5**

Second Semester

CHEM 340	Fundamentals of Physical Chemistry	3
CHEM 370	Chemical Literature	1
Advanced Elective(s)[3]		3
Chem. 460	Biochemistry	3
Electives		6
Advanced Elective(s)[3]		3
CHEM 490	Senior Seminar	0.5
TOTAL		**16.5**

Senior Year

First Semester

CHEM 446	Industrial Organic Chemistry	3
Advanced Elective(s)3		6
Elective(s)		8
CHEM 490	Seminar	0.5
TOTAL		**17.5**

Second Semester

Advanced Chemistry Elective[2]		3
Advanced Elective[3]		3
Elective(s)		8
CHEM 490	Seminar	0.5
TOTAL		**14.5**

128 credits required for graduation

Curriculum Notes

[1] A minimum of sixteen (16) credit hours of university-approved humanities and social sciences are required, with a minimum of six (6) hours in humanities and six (6) hours in social sciences.

[2] Three (3) credits of advanced chemistry electives are required. Take any one of the following courses: Chem. 330, 420, 421, and 482.

[3] Fifteen (15) credits of electives in courses numbered 300 or higher are required; a minimum of six (6) credits of these must be taken from any combination of math, science, and/or engineering courses.

Geology

Contact Information

Dr. Arden D. Davis
Department of Geology and Geological Engineering
Mineral Industries 307
(605) 394-2461
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Faculty

Professor Davis, Chair; Professors Bishop, Duke, Fox, Lisenbee, and Paterson; Associate Professor Price; Melvin Haslem Post-doctoral Fellow in Paleontology.

Supporting Faculty

Professor Roggenthen; Associate Professor Stetler.

Geology

The program in Geology fully utilizes the magnificent geologic setting of the Black Hills and adjacent Badlands to develop geologists for careers in geology including environmental applications, mineral and petroleum exploration, governmental agencies, museums, academic fields, and entrepreneurship. Both undergraduate and graduate programs are available. The undergraduate program develops a strong background in basic sciences and permits considerable variation in course choice depending on individual interests. Students may choose from specializations in Applied Geology, Earth Systems, or Paleontology. The senior year culminates in an individual research project.

For career areas such as earth science teaching, students should consult teaching programs at other colleges for auxiliary education courses that would be needed for teacher certification. The basic program also prepares the individual for graduate study in geology or related areas.

The graduate programs, both Masters and Doctoral, involve additional specialization in geology and paleontology and commonly include research on regional or local problems. Analytical and computational facilities in the Department and related departments include the electron microprobe, heating-cooling fluid inclusion stage, AA-ICP, XRD, SEM, TEM, the Geographic Information Systems/ Remote Sensing Laboratory. Completion of graduate degrees leads to higher-level professional employment including college-level instruction.

MINOR IN GEOLOGY

Other science and engineering majors may pursue a minor in Geology by completing eighteen (18) credit hours of Geology courses including the following: GEOL 201, 201L, 212, 321, 341, and GEOE 322. GEOL 331 may be substituted for GEOL 321 with the permission of the Chair of the Department of Geology and Geological Engineering.

GEOLOGY CURRICULUM/CHECKLIST

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

Applied Geology Specialization

FRESHMAN YEAR

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
ENGL 101	Composition I	3
GEOL 201	Physical Geology	3
GEOL 201L	Physical Geology Lab	1
GES 115	Professionalism in Sci	2
TOTAL		**17**

Second Semester

CHEM 114	General Chemistry II	3
CHEM 114L	General Chemistry II Lab	1
MATH 125	Calculus II	4
PHYS 211	University Physics I	3
Humanities/Social Science Elective(s)[1]		6
TOTAL		**17**

SOPHOMORE YEAR

First Semester

GEOL 331	Stratig and Sedimentation	3
MATH 225	Calculus III	4
PHYS 213	University Physics II	3
MEM 201	Surveying for Mineral Engineers	2
GEOL 321	Search For Our Past	3
TOTAL		**15**

Second Semester

ENGL 279	Technical Communications I	3
GEOL 212	Mineralogy and Crystallography	3
GEOE 211	Earth Systems Engr Analysis	1
PE	Physical Education	1
Gen Ed Humanities Elective(s)[1]		6
PE	Physical Education	2
TOTAL		**15**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II[1]	3
GEOL 341	Elementary Petrology	3
GEOL 416	GIS I: Intro to GIS	3
GEOL 461	Invertebrate Paleo[2]	3
Free Elective		3
Humanities/Social Science Elective(s)		1
TOTAL		**16**

Second Semester

GEOE 322	Structural Geology	3
GEOL 403	Regional Field Geology	1
GEOE 324	Engr Geophysics I	3
GEOL 442	Optical Petrology[2]	3
Geology Elective(s)[3]		3
TOTAL		**13**

Summer

GEOL 410	Field Geology	**6**

SENIOR YEAR

First Semester

GEOL 464	Senior Research I[4]	1
GEOE 475	Ground Water	3
GEOE 461	Petroleum Production	3
Free Elective(s)[3]		3
Humanities/Social Science elective(s)		3
TOTAL		**13**

Second Semester

GEOE 482	Applied Geomorphology[2]	3
GEOE 451	Economic Geology	3
GEOL 465	Senior Research II[4]	3
Geology Elective(s)[3]		3
Free electives		3
TOTAL		**15**

128 credits required for graduation

Earth System Science Specialization

Freshman Year

First Semester

BIOL 151	General Biology I	3
MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
GEOL 201	Physical Geology	3
GEOL 201L	Physical Geology Lab	1
GES 115	Professionalism in Eng And Sciences	2
TOTAL		**17**

Second Semester

CHEM 114	General Chemistry II	3
CHEM 114L	General Chemistry II Lab	1
ENGL 101	Composition I	3
PHYS 211	Univ. Physics I	3
Gen Ed Humanities Elective(s)[1]		3
MATH 125	Calculus II	4
TOTAL		**17**

Sophomore Year

First Semester

ATM 301	Intro to Atmospheric Sci	3
GEOL 331	Stratig and Sedimentation	3
MATH 225	Calculus III	4
PHYS 213	Univ. Physics II	3
Gen Ed Humanities Elective(s)[1]		3
TOTAL		**16**

Second Semester

ENGL 279	Technical Communications I[1]	3
GEOL 212	Mineralogy and Crystallography	3
GEOE 211	Earth Systems Engr Analysis	1
Gen Ed Humanities/Social Science Electives		6
PE	Physical Education	2
TOTAL		**15**

Junior Year

First Semester

ENGL 289	Technical Communications II[1]	3
GEOL 341	Elementary Petrology	3
GEOL 416	GIS I: Intro to GIS	3
BIOL 311	Principles of Ecology	3
GEOL 321	Search For Our Past	3
Humanities/Social Science Elective(s)		1
TOTAL		**16**

Second Semester

GEOE 322	Structural Geology	3
ATM 401	Global Environ. Change	3
Program Elective(s)[5]		3
Free Elective(s)		3
TOTAL		**12**

Summer

GEOL 410	Field Geology	6

Senior Year

First Semester

GEOL 464	Senior Research I	1
ATM 402	Global Carbon Cycle	3
ATM 410	Environmental Remote Sensing	3
Program Elective(s)[5]		2
Free elective(s)		3
TOTAL		**15**

Second Semester

ATM 403	Biogeochemistry[2]	3
GEOE 482	Applied Geomorphology	3
GEOL 465	Senior Research II[4]	3
Program Elective(s)[5]		2
Free elective(s)		3
TOTAL		**14**

128 credits required for graduation

Paleontology Specialization

Freshman Year

First Semester

BIOL 151	General Biology I	3
CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
ENGL 101	Composition I	3
GEOL 201	Physical Geology	3
GEOL 201L	Physical Geology Lab	1
GES 115	Professionalism in Eng. And Science	2
TOTAL		**16**

Second Semester

CHEM 114	General Chemistry II	3
CHEM 114L	General Chemistry II Lab	1
BIOL 153	General Biology II	3
MATH 123	Calculus I	4
PHYS 111	Intro to Physics I	3
GenEd Humanities Elective(s)[1]		3
TOTAL		**17**

Sophomore Year

First Semester

GEOL 331	Stratig and Sedimentation	3
BIOL 121	Basic Anatomy	3
BIOL 121L	Basic Anatomy Lab	1
GEOL 321	Search for our Past	3
Social Science and Humanities Elective(s)[1]		6
TOTAL		**16**

Second Semester

ENGL 279	Technical Communications I1	3
GEOL 212	Mineralogy & Crystallography	3
GEOL 276	Dinosaurs and Extinct Vert	3
GEOE 211	Earth Systems Engr Analysis	1
Gen Ed /Social Science Elective(s)		3
PE	Physical Education	2
TOTAL		**15**

Junior Year

First Semester

ENGL 289	Technical Communications II[1]	3
GEOL 341	Elementary Petrology	3
GEOL 416	GIS I Intro to GIS	3
GEOL 461	Invertebrate Paleo[2]	3
BIOL 311	Principles of Ecology	3
Humanities/Social Science Elective(s)		1
TOTAL		**16**

Second Semester

GEOE 322	Structural Geology	3
GEOL 403	Regional Field Geology	1
GEOL 472	Museum Conserv Curation	3
MATH 281	Intro to Statistics	3
Geology Elective(s)[3]		3
TOTAL		**13**

Summer

GEOL 410	Field Geology	**6**
GEOL 371	Field Paleontology	2
TOTAL		**8**

Senior Year

First Semester

GEOL 464	Senior Research I	1
GEOL 473	Museum Prep/ Tech Exh Design	3
Math Elective(s)		3
Free elective(s)		3
Humanities/Social Science Elective(s)		3
TOTAL		**13**

Second Semester

GEOL 351	Earth Resources and the Environment	3
GEOL 465	Senior Research II[4]	3
Geology Elective(s)[3]		2
Free elective(s)		6
TOTAL		**14**

128 credits required for graduation

Curriculum Notes

[1] Students must complete twenty-seven (27) credits of the general education core in their first sixty-four (64) credit hours, including six (6) credits of science, three (3) credits math, six (6) credits English/Technical Communication, six (6) credits humanities, and six (6) credits social science. ENGL 289 yields an addition three (3) general education credits, for a total of thirty (30).

[2] Courses offered alternate years.

[3] A Geology Elective is any course with a GEOL or GEOE prefix.

[4] Under exceptional circumstances, a student may petition the department chair to substitute Geology Electives for Senior Research.

[5] A program elective is any 300-400 level course with a prefix of GEOL, GEOE, ATM, BIOL, CHEM, or MATH. MATH 441 Engineering Statistics I, and MATH 442 Engineering Statistics II are particularly recommended.

Additional course work in mathematics and statistics is strongly recommended, especially for students planning to go to graduate school. MATH 381 and MATH 382 are recommended statistics courses; MATH 432 is recommended for students interested in numerical modeling of partial differential equations.

Interdisciplinary Sciences

The Bachelor of Science degree in Interdisciplinary Sciences is a science degree program that seeks to serve the needs of students whose goals cannot be met within the other science departments. IS students choose from four areas of specialization: Atmospheric Sciences; Business Applications in Science and Technology; Pre-Professional Health Sciences; and Science, Technology, and Society. The IS degree program allows students to enroll in a wide variety of math and science courses, as well as carefully chosen electives in the humanities, fine arts, and social sciences.

The Interdisciplinary Sciences degree is especially appropriate for the following individuals:

- Students pursuing pre-professional and health services careers, such as law, business, medicine, physical therapy, radiography, etc.;
- Students whose educational and career goals necessitate courses in several departments;
- Students whose professional experiences require that they integrate knowledge from diverse fields.

The benefits of the Interdisciplinary Sciences degree include:

- Flexibility in a wide range of study;
- Individual design allowing the student to help select the content of the degree; and
- The opportunity to study natural sciences, social sciences, humanities, and liberal arts from a broad perspective, thus providing a well-rounded program.

Areas of Specialization

IS majors choose from four areas of specialization that will prepare them for a career or for graduate and professional programs.

1. Atmospheric Sciences:

The Atmospheric Sciences specialization is designed for students whose career goal is meteorology or atmospheric research. Working with faculty from the Dept. of Atmospheric Sciences, students can take coursework to satisfy federal guidelines (e.g., for National Weather Service, US Bureau of Reclamation and US Geological Survey) for the title of meteorologist. This specialization also serves as excellent preparation for graduate study in meteorology, atmospheric sciences, and adjacent fields. Courses range from those in traditional operational meteorology to those in earth system sciences.

2. Business Applications in Science and Technology:

Students pursuing Business Applications in Science and Technology complement a strong background in the mathematics and natural sciences with coursework in business. Through collaboration with the Black Hills State University College of Business and Technology, students in this area of study complete a minor in either business administration (24 cr.) or entrepreneurial studies (25 cr.). These students will be prepared for additional study in Master of Business Administration (MBA) or Technology Management (TM) programs. Potential careers also include pharmaceutical sales and business consulting or working for community and government science agencies.

3. Pre-Professional Health Sciences:

A strong background in science will prepare students in the Pre-Professional Health Sciences specialization for entry into a variety of graduate and professional programs, including medical and dental schools, physical and occupational therapy programs, physicians assistant and chiropractic programs, optometry and ophthalmology specialties, and radiography or medical technology programs. Internships in the community and complementary coursework in the humanities and social sciences are included to help students meet the admissions requirement of the professional schools.

Students planning to enter these professions should consult the programs of study of the schools they plan to attend. Working closely with their advisor, they will select the courses needed to fulfill the graduation requirements for the IS degree and to meet the entrance requirements for the professional schools in health science.

Medical Technology (MT)/Radiologic Technology (RT):

School of Mines has an articulation agreement with Rapid City Regional Hospital, which has fully certified MT and RT programs. Students take prerequisite coursework for MT or RT at School of Mines before applying to either program. Upon completion of the MT or RT program, a student may elect to complete the requirements for the IS degree, thus graduating with both a bachelors degree in IS and the MT or RT certification. A number of the courses needed to complete the MT or RT program count towards the IS degree. Note: Faculty and staff from School of Mines and the IS degree program are not involved in the selection of candidates for the RT/MT programs. School of Mines students are not guaranteed admission to the RT/MT programs.

4. Science, Technology, and Society:

The Science, Technology, and Society specialization combines a strong science background with a firm grounding in environmental, social and science policy issues. Students pursue a science concentration, such as environmental science, or a minor in a science field, which is complemented by studies in areas such as political science, history, humanities, English, and philosophy. Coursework will prepare students for additional study in law school or in science policy and public policy programs. Careers will include positions in community and government agencies, in science and technology companies, in the military, or as science lobbyists.

INTERDISCIPLINARY SCIENCES PROGRAM ADMISSION POLICY

After successful completion of at least sixty-four (64) credit hours and at least one year prior to the intended graduation date, the student must apply for admission to the degree program by filing a plan of study with the IS Steering Committee. The plan of study must be approved by the Steering Committee before a student will be formally admitted to the program. This plan of study consists of (1) a Letter of Intent stating the career goals to which the IS degree coursework is to be applied and (2) an IS worksheet showing the courses already taken and the courses to be completed prior to graduation. The Letter of Intent and worksheet must be reviewed and approved by the student's IS advisor before submission to the Steering Committee. The Letter of Intent form and worksheet are available from the IS office or may be accessed at the IS website online.

The deadlines for submitting the Letter of Intent and worksheet to the IS office are as follows: For May graduates - April 30 of the preceding year; for August graduates - July 30 of preceding year; for December graduates - November 30 of preceding year. Students must have an approved Letter of Intent/worksheet on file in the IS office before registering for IS 498, the senior capstone project.

GENERAL REQUIREMENTS FOR GRADUATION: ALL IS SPECIALIZATIONS

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

I. IS Course Courses (GES 115, IS 201, IS 301, IS 498)	11
II. English sequence (ENGL 101, 279, 289)	9
III. Math, Computer Science, Sciences	
Math and Computer Sciences[1]	min. 12
Biology[2]	min. 3
Chemistry[2]	min. 3
Additional Natural Sciences[3]	min. 24
Other Math, CSC, Science	min. 18
SUBTOTAL	**60**
IV. Humanities and Social Sciences	
Humanities general education	6
Humanities upper division	6
Social Sciences general education	6
Social Science upper division	6
SUBTOTAL	**24**
V. Physical Education	2
VI. Program (Specialization) Approved Electives[4]	22
TOTAL REQUIRED FOR GRADUATION	**128**

[1]All IS specializations require Math 123 Calculus I and a minimum of 3 credit hours in computer science.

[2]Some specializations require additional coursework in chemistry and biology.

[3]All IS specializations require a minimum of 30 credit hours in the natural sciences, including 6 hours in sequence and 12 hours at the upper division.

[4]Business Applications in Science and Technology requires a minor in either business administration or entrepreneurial studies, completed in collaboration with Black Hills State University.

Thirty-six (36) of the required 128 credits must be at the junior or senior level (courses numbered 300 and above.)

IS Core Courses
All IS students take a sequence of four core courses, spread out over the course of four years:

- GES 115: Professionalism in Engineering and Science in the freshman year;
- IS 201: Introduction to Science, Technology, and Society in the sophomore year;
- IS 301: Writing and Research in the Interdisciplinary Sciences in the junior year; and
- IS 498: Undergraduate Research/Scholarship (senior project) in the senior year.

Science Minors available to IS Students:

When possible, students pursuing the IS specializations are strongly encouraged to complete a minor in another science field at School of Mines as part of their 128 total credits. Minors are available in computer science, geology, mathematics, physics, or occupational safety. Students should consult the policy on minors and the specific courses required for each minor, provided elsewhere in the catalog. The IS degree is not available as a minor.

Transfer Studies:

Students who reside in local communities can achieve considerable savings in their education costs by completing a significant portion of their studies close to home before transferring to another institution to complete their desired major. Students who do not intend to pursue a degree offered at School of Mines are encouraged to take courses appropriate for the two-year Associate of Arts (AA) Degree in General Studies. Through this program of access and transfer, students still experience the excellent educational environment found on the School of Mines campus. Students should consult the programs of study for the school from which they plan to graduate and then work closely with their AA advisor to select courses with the highest likelihood of transferability. Completion of the AA degree will fulfill the general education requirements for a baccalaureate degree at the other state universities of South Dakota (BHSU, DSU, NSU, SDSU, USD).

Pre-law/Pre-medicine Study at School of Mines:

While the IS specializations in Pre-Professional Health Sciences and Science, Technology, and Society (STS) are especially designed to help students meet the entrance requirements for medical or law school, a particular baccalaureate degree is not required for admission into most law and medical programs. Graduates from School of Mines with degrees in several of the science and engineering programs have successfully completed these professional programs. Students are encouraged to consult the admissions requirements and policies for those law and medical schools to which they intend to apply.

Teaching Opportunities and Certification:

Students who are interested in teaching science at the secondary education level should contact education programs at the other state universities for information on the auxiliary courses required for certification. Project SELECT, an intensive one-year certification program offered through the Black Hills State University College of Education, may be of interest to students completing the IS and other science degrees at School of Mines. Information on this BHSU program can be obtained from the IS office.

Minor in Entrepreneurial Studies:

A 25 credit minor in Entrepreneurial

Studies is available to all School of Mines students through collaboration with the Black Hills Sate University College of Business and Technology. The requirements for the minor are BADM 406 or ACCT 210/ACCT 211, BADM 336, BADM 438, BADM 334, BADM 360, BADM 370, BADM 474, and BADM 492. The minor must be approved by the student's major department. Contact the Office of Interdisciplinary Sciences for more information.

Interdisciplinary Sciences
(Upper level courses are in bold print)

IS 191, 192, 201[1], 270, 291, 292, 301[1], 370, 380, 391, 392, 491, 498[1], 492, 691, 692

[1]IS Degree core courses.

Specialization in Atmospheric Sciences: Curriculum/Course Checklist

Course sequences vary by student entry year, math/science placements, availability of ATM courses, and career objectives. Students should consult with an ATM/IS advisor for a more personalized course of study based on career goals within the atmospheric sciences.

Freshman Year

First Semester

CHEM 112[1]	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
ENGL 101	Composition I	3
GES 115/L	Professionalism/Engr and Sci	2
IS 090	University Mentoring	0
MATH 123	Calculus I	4
Gen Ed Humanities/Social Science Elective		3
TOTAL		**16**

Second Semester

CHEM 114	General Chemistry II	3
CHEM 114L	General Chemistry II Lab	1
CSC 150/L	Computer Science I/Lab	3
MATH 125	Calculus II	4
PE	Physical Education	1
Gen Ed Humanities/Social Science Elective		3
TOTAL		**15**

Sophomore Year

First Semester

ATM 301	Intro to Atmospheric Science	3
ENGL 279	Technical Communications I	3
MATH 225	Calculus III	4
PE	Physical Education	1
PHYS 211	University Physics I	3
Gen Ed Humanities/Social Science Elective		3
TOTAL		**17**

Second Semester

ATM 406	Global Environ Change	3
ENGL 289	Technical Communication II	3
IS 201	Introduction to Science, Technology, and Society	3
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
Gen Ed Humanities/Social Science Elective		3
TOTAL		**16**

Junior Year

First Semester

ATM 402	Global Carbon Cycle	3
ATM 450/L	Synoptic Meteorology I/Lab	3
BIOL 311	Principles of Ecology	3
PHYS 341	Thermodynamics	3
Upper Division HU/SS Elective		3
TOTAL		**15**

Second Semester

ATM/SCI/MATH/ENG Electives		10
IS 301	Writing and Research in the Interdisciplinary Sciences	3
Upper Division HU/SS Elective		3
TOTAL		**16**

Senior Year

First Semester

ATM/SCI/MATH/ENG Electives		14
Upper Division HU/SS Elective		3
TOTAL		**17**

Second Semester

ATM/SCI/MATH/ENG Electives		10
IS 498	Undergrad Res/Scholarship	3
Upper Division HU/SS Elective		3
TOTAL		**16**

128 credits required for graduation

Curriculum Notes

[1]All IS specializations require a minimum of thirty (30) semester hours of natural sciences, including a minimum of three (3) semester hours in chemistry, three (3) semester hours in biology, six (6) semester hours in a

science sequence, and twelve (12) semester hours at the upper division. The Atmospheric Sciences/Meteorology specialization requires one year of General Chemistry with labs, one year of University Physics with lab, and one semester of Biol 311: Principles of Ecology. Students should consult with their advisors to determine additional science courses appropriate for their career paths.

[2]All IS specializations require Math 123 or a math course requiring Math 123 as its prerequisite. Atmospheric Sciences/Meteorology requires CSC 150/150L and additional math coursework beyond Math 123. Math 102 and Math 120 may be used towards graduation requirements.

[3]Students should consult with their Atmospheric Sciences/IS advisors on the most appropriate ATM/Science/Math/ Engineering electives for their career paths. See also p. 140.

Specialization in Business Applications in Science And Technology--Business Administration Minor: Curriculum/Course Checklist

IS students selecting the Business Applications in Science and Technology specialization are expected to pursue a minor in one of two areas: Business Administration or Entrepreneurial Studies. These minors are earned through collaboration with Black Hills State University. Students should consult with their advisors to determine the most appropriate minor for their career interests. Course sequence may vary by student entry year, math/science placements, availability of business courses, and career objectives. Students should consult with an IS advisor for a more personalized course of study.

Freshman Year

First Semester

ECON 201	Principles of Microeconomics	3
ENGL 101	Composition I	3
GES 115/L	Professionalism/Engr and Sci	2
IS 090	University Mentoring	0
Math/CSC Elective[1]		3
Science Elective[2]		4
TOTAL		**15**

Second Semester

Math/CSC Elective		6
PE	Physical Education	1
Science Electives		7
Gen Ed Humanities/Social Sciences Elective		3
TOTAL		**17**

Sophomore Year

First semester

ACCT 210	Principles of Accounting I	3
ENGL 279	Technical Communications I	3
IS 201	Intro to Science, Technology, and Society	3
PE	Physical Education	1
Science Elective		4
Gen Ed Humanities/Social Science Elective		3
TOTAL		**17**

Second Semester

ACCT 211	Principles of Accounting II	3
ENGL 289	Technical Communications II	3
MIS 205	Advanced Computer Appl	3
Science Elective		5
Gen Ed Humanities Elective		3
TOTAL		**17**

Junior Year

First Semester

BADM 350	Legal Environ Business	3
Math/CSC Elective		3
Science Electives		7
Electives		2
TOTAL		**15**

Second Semester

BADM 360	Organ and Management	3
IS 301	Writing and Research in the Interdisciplinary Sciences	3
Science Electives		7
Electives		2
TOTAL		**15**

Senior Year

First Semester

BADM 370	Marketing	3
Science Electives		7
Upper Division Humanities Elective		3
Electives		3
TOTAL		16

Second Semester

BADM 310	Business Finance	3
IS 498	Undergrad Res/Scholarship	3
Science Electives		7
Upper Division Humanities Elective		3

TOTAL 16

128 credits required for graduation

Curriculum Notes:

[1]All IS specializations require Math 123 or a math course requiring Math 123 as its prerequisite. Math 102 and Math 120 may be used towards graduation requirements. Students should consult with their advisors on the most appropriate math/computer science courses for their career paths.

[2]All IS specializations require a minimum of thirty (30) semester hours of natural sciences including a minimum of three (3) semester hours in chemistry, three (3) semester hours in biology, six (6) semester hours in a science sequence; and twelve (12) semester hours at the upper division level. Students pursuing the Business Applications in Science and Technology specialization are expected to choose a science concentration. A minor in a science field (e.g., computer science, geology, mathematics, physics, occupational safety) is highly encouraged. Students should consult with their advisors to determine the most appropriate science courses and sequence for their career paths.

SPECIALIZATION IN BUSINESS APPLICATIONS IN SCIENCE AND TECHNOLOGY--

IS students selecting the Business Applications in Science and Technology specialization are expected to pursue a minor in one of two areas: Business Administration or Entrepreneurial Studies. These minors are earned through collaboration with Black Hills State University. Students should consult with their advisors to determine the most appropriate minor for their career interests. Course sequence may vary by student entry year, math/science placements, availability of business courses, and career objectives. Students should consult with an IS advisor for a more personalized course of study.

ENTREPRENEURIAL STUDIES MINOR: CURRICULUM/COURSE CHECKLIST

FRESHMAN YEAR

First Semester

ENGL 101	Composition I	3
GES 115/L	Professionalism/Engr and Sci	2
IS 090	University Mentoring	0
Math/CSC Elective[1]		3
Science Elective[2]		4
Gen Ed Humanities/Social Sciences Elective		3
TOTAL		**15**

Second Semester

Math/CSC Elective		6
PE	Physical Education	1
Science Electives		7
Gen Ed Humanities/Social Science Elective		3
TOTAL		**17**

SOPHOMORE YEAR

First semester

ACCT 210	Principles of Accounting I	3
ENGL 279	Technical Communications	3
IS 201	Intro to Science, Technology, and Society	3
PE Physical Education		1
Science Electives		3
Gen Ed Humanities/Social Science Elective		3
TOTAL		**16**

Second Semester

ACCT 211	Principles of Accounting II	3
ENGL 289	Technical Communications II	3
Science Electives		7
Gen Ed Humanities/Social Sciences Elective		3
TOTAL		16

JUNIOR YEAR

First Semester

BADM 338	Entrepreneurship I	3
Math/CSC Elective		3
Science Electives		7
Upper Division Humanities Elective		3
TOTAL		**16**

Second Semester

BADM 348	Entrepreneurship II	3
BADM 360	Organ and Management	3
IS 301	Writing and Research in the Interdisciplinary Sciences	3
Science Electives		7
TOTAL		**16**

Senior Year

First Semester

BADM 334	Small Business Management	3
BADM 370	Marketing	3
Science Electives		7
Upper Division Humanities Elective		3
TOTAL		**16**

Second Semester

BADM 474	Personal Selling	3
BADM 492	Business Plan Writing	1
IS 498	Undergrad Res/Scholarship	3
Science Electives		6
Upper Division Social Sciences Elective		3
TOTAL		**16**

128 credits required for graduation

Curriculum Notes:

[1]All IS specializations require Math 123 or a math course requiring Math 123 as its prerequisite. Math 102 and Math 120 may be used towards graduation requirements. Students should consult with their advisors on the most appropriate math/computer science courses for their career paths.

[2]All IS specializations require a minimum of thirty (30) semester hours of natural sciences including a minimum of three (3) semester hours in chemistry; three (3) semester hours in biology; six (6) semesters in a science sequence; and twelve (12) semester hours at the upper division level. Students pursuing the Business Applications in Science and Technology specialization are expected to choose a science concentration. A minor in a science field (e.g., computer science, geology, mathematics, physics, occupational safety) is highly encouraged. Students should consult with their advisors to determine the most appropriate science courses and sequence for their career paths.

Specialization in Pre-Professional Health Sciences: Curriculum/Course Checklist

Students should consult with their advisors or the IS office for a more personalized course of study based on career goals within the health sciences. Course requirements vary according to professional program, e.g., medical school, radiographic technology, physical therapy. Course sequence may also vary by student entry year, math/science placements, and career objectives.

Freshman Year

First Semester

BIOL 121/121L	Human Anatomy & Lab	4
ENGL 101	Composition I	3
GES 115	Professionalism/Engr and Sci	2
IS 090	University Mentoring	0
Math/CSC Elective[1]		3
Gen Ed Humanities/Social Science Elective		3
TOTAL		**15**

Second Semester

BIOL 123/123L	Basic Physiology and Lab	4
CHEM 112/112L	Gen Chemistry I and Lab	4
Math/CSC Elective		3
PE	Physical Education	1
Gen Ed Humanities/Social Science Elective		3
TOTAL		**15**

Sophomore Year

First Semester

BIOL 151/151L	Gen Biology I & Lab	4
CHEM 114/114L	Gen Chemistry II & Lab	4
ENGL 279	Technical Communications I	3
IS 201	Introduction to Science, Technology, and Society	3
Gen Ed Humanities/Social Science Elective		3
TOTAL		**17**

Second Semester

BIOL 153/153L	Gen Biology II & Lab	4
ENGL 289	Technical Communications II	3
Math/CSC Elective		3
Gen Ed Humanities/Social Science Elective		3
Elective[2]		4
TOTAL		**17**

JUNIOR YEAR

First Semester

Math/CSC Elective		3
Upper Division Science Elective		3
Upper Division HU/SS Elective		3
Electives		7
TOTAL		**16**

Second Semester

IS 301	Writing and Research in the Interdisciplinary Sciences	3
Science Electives		4
Upper Division HU/SS elective		3

Upper Division Science Elective		3
Elective		4
TOTAL		**17**

SENIOR YEAR

First Semester

Science Elective		4
Upper Division HU/SS Elective		3
Upper Division Science Elective		3
PE	Physical Education	1
Elective		4
TOTAL		**15**

Second Semester

IS 498	Undergrad Res/Scholarship	3
Science Electives		4
Upper Division HU/SS Elective		3
Upper Division Science Elective		3
Elective		3
TOTAL		**16**

128 credits required for graduation

Curriculum Notes:

[1]All IS specializations require Math 123 or a math course requiring Math 123 as its prerequisite. Math 102 and Math 120 may be used towards graduation requirements. Students should consult with their advisors on the most appropriate math/computer science courses for their career paths.

[2]Elective credits may include additional course work at the 100 level or above in math, computer science, natural and physical sciences, humanities, social sciences, business, military science, or engineering as needed to meet the required minimums or to meet admissions requirements for professional programs in health science. Students should consult with their advisors on the most appropriate courses for their career goals.

SCIENCE, TECHNOLOGY, AND SOCIETY: CURRICULUM/COURSE CHECKLIST

Course sequence may vary by student entry year, math/science placements, and career objectives. Students should consult with their advisors for a more personalized course of study based on career plans.

FRESHMAN YEAR

First Semester

ENGL 101	Composition I	3
GES 115	Professionalism/Engr and Sci	2
IS 090	University Mentoring	0
Math/CSC Elective[1]		3
Science Elective[2]		4
Gen Ed Humanities/Social Science Elective		3
TOTAL		**15**

Second Semester

Math/CSC Elective		3
PE	Physical Education	1
Science Electives		7
Gen Ed Humanities/Social Science Elective		3
Elective[3]		3
TOTAL		**17**

SOPHOMORE YEAR

First semester

ENGL 279	Technical Communications I	3
IS 201	Introduction to Science, Technology, and Society	3
PE	Physical Education	1
Science Elective		4
Gen Ed Humanities/Social Science Elective		3
Elective		3
TOTAL		**17**

Second Semester

ENGL 289	Technical Communications II	3
Math/CSC Elective		3
Science Elective		4
Gen Ed Humanities/Social Science Elective		3
Elective		3
TOTAL		**16**

JUNIOR YEAR

First Semester

Math/CSC Elective		3
Science Electives		7
Upper Division HU/SS Elective		3
Elective		3
TOTAL		**16**

Second Semester

IS 301	Writing and Research in the Interdisciplinary Sciences	3
Science Electives		7
Upper Division HU/SS elective		3
Elective		3
TOTAL		**16**

Senior Year

First Semester

Science Electives		8
Upper Division HU/SS Elective		3
Elective		4
TOTAL		**15**

Second Semester

IS 498	Undergrad Res/Scholarship	3
Science Electives		7
Upper Division HU/SS Elective		3
Elective		3
TOTAL		**16**

128 credits required for graduation

Curriculum Notes:

[1]All IS specializations require Math 123 or a math course requiring Math 123 as its prerequisite. Math 102 and Math 120 may be used towards graduation requirements. Students should consult with their advisors on the most appropriate math/computer science courses for their career paths.

[2]All IS specializations require a minimum of thirty (30) semester hours of natural sciences including a minimum of three (3) semester hours in chemistry, three (3) semester hours in biology, six (6) semester hours of a science sequence, and twelve (12) semester hours at the upper division level. Students pursuing the Science, Technology, and Society specialization are expected to choose a science concentration. A minor in a science field (e.g., atmospheric science, computer science, geology, mathematics, physics, occupational safety) is highly encouraged. Students should consult with their advisors to determine the most appropriate science courses and sequence for their career paths.

[3] Elective credits may include additional college course work at the 100 level or above in math, computer science, sciences, humanities, IS, social sciences, business, military science, or engineering as needed to meet the required minimums or to qualify for a science minor. Students should consult with their advisors to determine the most appropriate elective courses for their career goals.

Humanities

CONTACT INFORMATION

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FACULTY

Associate Professor Rice, Chair; Professors Antonen, Boysen, Feiszli, Shirley, and Sneller; Associate Professors Hudgens, Lee, Mitchell, and Palmer; Assistant Professor Bruni; Instructor Swanson.

HUMANITIES

The Department of Humanities provides study in the fields of communication, fine arts, literature, religion, western civilization, and philosophy. The curriculum provides a broad-based approach, which develops linkages between the humanities areas and the technological fields that have been the mission of School of Mines. Interdisciplinary Sciences degree candidates are required to complete twenty-four (24) semester hours of humanities and social science courses. Other science and engineering degree candidates are required to complete sixteen (16) semester hours of humanities and social sciences courses - at least six (6) credits in each area. Engineering majors are required to enroll in at least one upper-level humanities or social science course (of at least three (3) credit hours).

All IS degree candidates must complete ENGL 101, ENGL 279, ENGL 289, IS 201, IS 301, and IS 498, which cannot be used to meet the humanities and social sciences requirements.

HUMANITIES
(Upper level courses are in bold print.)

Art:
ART 111, 112, 280, ARTH 251, 211, **321**, **491**, **492**

English:
ENGL 031[1], 032[1], 033[1], 101[2], 201[2] 221, 222, 241, 242, 250, 279[2], 289[2], **300**, **330, 343**, **350**,

360, **374**, **383**, **391**[3], **392**[3], **468**
Foreign Language:
FREN 101, 102, GER 101, 102, JAPN 101, 102, LAKL 101, 102, SPAN 101, 102

History:
HIST 121, 122

Humanities:
HUM 100, 200, 291, 292, **300**, **350**, **375**, **410**, **491**, **492**

Music:
MUAP 200, 201, MUEN 121[4], 122[4], 250[3], 260, **330** MUS 100, 110, 250, **326**
Philosophy:
PHIL 100, 200, 220, 233

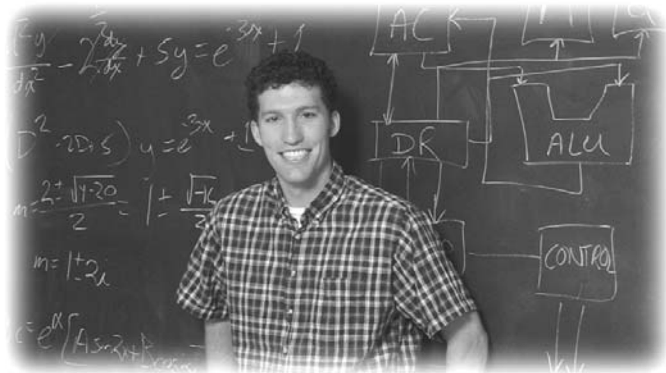
Religion:
REL 230, 250

Speech Communications:
SPCM 101[3]

[1] Does not meet general requirements for graduation.
[2] Meets general requirements for graduation, but not for humanities credits.
[3] May not be used as humanities credit, but may be used for free elective credit. (Consult advisor for further details.)
[4] May not be used as humanities credit, but may be used for PE or free elective credit. (Consult advisor for further details.)

Mines Matters: The Old Main, also called the Liberal Arts Building, was razed in 1994. The arches in the building were saved and rebuilt where they stand today in the Quad.

Applied and Computational Mathematics



Contact Information

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Faculty

Associate Professor Johnson, Chair; Professors Carda, Corwin, Logar, and Teets; Associate Professors Burgoyne, McGough, Riley; Assistant Professors Braman, Dahl, Geary, Hansen, and Kowalski, Instructors Lofberg and Trimble; Emeritus Professor Opp.

General Information

Mathematics is a broad field of study that is foundational to many areas of Science and Engineering. The Department of Mathematics and Computer Science offers a Bachelor of Science Degree in Applied and Computational Mathematics. This degree program emphasizes computational methods and the use of technology applied to the mathematical problems in industry and the sciences. Students who desire to major in this program should announce their intention to the Department of Mathematics and Computer Science as early as possible and should consult advisors in the department at each registration period before selecting electives to round out the courses of study outlined in the departmental curriculum. Any student who is pursuing a double major and whose designated advisor is in another department should consult an advisor in the Mathematics and Computer Science Department at each registration to ensure that reasonable progress is being made and that conflicts are avoided.

Prerequisite and Placement Information

Before registering for any course in Mathematics, a student must either have met all prerequisites and be enrolled in all corequisites, passed the appropriate placement examinations, or have obtained permission from the Chair of the Mathematics and Computer Science Department. Placement examinations, however, may only be used for initial mathematics course placement (exception - students successfully completing Math 021 may skip Math 101 and proceed to Math 102 if they have obtained the written permission of the Vice President for Academic Affairs and earned a successful Algebra Placement Examination score.) The prerequisite for MATH 120 is a grade of "C" or better in MATH 102, or equivalent transfer credit from an accredited college or university, or an acceptable ACT score and Algebra Placement Examination score. The prerequisite for MATH 123 is a grade of "C" or better in MATH 102, or equivalent transfer credit from an accredited college or university, or an acceptable ACT score and Algebra Placement Examination score. Additionally, students enrolling in MATH 123 must have passed MATH 120 with a grade of "C" or better, or have a high enough score on the Trigonometry portion of the COMPASS exam to enroll concurrently in MATH 120. The prerequisites for MATH 125 are a grade of "C" or better in Calculus I or equivalent transfer credit from an accredited college or university, and MATH 120 with a grade of "C" or better or an acceptable score on the Trigonometry portion of the COMPASS exam. Again, placement exams (with the exception noted above) may only be used for initial placement. A student enrolled in Trigonometry (MATH 120), for example, must pass this course with at least a "C" before being allowed to enroll in MATH 125; a student receiving below a "C" in Trigonometry may not use a placement examination to skip a repeat of Trigonometry before enrolling in MATH 125. Placement examinations are given immediately prior to registration.

Students transferring from other institutions or returning to School of Mines after interrupting studies for a period of one year or more should consult the Chair of the Department of Mathematics and Computer Science to discuss proper placement.

DEPARTMENTAL COURSES

Mathematics 021 and 101 may not be used for credit toward any Bachelor's degree at School of Mines. College Algebra, Trigonometry, and Pre-Calculus courses may not be counted toward any mathematics, computer science, or engineering degree. Other majors should consult their departments on policies regarding these courses.

In an attempt to help students plan their future semesters, the following information is presented. This reflects the best available knowledge at the time of the preparation of this document. This is not meant as a guarantee of when classes will be offered. Students concerned about when classes will be offered should contact the Department Chair for any changes to the following. Courses not listed below have no defined rotation and will be offered contingent upon demand and staff availability. Summer offerings are highly dependent on staffing. An attempt will be made to offer MATH 101, MATH 102, MATH 120, MATH 123, MATH 125, MATH 225, and MATH 321 during the summer.

Classes that are typically offered every semester include MATH 021, MATH 102, MATH 120, MATH 123, MATH 125, MATH 225, MATH 321, MATH 373, and MATH 381.

Classes that are typically offered every fall semester include MATH 101, MATH 281, and MATH 486.

Classes that are typically offered every spring semester include MATH 315, MATH 382, MATH 441, MATH 442, and MATH 353.

Classes that are typically offered in the fall semester of even numbered years, for example fall 2006, include MATH 413 and MATH 431.

Classes that are typically offered in the spring semester of odd numbered years, for example spring 2005, include MATH 421, and MATH 471.

Classes that are typically offered in the fall semester of odd numbered years, for example fall 2007, include MATH 432 and MATH 423.

Classes that are typically offered in the spring semester of even numbered years, for example spring 2006, include MATH 424, MATH 451, and MATH 687.

APPLIED AND COMPUTATIONAL MATHEMATICS MAJOR

Students majoring in Mathematics will use the accompanying Applied and Computational Mathematics curriculum. The curriculum includes fifty-seven (57) credits of mathematics courses, eleven (11) credits of computer science, ten (10) credits of sciences, and at least nine credits of additional science/engineering courses that fall in a specific field (see emphasis area below). Any student majoring in Mathematics and desiring a minor in another field should consult his or her advisor in the Department of Mathematics and Computer Science as early in his or her program of study as possible. In addition, the student must contact the Office of Academic and Enrollment Services in order to declare a major. Departmental majors contemplating a career in actuarial science should prepare for the examinations given by the Society of Actuaries. It is recommended that this preparation be attained, in part, by electing the following courses: MATH 353, MATH 381, MATH 382, MATH 471, MATH 687, IENG 362, and IENG 301 or IENG 302. Information concerning these examinations can be obtained from the Department of Mathematics and Computer Science.

The primary goal of the Applied and

Computational Mathematics program is to give our graduates a firm understanding of mathematics and its applications to science and engineering. We expect our graduates to develop a strong foundation of knowledge and skill in the core areas of analysis, differential equations, numerical methods, and modeling. We also expect them to attain a basic understanding of probability, statistics, and algebra. Since applied mathematicians are problem solvers, our graduates must develop the ability to formulate and solve problems arising from scientific and engineering applications. This entails acquiring fundamental knowledge in the basic sciences, which our students accomplish by taking courses in an emphasis area. The student will take three (3) courses in an external discipline that will provide exposure and depth in an application area of mathematics. Information on emphasis areas and the associated courses is available from the department or advisor.

Our graduates must be prepared to continue learning throughout their careers. In the two-course sequence of MATH 498 and MATH 402, students will have the opportunity to work with individual faculty members on research and develop their communication skills. This work will result in a technical paper and an oral presentation.

Upon graduation, we expect some of our graduates to pursue careers in fields such as computer software development, actuarial science, applied statistics, manufacturing quality control, and operations research. Others will go on to teach mathematics at the elementary or secondary levels or to pursue advanced degrees in mathematics.

An Applied and Computational Mathematics major must complete a minimum of sixteen (16) credit hours in Humanities and Social Sciences with at least six (6) credit hours in Humanities and at least six (6) credit hours in Social Sciences. Refer to the Humanities and Social Sciences section of this catalog for a list of courses satisfying these requirements. It is also important to refer to the General Education Core Requirements under Bachelor of Science Graduation Requirements for further information. Students must complete the General Education Core Requirements within the first sixty-four (64) credits.

The accompanying sample schedule lists all required classes for the degree in their proper prerequisite sequence. Students should consult course listings for prerequisites and should consult their advisors at each registration.

Minor in Mathematics

The requirements for a minor in Mathematics are MATH 123, MATH 125, MATH 225, MATH 423, and a minimum of 6 credit hours from the following list: MATH 315, MATH 381, MATH 382, or any MATH course 400-level and above, excluding Independent Studies courses. Thus, a total of at least twenty-two (22) semester credit hours is needed for a Math minor. MATH 423 is offered in alternate years so plans for a minor should be made early.

A minor in the Department of Mathematics and Computer Science must be approved by the student's major department. A form for declaring a minor is available at the Office of Academic and Enrollment Services. The form must be completed and signed by the Department Chairs from both departments involved in this minor.

Mathematics and Computer Science Double Major

Due to the large number of courses common to the Computer Science major and the Mathematics major, many students find it attractive to pursue a double major in these two areas. Students are encouraged to pursue the double major and should contact their advisor for details.

Applied and Computational Mathematics Curriculum

For the Bachelor of Science in Mathematics, a student must:

1. take all of the courses listed in the Applied and Computational Mathematics Curriculum;
2. take three (3) emphasis area courses (information about emphasis areas and supporting courses is available from the department); and
3. have a departmental Grade Point Average

of at least 2.00 in all Mathematics courses 300 level or higher. (Courses taken more than once will have only the higher grade counted for computing the departmental Grade Point Average.)

Applied and Computational Mathematics Curriculum/Checklist

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog. Additional information about the program may be found at http://www.mcs.sdsmt.edu/

Freshman Year

First Semester

ENGL 101	Composition I	3
CHEM 112	General Chemistry I	3
MATH 123	Calculus I	4
CSC 150	Computer Science I	3
PE	Physical Education	1
Elective/Lab[1]		3
TOTAL		**17**

Second Semester

MATH 125	Calculus II	4
PHYS 211	University Physics I	3
CSC 250	Computer Science II	4
PE	Physical Education	1
Elective/Lab[1]		5
TOTAL		**17**

Sophomore Year

First Semester

ENGL 279	Technical Communications I	3
MATH 225	Calculus III	4
MATH 321	Differential Equations	4
PHYS 213	University Physics II	3
Elective/Lab[1]		3
TOTAL		**17**

Second Semester

MATH 315	Linear Algebra	4
CSC 251	Finite Structures	4
ENGL 289	Technical Communications II	3
MATH 373	Intro to Numerical Analysis	3
Elective/Lab[1]		3
TOTAL		**17**

Junior Year

First Semester

MATH 413	Abstract Algebra	3
MATH 381	Probability and Statistics	3
MATH 431	Dynamical Systems	3
Elective[1]/Emphasis[2]		6
TOTAL		**15**

Second Semester

MATH 382	Probability and Statistics II	3
MATH 471	Numerical Analysis	3
MATH 421	Complex Analysis	3
Elective[1]/Emphasis[2]		6
TOTAL		**15**

Senior Year

First Semester

MATH 423	Advanced Calculus I	4
MATH 432	Partial Differential Equations	3
MATH 498	Undergraduate Research I	1
Elective[1]/Emphasis[2]		7
TOTAL		**15**

Second Semester

MATH 424	Advanced Calculus II	4
MATH 451	Math Modeling	3
MATH 402	Communicating Mathematics	1
Elective[1]/Emphasis[2]		7
TOTAL		**15**

128 credits required for graduation

Curriculum Notes

[1] Sixteen (16) semester hours of electives must be in Humanities and Social Sciences. At least six (6) hours must be in Humanities and at least six (6) hours must be in Social Sciences. See Humanities and Social Sciences sections of this catalog for courses in each area. Six (6) credits of Humanities, six (6) credits of Social Sciences, and PHYS 213L or CHEM 112L lab must be completed within the first sixty-four (64) hours. It is important to refer to the General Education Requirements under Bachelor of Science Graduation Requirements for further information.

[2] The student must complete three (3) courses from a science or engineering emphasis area. Information about emphasis areas and the associated courses is available from the department.

Military Science

CONTACT INFORMATION

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FACULTY

Professor Guthrie, Chair; Assistant Professors Alcorn, Porter, and Reudebusch.

GENERAL INFORMATION

School of Mines maintains a unit of the senior division of the Army Reserve Officers Training Corps (ROTC). The unit was established in 1950 and is administered by commissioned and noncommissioned officers of the United States Army nominated by the Department of the Army and approved by the president of the school. The ROTC program is open to both men and women. MSL courses complement any course of study providing leadership training unavailable anywhere else on campus. Participation in the ROTC Basic Course incurs no military obligation.

Laudable achievements by the ROTC corps of cadets includes: three-time consecutive first place finishes in varsity Ranger Challenge team competition, first-time occurrence of two competing teams in 2003, individual cadet accomplishment of #13 / 4890 on national order of merit listing and team / individual competition at Bataan Memorial Death March.

CURRICULUM

ROTC provides leadership training and experience demanded by both corporate America and the U.S. Army. ROTC consists of Basic and Advance courses of instructions. The Basic Course consists of the first four semesters of MSL. It is designed to provide all college students leadership and management skills that complement any course of study. There is no obligation or commitment to continue in ROTC or serve in the Armed Forces. The Advanced Course consists of the last four semesters of the ROTC program. The Advanced Course is offered to students possessing the potential to become Army officers and who desire to serve as commissioned officers in the Active Army, U.S. Army Reserve, or the Army National Guard. The objective of the Advanced Course is to select, train, and prepare students for military service. The ROTC program is designed to provide an understanding of the fundamental concepts and principles of military art and science; to develop leadership and managerial potential and a basic understanding of associated professional knowledge; to develop a strong sense of personal integrity, honor, and individual responsibility; and to develop an appreciation of the requirements for national security. Attainment of these objectives will prepare students for commissioning and will establish a sound basis for future professional development and effective performance in the Army or any chosen career field.

In the traditional four-year program, the student enrolls in eight consecutive semesters of MSL courses, two (2) credit hours each semester the first two (2) years, and four (4) credit hours each semester the last two (2) years. Leadership laboratories are offered concurrently with each of the classroom courses. Non-traditional two-year programs include eligible veterans with prior military service, current members of the US Army Reserve or Army National Guard, and students who have had high school Junior ROTC or Civilian Air Patrol experience. A two-year program is available for any student having four academic semesters remaining or enrollment into an School of Mines masters degree program after attending a summer ROTC Leadership Training Course at Ft. Knox, Kentucky. Participation at the basic course does not carry any commitment to participate in ROTC but it does satisfy the prerequisites necessary to enter the final four semesters of ROTC.

Students must additionally complete a course in the following areas to satisfy commissioning requirements: 1) American Military History, 2) Communications, and 3) Computer Literacy.

Tuition, Credit, and Equipment

Military Science and Leadership courses are tuition free. Books and equipment are provided by the department. Associated fees assessed for all courses do apply. MSL credit may be applied as free electives towards graduation or can be used as a physical education credit.

Financial Information

Financial support of $250 Freshman, $300 Sophomore, $350 Junior, and $400 Senior subsistence per month for up to ten months of the academic school year is paid to contracted students enrolled in the ROTC Advanced and Basic Courses. Students attending the four-week ROTC Leadership Training Course or the 32-day Leaders Development and Assessment Course (LDAC) receive approximately $800 plus room, board, and travel expenses.

Additional financial aid is available to eligible freshman, sophomore, and junior students in the form of four-year, three-year, and two-year Army ROTC scholarships. The scholarship provides tuition, fees, and a textbook allowance, in addition to the monthly subsistence allowance paid during the school year. In addition, all non-scholarship advanced course cadets receive a 50% reduction in tuition costs.

Extracurricular Activities

Military-related extracurricular activities and organizations available to the ROTC student include Scabbard and Blade, Pershing Rifles, Bataan Memorial Death March, and the School of Mines Ranger Challenge Team. Students may also take part in voluntary hands-on training to include physical fitness, self-defense, survival, weapons, orienteering, rappelling, mountaineering, and first aid. These exercises are designed to provide the student with an opportunity to practice and improve skills learned in the classroom.

Physical Education

<u>CONTACT INFORMATION</u>

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<u>FACULTY</u>

Associate Professor Schafer, Chair; Professors Felderman and Welsh; Assistant Professor Kratzer.

<u>PHYSICAL EDUCATION</u>

The physical education program is administered as a phase of a student's general education with the primary mission of the department being to provide physical activity for each student. The main objective is to assist in developing a healthy and active lifestyle for each student.

The specific objectives are to create an interest in physical fitness and physical skills and to develop those skills as much as time and facilities permit, while fulfilling the physical education requirement for graduation.

Physics

CONTACT INFORMATION

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FACULTY

Associate Professor Corey, Chair; Professors Foygel and Petukhov; Associate Professor Sobolev.

PHYSICS

The goal of a program of study in Physics is to provide the student with an understanding of the basic laws of physics and to develop skills that will enable the student to further explore physical phenomena and to solve related problems.

The student should have a sense of curiosity about their surroundings and a strong desire, not only to find solutions to problems that are encountered, but also to develop a deeper understanding of the basic principles involved. The student will be expected to develop a high level of mathematical skills and to become proficient in oral and written communications. Laboratory skills are also emphasized.

At the Bachelor of Science level, the student will not be expected to specialize in any branch of physics. However, the curriculum does have room for electives, providing an opportunity to develop a minor in other fields of science or in an engineering discipline. It provides a background in applications of physics for students seeking employment in industry and also provides a solid foundation for graduate study in physics or in other fields such as geophysics, meteorology, metallurgy, computer science, mathematics, materials science, and many branches of engineering.

Because physics is the basis of most engineering disciplines, understanding basic principles of physics can help one become a better engineer. An increasing number of students are choosing a double major, consisting of physics plus some field of engineering. Students going this route often end up in industrial research and development. Another factor to consider is that, in a rapidly changing economy, where one field of engineering may be in a slump while others are not, understanding physics can assist one in moving across disciplines. For these reasons, we encourage all students to consider double majors.

Graduate studies leading to the degree of Master of Science and Ph.D are offered. Research is primarily in solid state physics. At this level of study, the student will be expected to assume much of the responsibility for carrying out a research project. Graduate studies in the Physics Department are an integral component of the Materials Engineering and Science, and Nanoscience and Nanoengineering programs. For details of graduate programs in physics, see the Graduate section.

Minor in Physics

A minor in physics requires a minimum of eighteen (18) hours of courses in physics, which must include PHYS 213, and at least fifteen (15) hours of physics courses numbered higher than PHYS 213. All minors in physics must be approved by the department and must conform to the institutional policies and guidelines for minors.

Physics Laboratories

The facilities in the EE-Physics Building are ample for all aspects of the department's experimental work from the introductory laboratories through graduate research. They are equipped to enable the student to observe physical phenomena, demonstrate physical principles, and learn techniques for making quantitative measurements in the fields of mechanics, heat, optics, electricity and magnetism, atomic physics, and solid state physics. The equipment is of the type that the student is likely to encounter after graduation with emphasis on computer-based data acquisition and control of experiments.

Physics Curriculum/Checklist

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
ENGL 101	Composition I	3
PE	Physical Education	1
Humanities or Social Sciences Elective(s)		3
TOTAL		15

Second Semester

MATH 125	Calculus II	4
PHYS 211	University Physics I	3
PE	Physical Education	1
CHEM 114	General Chemistry II	3
CHEM 114L	Gen Chemistry II Lab	1
CSC 150	Computer Science I	3
TOTAL		**15**

Sophomore Year

First Semester

MATH 225	Calculus III	4
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
PHYS 275	Relativity	3
ENGL 279	Technical Communications I	3
Humanities or Social Sciences Elective(s)		3
TOTAL		**17**

Second Semester

MATH 321	Differential Equations	4
EE 220	Circuits I	4
ENGL 289	Technical Communications II	3
Humanities or Social Sciences Elective(s)		6
TOTAL		**17**

Junior Year

First Semester

MATH 432	Partial Differential Equations	3
PHYS 341	Thermodynamics	3
PHYS 312	Exper Physics Design I	2
CENG 244	Intro to Digital Systems	4
Humanities or Social Sciences Elective(s)		3
TOTAL		**15**

Second Semester

MATH 315	Linear Algebra	4
PHYS 451	Classical Mechanics	4
PHYS 471	Quantum Mechanics	4
PHYS 445	Statistical Mechanics[1]	4
PHYS 314	Exper Physics Design II	2
TOTAL		**18**

SENIOR YEAR

First Semester

PHYS 421	Electromagnetism	4
PHYS 361	Optics[1]	3
PHYS 412	Advanced Design Projects I	2
PHYS 481	Mathematical Physics[1]	4
Humanities or Social Sciences Elective(s)		3
TOTAL		**16**

Second Semester

PHYS 433	Nuclear and Particle Physics[1]	3
PHYS 439	Solid State Physics[1]	4
PHYS 414	Advanced Design Projects II	2
Humanities or Social Sciences Elective(s)		6
TOTAL		**15**

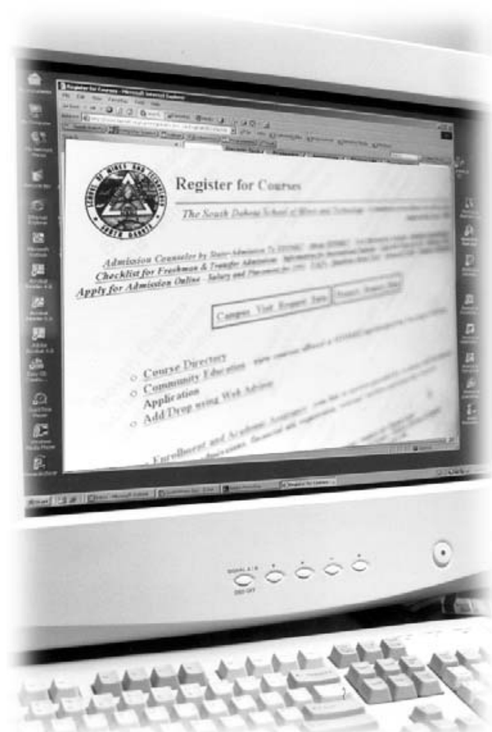
128 credits required for graduation

Curriculum Notes

At the end of the sophomore year twelve (12) hours of electives must include six (6) hours in humanities (in two (2) disciplines or in a sequence of foreign language courses) and six (6) hours in social sciences (in two (2) disciplines).

The electives must contain a minimum of sixteen (16) hours in social sciences and humanities and three (3) hours of mathematics or computer science at the 200 level or above. Ten (10) credit hours of Military Science may also be used as electives.

[1] Courses offered alternate years.



Mines Matters: Course registration is accomplished via WebAdvisor. Register for classes online at https://wa-sdsmt.state.sd.us/webadvisor

Social Sciences

CONTACT INFORMATION

Dr. Roger Dendinger
Department of Social Sciences
Classroom Building 311
(605) 394-5111
e-mail: roger.dendinger@sdsmt.edu

FACULTY

Associate Professor Dendinger, Chair; Professor Goss; Associate Professors McReynolds and Quinn; Assistant Professors Adamson and Van Nuys; Instructor Kirkpatrick-Sanchez; Devereaux Library Director Andersen; Associate Librarian Cataloger Davies

SOCIAL SCIENCES

The Department of Social Sciences provides study and understanding of that branch of science that focuses on the institutions and functioning of people in society. By utilizing empirical and quantitative methods in the study of human beings, the curriculum reflects the technical and scientific nature and the mission of the university.

Interdisciplinary Science degree candidates are required to complete twenty-four (24) semester hours of humanities and social sciences courses. Other science and engineering degree candidates are required to complete sixteen (16) semester hours of humanities and social sciences courses — at least six (6) credits in each area. Engineering majors are required to enroll in at least one upper-level humanities or social science course of at least three (3) credit hours.

SOCIAL SCIENCES

(Upper level courses are in bold print.)

Anthropology:
ANTH 210

Business Administration:
ACCT 210[1], BADM 101[1], 221[1], 293[1], 310[1], **345[1]**, **350**, **360**, **370[1]**, **491[1] 493[1].**

Economics:

ECON 201, 202
Geography:
GEOG 101, 212, **400**

History:
HIST 151, 152, **492**

Law:
LAW **457**

Political Science:
POLS 100, 350, **407**

Psychology:
PSYC 101, 261, **323**, **331**, **391, 392**, **441**, **451, 461,**

Sociology:
SOC 100, 150, 251, **351**, **391**, **392**, **402, 411/511**, **420/520**, **459, 483**, **491**, **492**

Social Work:
SOCW 200, 210

[1] May not be used as social sciences credits, but may be used for free elective credit. (Consult advisor for further details.)

Mines Matters: School of Mines has an active varsity athletic program. The university is a member of the DAC-10 and is associated with the National Association of Intercollegiate Athletics (NAIA). Varsity sports include men's football, women's volleyball, and men's and women's basketball, golf, and track and cross country.

GRADUATE STUDENT GENERAL INFORMATION

South Dakota School of Mines and Technology offers graduate degree programs at the master's and doctoral levels. The graduate program provides opportunities for advanced study and research in the fields of engineering and science. Each individual program of study is designed to broaden and extend the student's knowledge within the chosen field, to develop the power of independent critical thinking, and to promote the skill of individual and cooperative research.

A master's degree program was authorized at the South Dakota School of Mines and Technology in October, 1935, and the first degree was granted in 1937. Permission to start Ph.D. programs during the 1967-68 academic year was granted in January 1967 to the Department Geology and Geological Engineering. In June, 1983, the Board of Regents authorized the doctorate in Materials Engineering and Science. The Board authorized the Atmospheric, Environmental, and Water Resources Ph.D. program (cooperative with South Dakota State University) in October of 1993 for start-up at the 1994 spring semester. This program has been changed to Atmospheric and Environmental Sciences. In March 2005, The Board of Regents authorized a Ph.D. program in Nanoscience and Nanoengineering which will start with the Fall 2005 semester.

The Graduate Office was organized formally in 1950-51. The policies of the Graduate Office are formulated with the assistance of the Committee for Graduate Education, which is advisory to the Graduate Dean. The policies are approved by the faculty and the Regents of Higher Education for South Dakota and are administered by the Dean of Graduate Education. The Committee for Graduate Education consists of one faculty representative from each college, the dean of each college, two (2) members appointed by the Faculty Advisory Council, and the Dean of Graduate Education or his or her designee. (The Vice President for Academic Affairs serves in an ex-officio capacity.)

GRADUATE PROGRAMS

Master of Science degrees are offered in:
- Atmospheric Sciences
- Chemical Engineering
- Civil Engineering
- Computer Science
- Electrical Engineering
- Geology/Geological Engineering
- Materials Engineering and Science
- Mechanical Engineering
- Paleontology
- Technology Management

Doctor of Philosophy degrees are offered in:
- Atmospheric and Environmental Sciences (multi-disciplinary)
- Materials Engineering and Science (multi-disciplinary)
- Geology/Geological Engineering
- Nanoscience and Nanoengineering

ADMISSION TO THE GRADUATE SCHOOL

The Graduate Office encourages applications from qualified students holding bachelor's degrees in engineering or science from accredited four-year colleges and universities. Bachelor's degrees or "diplomas" in technical engineering fields generally do not qualify as accredited four-year degrees for purposes of admission. A student desiring admission should obtain an application form from the Graduate Office or via the website at gesp.sdsmt.edu. The completed form, accompanied by a transcript of all undergraduate work and a non-refundable application fee of $35 for all applicants should be submitted to the Graduate Office. Application materials of domestic applicants should be received at least three (3) months before the beginning of the semester for which the student desires admission (July 1 for fall semester and November 1 for spring semester). International applicants must submit all of their materials at least five (5) months before the beginning of the semester (April 1 for fall semester and September 1 for spring semester). Applicant files will not be reviewed for possible admission until the $35 application fee has been paid.

Three recommendations are required. These should be submitted, upon request of the applicant, by three (3) persons familiar with the scholastic ability and interests of the applicant. However, applications from students at or graduated from South Dakota School of Mines and Technology need only to include the signatures of two (2) faculty members familiar with the applicant's academic performance unless otherwise specified on the application form.

If the applicant has not completed an undergraduate program, a list of the remaining requirements should accompany the application. Evidence of graduation must be submitted prior to enrollment.

Although not required by every graduate program, the Graduate Office strongly recommends that all applicants submit scores of the Graduate Record Examinations (GRE) in advance of registration. This examination is prepared by the Educational Testing Service, Princeton, New Jersey. Moreover, any applicant whose background is deemed to be either weak or uncertain may be requested to take the GRE. The descriptions that follow provide information on requirements for specific graduate programs.

When an application for admission to a graduate program is received, the chair of the department or the coordinator of the multi-disciplinary program in which the applicant expects to major will evaluate the applicant's academic qualifications. The chair/coordinator will recommend whether or not the applicant should be accepted into the graduate program, and whether the admission should be as an unconditional, provisional, probationary, or special student. The Dean of Graduate Education will review this recommendation and provide a letter of decision to the applicant. For further information, refer to the section on "Probation Policy."

Admission to the Graduate School for study toward a master's degree does not imply that the student will be allowed to work toward a doctorate. A separate application and evaluation of the student's qualifications are necessary before acceptance into a doctoral program. It should be noted further that admission to the Graduate School for study toward a Ph.D. degree does not constitute admission to candidacy for the Ph.D. degree. Refer to a later section for information on admission to candidacy.

International Student Admissions

An international applicant for graduate school must provide evidence of English proficiency. English proficiency for graduate applicants from countries in which English is not the native language must be verified by the TOEFL (Test of English as a Foreign Language). In addition, TWE (Test of Written English) scores are recommended but are not required. TOEFL results must be sent to the Graduate Office, South Dakota School of Mines and Technology, 501 East Saint Joseph Street, Rapid City, SD 57701-3995. A minimum score of 560/220 is required for unconditional satisfaction of the requirement. Students having scores greater than 520/190 but below 560/220 will be required to undergo an evaluation and will be required to complete a program of study in English as a second language. Admittance will not be granted to students with TOEFL scores below 520/190. Information on worldwide test centers and on registration for the TOEFL can be obtained by contacting any U.S. Embassy or Consulate or by writing to Test of English as a Foreign Language, Educational Testing Service, Princeton, New Jersey 08540, U.S.A. International students from countries where English is either the native or common language may be exempted by the Dean of Graduate Education from the TOEFL requirement. Likewise, applicants who have a prior degree from a college or university in the United States are generally exempted.

An international applicant will not be issued the U.S. Department of Justice Form I-20, Certificate of Eligibility for Non-immigrant (F-1) Student Status, until admission to graduate school for study toward a specific advanced degree has been granted and the applicant has provided documentary evidence of financial ability to cover the projected annual costs of education at this university. Form I-20 is usually necessary for admission to the United States for college attendance. This institution will issue a Form IAP-66 only in very exceptional circumstances.

All international applicants are required to submit the $35 application fee. (At the time of first registration on campus, a $110.40 international student enrollment fee must be paid.) Both charges are non-refundable.

International students are advised that full-time status at this university is necessary in order to satisfy F-1 status requirements (see "Tuition and Fees" section of the catalog).

Each international student (and any dependents accompanying him/her to the United States) is REQUIRED to enroll in the Major Medical Hospitalization/Surgical Insurance Plan provided through South Dakota School of Mines and Technology. No outside policies will be accepted as substitutes. The only exception to this rule is if the student is covered by his/her home country (documentation of this policy is necessary). Additionally, each international student is required to carry at least $10,000 of life insurance while enrolled at South Dakota School of Mines and Technology.

New US government reporting requirements have been added for international students (F and J status). As a result of the regulations that became effective on January 1, 2003, the Family Educational Rights and Privacy Act (FERPA) is waived for F and J students in respect to these specific reporting requirements. The regulations will be strictly enforced by the appropriate bureau(s) within the US Department of Homeland Security (DHS) and information will be reported electronically to DHS via Student and Exchange Visitor Information System (SEVIS). The consequences to students for non-compliance with the new regulations are severe. Contact the Director of the Ivanhoe International Center for additional information.

FULL-TIME/HALF-TIME DEFINED

Full-time Graduate Student is Defined as:

A student registered for nine or more credit hours per semester at any of the six universities in the South Dakota regental system during the academic year, or six (6) or more credit hours during the summer session.

Half-time Graduate Student is Defined as:

A student registered for five (5) to eight (8) credit hours per semester during the academic year, or three (3) to five (5) credit hours during the summer session.

Audited or remedial English credits do not apply to the above definitions.

During the regular academic year, registration in evening courses counts toward the determination of full-time status if the student is registered also in regular daytime courses. During the summer session, full-time student status may be earned completely with evening courses.

Graduate students are assessed the same campus fees as undergraduates (see "Tuition and Fees"). State law does not permit reduction or remission of fees under any circumstances.

ASSISTANTSHIPS AND FELLOWSHIPS FOR GRADUATE STUDENTS

South Dakota School of Mines and Technology has funds available from various sources for graduate assistantships and fellowships. Such awards are usually made on the basis of scholastic merit and the availability of funds. Assistantships are not available to students on probation.

The Dean of Graduate Education grants the award, acting upon the recommendation of the department chair, program coordinator, or major faculty advisor after evaluation of the student's academic record, overall qualifications, and programmatic progress. Graduate assistants are required to attend GTA/GRA training each semester prior to any release of funds.

Assistants and fellows must receive compensation of at least the current posted minimum stipend per semester unless special approval of a lower value is granted by the Dean of Graduate Education. They must also be registered for nine credit hours a semester in order to be eligible for reduced tuition. Eligibility for the special tuition rate is limited to graduate assistants and fellows who are:
a) unconditionally admitted to a graduate degree program and are registered at the university for its required minimum number of credit hours; and,
b) awarded an assistantship or fellowship at or above the minimum rate established annually by the Board. Graduate students receiving a summer assistantship and who have received a qualifying graduate assistantship or fellowship for the preceding fall and spring are automatically eligible for the special graduate assistant tuition rate for the following summer. Graduate assistants and fellows who are

eligible for the special tuition rate at one institution are eligible at other regental institutions.

Graduate students who are United States citizens or eligible non-citizens may be eligible for other forms of financial aid such as Federal Stafford Student Loans, Federal Perkins Student Loans, or Federal Work-Study. Application and requests for additional information on these programs should be made to the Academic and Enrollment Services Office - Financial Aid.

Graduate assistants under state contract are subject to institutional policies set forth in the Faculty/Staff Handbook.

Graduate Assistantships

Financial assistance is available for graduate teaching assistants (GTA) and for graduate research assistants (GRA). A GTA handles laboratory sections, grades papers, or performs other assigned instructional duties. A GRA is compensated to conduct supervised research, which generally relates to the student's thesis or dissertation research.

The minimum compensation rate for graduate assistants is $14.68 per hour for master's degree candidates and $15.71 per hour for Ph.D. students. A conventional full-time GRA/GTA (twenty (20) hours per week) for an M.S. degree pays $9,689 per academic year and $2,545 per month in the summer (forty (40) hours per week) for a total of approximately $18,595 per calendar year. A conventional full-time GRA/GTA (twenty (20) hours per week) for a Ph.D. degree pays $10,369 per academic year and $2,723 per month in the summer (forty (40) hours per week) for a total of approximately $19,900 per calendar year.

If funds are available, extra support can also be provided for work effort during the Christmas break. A full-time GTA or GRA is expected to devote a minimum of twenty (20) hours per week to assigned duties during the academic year. Part-time service is compensated in accordance with expected hourly effort and the above hourly rates.

The student with a research assistantship (GRA) should recognize that the prescribed hours of research work are minimum expectations mandated by employment practices and may not represent the effort which actually will be necessary to produce a satisfactory thesis or dissertation within a reasonable period of time.

The graduate student must be registered as a full-time student during the academic period in order to receive an assistantship. Up to eight (8) semester hours of research credit may be awarded for one summer of work. Continuing students must register before assistantships and fellowships are processed for the semester for which they are authorized. Pre-registration is required to prevent payment delays.

Graduate Fellowships

A growing number of fellowships from industrial and governmental agency sources are currently available. Eligibility requirements and restrictions are parallel to those for research assistantships. A fellowship award may not always include reduced tuition as a benefit. Pre-registration by continuing students is required to prevent payment delays.

CHANGE OF MAJOR

A student admitted to the Graduate School in a specified department/program must complete at least one semester in the original department/program before being allowed to change to another department/program.

A student who wishes to change majors should:

1. Obtain from the Graduate Office an "Intent to Transfer" form.
2. Complete the form and obtain appropriate signatures at his/her current department/program.
3. Return the form to the Graduate Office.

Upon favorable recommendation from the relevant departments/programs, the Dean of Graduate Education will usually issue a letter of transfer and notify the appropriate offices and the student of the change.

CONCURRENT ENROLLMENT IN PH.D./M.S. PROGRAMS

Concurrent enrollment in a Ph.D. program and an M.S. program in a different department is normally not allowed. Students who are pursuing a Ph.D. may not take more than 15 graduate credits in a second department. If the student leaves the Ph.D. program and is admitted to the second department, no more than fifteen (15) credits may be counted toward the M.S.

Exception Policy

A student who seeks an exception to the above policy must follow the procedure set forth below. Students must be aware that exceptions to this policy will only be granted under extraordinary circumstances.

1. The Ph.D. student must obtain prior written approval for this dual-degree plan from his/her major professor and the chair/coordinator of the relevant Ph.D. program.
2. If approval is granted in Step 1, then the Ph.D. student must obtain written approval for the M.S. degree plan from the chair of the corresponding M.S. program.
3. If approval is granted for Step 2, then the student will need to establish a second graduate committee and file a separate program of study for the M.S. degree with the Graduate Office.
4. The Dean of Graduate Education will have the normal authority to either approve or disapprove this second program of study. If the M.S. program of study is approved by the Dean of Graduate Education, then the major professor of the student's Ph.D. program will be appointed as the representative of the graduate school of the student's M.S. graduate. committee.
5. The first two (2) semesters of the dual program will be considered probationary. The second program of study can be terminated based on recommendations of the Ph.D. major professor and/or M.S. major professor to the Dean of Graduate Education.

SPECIAL STUDENTS

An individual who holds a baccalaureate degree and wishes to pursue further study without a commitment to advanced degree candidacy may apply to the Graduate Office for admission as a special student at the graduate level. The applicant must provide evidence of the baccalaureate degree. Upon admission as a special student, he/she will be assigned an advisor and will be subject to Graduate Office policies including the probation policy. A maximum of twelve (12) semester credits may be accumulated, after which the student must either apply for admission as a degree-seeking student or must petition for a variance from this policy. Graduate students classified as Special students are not eligible for assistantships

REGISTRATION

A graduate student will report to the advisor specified in the admission letter and thereafter will follow the registration procedure for all South Dakota School of Mines and Technology students. The advisor is responsible for counseling the graduate student in the formulation of a program of study until the student has selected a major professor.

CONTINUING REGISTRATION

Note: Graduate-level Special Students (as defined in another section) are exempt from the following continuing registration rule. The only other exception to the continuing registration policy is when a student has been granted a formal leave of absence (see "Leave of Absence" section below).

Degree-seeking graduate students must be registered on a continuing basis during each fall and spring semester of the regular academic year (see section on "Minimum Registration"). This applies regardless of whether the graduate student is in residence, is off-campus, or is pursuing a degree on a part-time basis. Failure to maintain continuing registration will result in deactivation of the graduate student's program. Therefore, graduate students who fail to comply and subsequently wish to return to their same program of study will be required to obtain written permission from the Dean of Graduate Education and may be charged a minimum reinstatement fee of $50.

All graduate students must register within the designated period each semester. Beyond that point, the reinstatement fee may be imposed along with any other late registration fees.

Minimum Registration

The minimum registration for graduate students, including graduate-level Special Students, is two (2) credits. Registration for two (2) or more credits is required during any semester or summer when using departmental or institutional resources, including scheduling and taking exams. The number of credit hours taken in excess of the minimum should accurately reflect the extent of the graduate student's course work and research activities.

Graduate students must also meet this minimum registration requirement during the specific semester or summer in which they complete all requirements for their degree and become eligible for graduation. There will be no grace period; hence, students who fail to complete all degree requirements prior to the official closure date for a given semester or summer will be required to register for a minimum of two (2) credits during a subsequent semester or summer in order to graduate.

Course Retake Policy

A student will be allowed a total of two (2) registrations for any particular graduate course (course numbers of 500 and above) for which credit is to be counted toward graduation. The student must petition the Dean of Graduate Education and obtain the Dean's approval to be permitted to take a graduate course more than two (2) times. Only the LAST attempt of the course will count in the grade point average calculations.

A student will be allowed multiple registrations for certain graduate courses for which credit toward graduation may be received more than once (e.g., Independent Study, Thesis, Research, etc.). Grades for all such courses will be used for grade point average calculations. Please note that individual departments/programs may limit the number of credits allowed toward graduation in these types of courses.

Leave of Absence

A student who is unable to continue his/her program of graduate study due to unanticipated major circumstances may request a Leave of Absence from his/her program of study by completing and submitting a "Request for Leave of Absence" form, available in the Graduate Office. The form must be completed and signed by the student, the student's advisor, department chair or program coordinator, and then submitted to the Graduate Office. The Dean of Graduate Education will evaluate the request, and either approve or deny it. If the request is approved, the student will not be subject to continuing registration and the Leave of Absence will not count toward the time limits to complete his/her program of study. A Leave of Absence is determined on a semester-by-semester basis and is usually limited to a maximum of one (1) calendar year.

Academic Loads

Thirteen credit hours per semester are considered to be the normal maximum graduate load. Higher loads must be approved by the Dean of Graduate Education and may be permitted if the student is taking a combination of courses at the graduate and undergraduate level. A reduced load may be recommended at the discretion of the student's advisor and major professor for students working as GTA's or GRA's.

Please refer to a previous section for additional information on assistantships and financial aid.

Undergraduates Taking Graduate Courses/Graduates Taking Undergraduate Courses

1. Graduate-level credits (500 level or above) taken as an undergraduate student are automatically placed on a graduate transcript, and may not be used toward an undergraduate degree unless appropriate approvals and credit transfers are obtained through Academic and Enrollment Services. Graduate-level credits taken as an undergraduate and used to fulfill requirements for the undergraduate degree may not be used also toward a graduate degree.
2. Graduate-level credits taken as an undergraduate and not used to fulfill

requirements for the undergraduate degree may be used toward a graduate degree only after the courses in question are included on the student's Program of Study with all necessary approvals listed thereon.

3. Undergraduate-level credits (300 or 400 level) taken as a graduate student are automatically placed on an undergraduate transcript, and may not be used toward a graduate degree except under the following circumstances:

a. The courses in question are outside the student's major department, but are included on the student's Program of Study with all necessary approvals listed thereon. (See also individual department restrictions on 300-400 level courses.)

b. The courses in question are within the student's major department, appear on the waiver list pre-approved by the Graduate Education and Research Council, and are included on the student's Program of Study with all necessary approvals listed thereon. (See also individual department restrictions on 300-400 level courses.)

c. The courses in question are at the 400 level, are within the student's major department, do not appear on the waiver list pre-approved by the Committee for Graduate Education, but are included on the student's Program of Study along with a petition of support from the student's major professor, with all necessary approvals listed thereon.

Upon written justification by the chair/coordinator of the graduate student's major department/program, the Dean of Graduate Education may approve a minor variance from the twelve (12) credit hour limit.

Forms mentioned above are available at the Graduate Office in MI-235.

Regental and Institutional Credit Requirements for Degree-Seeking Graduate Students:

Minimum percentage of credit hours in the graduate degree program that must be completed from the institution granting the degree: 60%.

Graduate Transfer Courses Received from United States Colleges and Universities Accredited by a United States Regional Accrediting Association:

Graduate transfer courses and transfer grades are recorded and evaluated by School of Mines, calculated into grade point averages according to the SD Regental grade scheme, and recorded on the student's academic transcript ONLY if these transfer courses are equivalent to a specific graduate course at South Dakota School of Mines and Technology.

Work Taken at Another Institution

Credit for up to twelve (12) semester hours of graduate-caliber course work taken at another institution may be transferred toward the requirements for the Master's degree at South Dakota School of Mines and Technology. Such credit from institutions external to the South Dakota regental system must be reviewed and approved by the student's committee and by the Graduate Dean.

The Dean of Graduate Education shall notify the Director of Academic and Enrollment Services in writing of the credits to be accepted and inserted on the student's transcript. An official transcript received directly from the issuing institution to support the request is required. The transferred course number, title, and semester hours will be entered on the student's transcript. Credits transferred from an institution outside the South Dakota regental system may be used to reduce graduation requirements, but will not affect the cumulative GPA earned at South Dakota School of Mines and Technology.

Advanced-Degree Grade Requirements

To qualify for any advanced degree, the faculty has stipulated that the following requirements must be satisfied:

1. The student must earn a minimum 3.00 average of grades in all 300- through 800-numbered courses taken (a) in all departments AND (b) in his/her major department after admission to the graduate program, or taken for graduate credit at School of Mines as an undergraduate or

special student. Note that thesis and dissertation research credit hours and grades will not be counted in the determination of these grade-point ratios.

2. The student must earn a “C” grade or better in any graduate course (500 through 800 level), which is to be credited toward advanced degree requirements.
3. The student must earn a “B” grade or better in any 300 or 400 level course, which is to be credited toward advanced degree requirements.
4. The student’s thesis or dissertation research must be of a quality to earn a final grade of “S.”
5. The student who fails any course must repeat the course with a passing grade. The student may petition, through his/her advisor or major professor, guidance committee, the Dean of Graduate Education for a potential waiver of this rule.
6. The student cannot apply any credit hours or grades for 100 and 200 level courses (which are usually taken to overcome academic deficiencies) toward advanced degree requirements. If, in the opinion of the student’s advisor, major professor, guidance committee, progress in these courses is unsatisfactory, additional work may be required to demonstrate proficiency.
7. Of credits counted for an advanced degree, not more than 50% of the credit hours in any graduate program can be at the 500 level.

If a course is repeated for a passing or improved grade, only the grade for the last attempt will be included in the computation of the cumulative grade-point average shown on the graduate student’s transcript.

A limitation of a total of nine credit hours exists for advanced-degree credit for courses identified as “Special Topics in,” “Advanced Topics in,” or “Seminar in.” Refer to the specific course description for any other restrictions.

All graduate research credit hours are graded according to regular grading standards. However, for thesis research (courses numbered 700) and dissertation research (courses numbered 800) the final grades for a completed program will be issued as either “U” for Unsatisfactory or “S” for Satisfactory. These S and U grades will not be used in the computation of grade- grade-point averages.

Research credit may be applied toward the fulfillment of credit-hour requirements. The number of credit hours so applied is identified in the relevant sections under Master of Science and Doctor of Philosophy degree programs.

Graduate Grading System:

The Graduate Grades will be assigned to the Graduate Academic Level and to all Courses and Sections with course numbers of 500 or greater. Plus and minus grades are not used.

The following grades are recommended to be associated with the Graduate Grade System:

1. Standard Grades:

A Exceptional
4.00 grade points per semester hour
B Good
3.00 grade points per semester hour
C Average
2.00 grade points per semester hour
D Unsatisfactory
1.00 grade points per semester hour
F Failure
0.00 grade points per semester hour
S Satisfactory
Does not calculate into any GPA
U Unsatisfactory
Does not calculate into any GPA
W Withdrawal
Does not calculate into any GPA,
no credit granted
AU Audit
Does not calculate into any GPA
An audit (AU) grade may be granted only when the student has elected the AU option on or prior to the census date of the term..
I Incomplete
Does not calculate into any GPA
An incomplete (I) grade may be granted only when all of the following conditions apply:
a. A student has encountered extenuating circumstances that do not permit him/her to complete the course.
b. The student must be earning a passing grade at the time the Incomplete is

necessitated. Anticipated course failure is not a justification for an incomplete.

c. The student does not have to repeat the course to meet the requirements.

d. The instructor must agree to grant an incomplete grade.

e. The instructor and student must agree on a plan to complete the coursework.

f. The coursework must be completed within one calendar year; extensions may be granted by the Graduate Dean.

g. If the student completes the course within the specified time, the grades that may be assigned are A, B, C, D, F, S, or U.

h. If the student does not complete the course within the specified time, the Incomplete grade remains on the transcript.

IP In Progress

Does not calculate into any GPA

An in progress (IP) grade may be granted only when all of the following conditions apply:

a. The requirements for the course (for every student enrolled in the course) extend beyond the current term.

b. The extension beyond the current term must be defined before the class begins.

c. The instructor must request permission to award IP grades for a course from their Department Head and Dean, and then approval must be obtained from the Vice President for Academic Affairs.

d. A definite date for completion of the course must be established in the course syllabus.

NP Normal Progress

Does not calculate into any GPA. A normal progress (NP) grade calculates into attempted credits but does not calculate into completed credits or grade point averages.

A normal progress (NP) grade may be granted by an instructor when the instructor determines that a graduate student is making normal progress in a graduate Thesis/Dissertation course. If a graduate student does not enroll for a period of one calendar year, the NP grade may change to I (Incomplete) upon approval by the Dean of Graduate Education. A Satisfactory/Unsatisfactory (S/U) grade may be granted only when the entire course requires the S/U grade or the student has elected the S/U option on or prior to the census date of the term.

NR Grade not reported by the Instructor

Does not calculate into any GPA

EX Credit by Exam

Does not calculate into any GPA

An examination for credit (EX) grade may be granted only for non course credit validation obtained through a validation process. This grade is not used for any Regental university course.

CR Credit

Does not calculate into any GPA

A credit (CR) grade may be granted only for non course credit that is not related to an examination or to equating transfer grades to the BOR grading system. This grade is not used for any Regental university course.

TR Transcripted

Does not calculate into any GPA and no credit is granted

LR Lab grade linked to Recitation Grade

0 credit course

Probation and Reinstatement Policy

An applicant who has a large number of deficiencies, or whose undergraduate record is relatively weak, may be admitted to the graduate program on probationary status. For a student admitted on probation, a deficiency in grade requirements during the first semester of enrollment may be considered sufficient grounds for terminating the student's enrollment in the graduate program. Such a termination decision will be made by the Dean of Graduate Education after consulting with the student's major professor and the department chair or relevant program coordinator.

A current graduate student who does not meet the following requirements (items 1-7 below) during any semester will be placed on probation and will be so informed by the Dean of Graduate Education. A failure to remove the deficiencies during the following semester may be considered sufficient grounds for terminating the student's enrollment in the graduate program. For further information regarding restrictions on financial assistance to graduate students on probation, refer to the section entitled "Assistantships and Fellowships for Graduate Students." Probation imposed because of grade deficiencies in specific courses (items 2-3 below) will continue each semester until the course(s) has been retaken and an acceptable grade(s) has been received.) Probation imposed because of overall GPA deficiencies (item 1 below) will continue each semester until GPA reaches the acceptable level.

A student will be placed on probation for a "U" grade received for research credit(s). Since a "U" is a final grade, probation will be maintained until at least one subsequent "S" credit is awarded. A student may graduate with "U" grades, but must also accumulate "S" grades for the required minimum number of research credits in a given advanced degree program. A student who has transferred from a thesis to a non-thesis program and who has received "U" grades as the last research grades in the thesis program will be admitted to the new program on a probationary status. Such probation may be removed by satisfactory progress (according to the usual performance criteria) during the first semester in the new program.

A student may be placed on probation for failing to meet either general or specific program requirements, e.g., failure to meet the required deadline for filing the required program of study with the Graduate Office and/or failure to meet the deadlines for taking and passing applicable qualifying, comprehensive, and final exams, etc. Probation for such deficiencies will be removed after the requirement(s) has been satisfied. A student's probationary status will be reviewed at the close of each semester for appropriate action-removal from probation, continuation of probation, or termination. A student may petition the Dean of Graduate Education for reconsideration of a termination decision. (Refer to section on "Appeal Procedure.")

1. A student must maintain a "B" (3.00) or better grade point average in all 300 through 800 level courses taken for graduate credit at School of Mines. Thesis and dissertation research credit hours and grades will not be counted in the determination of this grade-point.
2. A student must earn no less than a "C" (2.00) grade in any graduate course (500 through 800 level) taken for grade credit, and which is to be credited toward advanced degree requirements.
3. A student must earn no less than a "B"(3.00) in any 300 or 400 level course taken for grade credit, and which is to be credited toward advanced degree requirements.
4. A student's thesis or dissertation research must be of a quality to warrant the issuance of a semester grade of "S" or an interim grade of "NP."
5. A student must earn no less than a "B" (3.00) in any 100 and 200 level courses taken for grade credit even though they cannot be applied toward a graduate degree.
6. A student must pass all courses taken on the pass-fail basis. (Refer to section on "Pass-Fail Option for Graduate Students.")
7. A student must remove all other program deficiencies, such as meeting stated deadlines for applicable qualifying, comprehensive, and final examinations; selection of a graduate guidance committee; and filing of a satisfactory program of study in the Graduate Office.

PASS-FAIL OPTION FOR GRADUATE STUDENTS

The following policy pertains to the pass/fail option at the graduate level:

1. 100 and 200 level courses, either within or without the department, which cannot be applied for credit toward a graduate degree may (with the consent of the student's graduate advisor or advisory committee) be taken on a pass-fail basis under the same rules that apply to undergraduate students.
2. 300 through 800 level courses outside of the student's department/program may (with the consent of the student's major professor guidance committee) be taken on a pass-fail basis except that a "C" grade shall be considered the lowest passing grade. The maximum number of hours of pass-fail work for which a master's degree candidate may receive credit will be six (6) for the thesis option and nine (9) for the non-thesis option.
3. No 300 through 800 level courses offered by the student's major department/program may be taken for credit under the pass-fail option.
4. Beyond the master's level, the pass-fail option may be exercised at the discretion

of the candidate's guidance committee, but must still be approved by the Dean of Graduate Education.
5. All "F" grades will be incorporated into cumulative grade-point averages.

APPEAL PROCEDURE

Procedures for appealing or petitioning for a variance from certain policies are set forth in the relevant sections of this document when such variances are permitted in unusual or exceptional circumstances. Appeals or petitions involving such matters as grade changes from "F" or "I" to "W" and refund of late registration fees should be lodged with the Student Personnel Committee through the Vice President for Student Affairs and Dean of Students, after review by the Dean of Graduate Education.

Appeals concerning probation, suspension, or potential variances in academic graduate policy should first be lodged with the student's major department/program. Before rendering a decision on the appeal, the department chair or program coordinator will seek a recommendation from the student's guidance committee. If the student is not satisfied with the decision on the appeal, the student may petition the Committee for Graduate Education for reconsideration. Such petition must be filed with the Dean of Graduate Education.

In those cases where this document does not provide appropriate information concerning the resolution of a conflict or problem encountered by the graduate student, or if the student is dissatisfied with a prior appeal decision, he/she should seek the advice of the Dean of Graduate Education or the Dean of Students to determine what recourse is available to assist in seeking a solution to such problems.

CERTIFICATION FOR THE DEGREE

Before a diploma can be released, the Dean of Graduate Education must certify that the candidate has fulfilled all degree requirements. For certification of the degree for a given semester, ALL requirements must be complete on or before the day grades are due for that semester or end of the summer session. Note that ALL KEYS MUST BE RETURNED to the Physical Plant before the degree is granted.

Candidates are cautioned not to make travel plans or other arrangements that will be difficult or costly to change until they are certain that all degree requirements can and will be satisfied. It is the responsibility of the candidate to know and comply with these degree requirements

MASTER OF SCIENCE PROGRAMS

THESIS AND NON-THESIS OPTIONS

With the thesis option, the minimum graduation requirement is thirty (30) credit hours including six (6) to nine (9) hours of thesis research credit.

At the discretion of the student's major department/program, thesis research and the submission of a thesis may be waived and additional course work substituted. Such course work may include a limited number of credits for non-thesis or project research. The graduation credit minimum in this option is thirty-two (32) credit hours. Candidates for the non-thesis option may not normally use thesis research credits for the fulfillment of credit-hour requirements for the Master's degree. However, when a student is transferring from a MS thesis degree program to a MS non-thesis program, the student may petition the Dean of Graduate Education to transfer up to 3 cr. hrs. of previous thesis research with the documented support and approval of the student's major professor.

M.S. DEGREE REQUIREMENTS

The M.S. degree minimum requirements for the thesis option are:

1. A program of at least thirty (30) credit hours of course work and research.
2. At least fifteen (15) credit hours of graduate course work (500 level courses and above).
3. At least six (6) credit hours of thesis research. (No more than nine credit hours of thesis research will count toward degree requirements.)
4. A satisfactory thesis based upon individual research.
5. Meeting or exceeding academic standards prescribed elsewhere in this bulletin.

6. Passing an examination on general knowledge and successfully defending the thesis.

The non-thesis option requires:

1. A program of at least thirty-two (32) credit hours of course work (refer to specific program requirements for exact number of minimum course work credit hours).
2. At least twenty (20) credit hours of graduate course work (500 numbered and above).
3. Meeting or exceeding prescribed academic standards.
4. Passing an examination on general knowledge in the field.

A candidate for the Master's degree is expected to make up undergraduate deficiencies as determined by the department/program. Credit for such makeup work is generally not allowed toward the degree. However, the policy established by the faculty does allow for a certain number of upper-level undergraduate credits to be used for the fulfillment of master's degree requirements according to the following limitations and conditions[1]:

1. For the thesis option, the number of undergraduate credits that may be used for the degree is limited to six (6) hours.
2. For the non-thesis option, the number of undergraduate credits that may be used for the degree is limited to nine hours.
3. Out-of-program courses at the 300 level may be accepted toward the fulfillment of degree requirements in exceptional circumstances but only with the approval of the Dean of Graduate Education. This written justification should be submitted by the chair/coordinator of the student's major department/program to the Graduate Dean.
4. Major department (or program) courses at the 300 level are not acceptable for graduate degree credit under any circumstances.
5. Out-of-program courses at the 400 level may be used to fulfill degree requirements at the discretion of the chair/coordinator of the student's major department/program in accordance with the credit hour limitations prescribed above. Also, see individual departmental restrictions.
6. Major program courses at the 400 level may be accepted toward the fulfillment of degree requirements in exceptional circumstances. Such courses will only be considered after a written justification is submitted by the chair/coordinator of the student's major department/program to the Dean of Graduate Education for his or her review and potential approval.

[1] In the above sections (1-6) the term "program" refers to a division in a department (i.e., chemical engineering program within the Department of Chemistry and Chemical Engineering) or a non-departmental unit such as Technology Management, Materials Engineering and Science, or Atmospheric and Environmental Sciences. The maximum number of thesis credit hours required for the thesis option is determined by the department and the thesis committee. At least six credit hours and no more than nine credit hours of thesis research will be permitted to count toward the degree credit requirements for the thesis option. However, the student may register for additional research credits for continuing registration purposes.

Language Requirement

There is no standard language requirement by the Graduate Division for the master's degree. However, Departments/Programs may establish their own language requirement.

Minors

Faculty rules permit, but do not require, a minor field of study for the master's degree. Nevertheless, limited work outside of the major department/program is encouraged. If such work is concentrated in one department, it may be considered to informally constitute a minor and a faculty member from that department/program should be appointed to the graduate student's guidance committee.

Dual Majors

South Dakota School of Mines and Technology does not permit, in general, credit hours that have been used to satisfy requirements for one master of Science degree to be applied toward another master's degree from this institution. Under exceptional circumstances however, a student may petition the Committee for Graduate Education through his/her guidance committee for a variance from this policy.

SUPERVISION OF THE MASTER'S PROGRAM

The supervision of the general study program of each master's student, including compliance with all the various Board of Regents, institutional, and Graduate Division policies, is primarily the responsibility of the advisor. The graduate guidance committee, which consists of a major professor, a Graduate Office representative, and at least one additional member, assists in this role. The major professor is primarily responsible for supervision of the graduate student's research and thesis preparation, as well as ensuring that academic standards and requirements are met and satisfied. The advisor and the major professor may or may not be the same person, depending on restrictions/requirements within the student's program and/or department.

The major professor serves as chairperson of the graduate guidance committee, assists the student in selection of other members of the committee, and is responsible for obtaining approval from each prospective member for that person's service on the committee. The Graduate Office representative must be chosen from outside the major department/program.

A change in advisor may be accomplished at the student's request, only by submitting a Request to Change Advisor form, with all appropriate approval signatures, to the Dean of Graduate Education. (Change of Advisor forms are available from the Graduate Office.)

If staff changes or other valid reasons dictate a change in major professor, such a transition can be made at the request of the student and with the consent the student's committee as evidenced by filing a revised Program of Study with the Graduate Office. A written appeal by a student for a change in major professor may be filed with the Committee for Graduate Education through the Dean of Graduate Education in contested cases. The decision by the Committee for Graduate Education is final. When such changes occur, a new Program of Study must be submitted to the Graduate Office.

PROGRAM OF STUDY

The student's guidance committee will assist the student in formulating a program of study leading to the master's degree. A copy of the program of study and advisory committee assignments must be filed with the student, the student's department/program, and the Graduate Office no later than the mid-term of the second semester of the student's registration as a degree-seeking candidate. The student must seek the guidance committee's approval for any subsequent modification of the original plan of study. A copy of any amended program must be filed in a timely manner by the student and with the same offices as the original schedule. Each program of study or amendment thereof must have the signature approval of the student and all members of the student's committee before it will be reviewed for final approval by the Graduate Dean.

THESIS

The thesis should represent an effort of such quality and construction that it can be displayed in the school library with similar scholarly works, as well as providing material for publication(s) in an appropriate professional journal(s).

The thesis is written under the direction of the major professor, but the student should feel free to seek guidance from all members of his/her guidance committee. Before starting to write the thesis, the student is urged to consult "Instructions for the Preparation of Theses and Dissertations" on the Graduate Education website, and to consult style manuals in the Devereaux Library. In general, the thesis may follow the style of captions, footnotes, and bibliographical references used by the leading technical journal in the student's field. Students are urged to review carefully copyright ownership provisions in the "Instructions" document.

A final draft of the thesis should be submitted by the student to each member of his/her guidance committee a minimum of two full weeks before the time and date of the student's scheduled examination. Earlier submission deadlines may be required by the guidance committee.

The final draft of the thesis, after all revisions recommended by the committee have been made, must be signed by the author and approved and signed by the major professor, the chair/coordinator of the student's major department/program, and the Dean of Graduate Education before final reproduction. The Dean requires that the final draft of the thesis be submitted to the Graduate Office 21 calendar days before graduation to allow adequate time for review, corrections and revisions, and potential approval.

The institution requires five (5) copies of the thesis in final form: the original (unbound) manuscript and one bound copy for the Devereaux Library; two (2) bound copies for the student's department/program, one of which will be forwarded to the major professor; and an unbound security copy for the department. An electronic version of the thesis will also be required in digital format. Contact the Graduate Office for instructions and requirements for this digital version. In case of a proprietary thesis, the original hard copy and digital version will be retained without reproduction in secured Graduate Office files throughout the specified proprietary period.

FINAL EXAMINATION

All master of Science degree candidates will be given a final examination covering course material. The examination may be written, oral, or both at the discretion of the major department or program.

Students pursuing the thesis option must also defend their thesis in an oral examination. Final examinations covering both course work and thesis research may be combined. Oral examinations are open to all interested faculty members. Departmental or program policy shall determine whether non-faculty persons may attend the examination.

The student shall obtain and complete the relevant Graduate Office form to schedule the final examination. The major professor shall seek the approval of all committee members and shall file the form with the Graduate Office no less than five (5) working days before the exam. The Graduate Office will announce this exam information as appropriate.

The thesis defense oral examination will normally be held during the last six (8) weeks of the student's last term, but it may be given at any time after the thesis has received committee approval. No final examination may be scheduled during the period of course work final examinations.

The student's committee constitutes the examining board for a final oral examination. The major professor will chair the session. The major professor is responsible for ensuring that a majority of the committee, as well as the Graduate Office representative, is present. The examination will not be held if these conditions cannot be met. A negative vote by any two (2) or more members of the student's committee or a negative vote by the Graduate Office representative will signify failure of the examination. All committee members must be given the opportunity for input to, and evaluation of, a written non-thesis final examination. Refer to the Graduate Office policies for information on committees and exam procedures for proprietary thesis programs.

Results of all written or oral examinations will be attested to by all committee members on a form furnished to the Graduate Office representative by the Graduate Office. The original form with signatures and dates will be filed with the Graduate Office and a copy with the department/program.

If the candidate fails to satisfy the examiners on either course work or thesis, written or oral examinations, the committee may schedule a re-examination over general background, thesis, or both. The re-examination will be scheduled at the discretion of the candidate's guidance committee, normally eight (8) to twelve (12) weeks after the date of the first examination.

TIME LIMITATION

A Master of Science degree program must be completed within five (5) calendar years dating from the student's formal entrance into a degree-seeking program. Courses taken by the student at any institution that are requested to be part of the degree program and that were taken more than five (5) years prior to the date of anticipated graduation must be reviewed by the student's major department/program and the Dean of Graduate Education for possible acceptance. Following this review, the student's major department/program and the Dean of Graduate Education will determine whether a reduction in credits applicable toward the degree, a re-examination, or both is required for the student to complete his or her degree program.

DOCTOR OF PHILOSOPHY PROGRAMS

NATURE AND PURPOSE OF THE DOCTORAL PROGRAMS

The doctoral program is designed to prepare a student for a lifetime of intellectual inquiry that manifests itself in creative scholarship and research, often leading to professional careers in social, governmental, business, industrial organizations, and academia. The program emphasizes freedom of inquiry and expression and development of the student's capacity to make significant contributions to knowledge. An essential element is the development of the ability to understand and evaluate critically the literature of the field and to apply appropriate principles and procedures to the recognition, evaluation, interpretation, and understanding of issues and problems at the frontiers of knowledge. These goals are most effectively accomplished in close association with those experienced in research and teaching.

A central purpose of doctoral programs is the extension of knowledge, but this cannot be accomplished on all fronts simultaneously. Students must choose an area in which to specialize, a faculty member with whom to work, and a research topic of mutual interest to the student and the faculty advisor. Individualized programs of study are then developed, and committee members are selected cooperatively as course work and research are undertaken. When all course work has been completed, the research finished, the dissertation written, and all examinations passed, the student will have acquired the knowledge and skills expected of a scholar and will have extended knowledge and research capability in the field.

PH.D. DEGREE REQUIREMENTS

The requirements for the Doctor of Philosophy degree are:

1. Satisfactory completion of a Comprehensive Examination.
2. A minimum of a total of eighty (80) semester credits (ninety (90) for the AES program) beyond the bachelor's degree.
3. A minimum of fifty (50) semester credit hours of course work (forty-five to sixty (45-60) for the AES program[1]) beyond the bachelor's degree. A maximum of twenty-four (24) semester credits are allowed from appropriate M.S. course work to apply to the Ph.D. credit requirement.
4. A minimum of twenty (20) semester credit hours (thirty (30) for the AES program) of appropriate research credits. A maximum of six (6) semester credits of acceptable M.S. research credits can be applied to the Ph.D. research credits upon approval of a corresponding petition by the candidate's department/program and the Dean of Graduate Education.
5. Satisfaction of academic standards as prescribed elsewhere in this catalog.
6. At least two (2) consecutive semesters of residence as a full-time student.
7. Satisfaction of any departmental language or other specific requirements.
8. A dissertation written in grammatical English that represents results from at least the equivalent of one academic year of full-time research.

[1] See AES program description for details of course work and research credits in the 90-credit program.

Between three (3) and four (4) academic years of full-time graduate study beyond the baccalaureate degree normally are required to earn a doctorate.

A candidate who has entered a Ph.D. program directly from a baccalaureate program may be allowed to use up to twelve (12) credits of upper-division undergraduate 400 level courses toward the fifty to sixty (50-60) credit-hour course requirement for the degree with the same restrictions and procedures as those specified for master's degrees. Ph.D.

candidates already holding an M.S. degree may use up to six (6) credits of 400 level course work toward the twenty-six to thirty-six (26-36) credit course work requirement. The chair of the student's major department must petition the Committee for Graduate Education through the Dean of Graduate Education for use of 300 level credits for Ph.D. programs.

The dissertation guidance committee approves the total number of research credits that the candidate may carry, consistent with departmental, continuing registration, and other requirements. The student's guidance committee can recommend to the Dean of Graduate Education a program requiring more credits than the minimum indicated above if it believes that this is in the best interests of the student. Furthermore, the committee may approve a plan for the student to undertake work at some other institution of recognized standing, but may not reduce the two-semester residence requirement.

Residence Requirements

At least two (2) consecutive semesters of residence as a full-time student are required at South Dakota School of Mines and Technology. The comprehensive examination may not be taken before the last half of the second semester of residence. The final defense of the dissertation will not be permitted within the first five (5) months following the successful completion of the comprehensive examination.

Language Requirements

Atmospheric, & Environmental Sciences (AES): No language requirement.

Materials Engineering and Science (MES): No language requirement.

Geology/Geological Engineering: The student, working with his/her committee, may select one of the following four options:

1. A reading knowledge of two (2) foreign languages.
2. A reading, writing, and speaking competence in one foreign language pertinent to the field of study.
3. A reading knowledge of one foreign language plus nine semester hours of course work in a collateral field, credit for which may not be applied toward the degree. A list of collateral courses should be prepared by the student, approved by the guidance committee, and submitted to the Graduate Office.
4. Competence in at least two (2) computer languages and in software pertinent to the student's field of study (*e.g.*, Geographic Information Systems Software). Competence in computer languages shall be determined by a qualified faculty member from outside of the department. Documentation of this competence shall be approved by the guidance committee and submitted to the Graduate Office.

A foreign national may satisfy the language requirement by demonstrating competence in reading, writing, and speaking English provided that, in the opinion of the guidance committee, a significant scientific literature pertinent to the field of study exists in his/her native language.

Any language requirements should be completed within the first two (2) years of doctoral work and must be fulfilled before the student is admitted to the comprehensive examination for the degree of Doctor of Philosophy.

A high standard of proficiency both in speaking and writing the English language is expected of all graduate students.

Minor or Supporting Fields

In order to foster the principles upon which a Doctor of Philosophy degree is based, as set forth in the introductory paragraphs to this section on doctoral programs, a Ph.D. candidate and his/her guidance committee are strongly encouraged to formulate a program of study that comprises, minimally, one-quarter of the required course work in minor or supporting fields. These courses may be completed in one or more departments in areas of study consistent with the student's major program. Typically, therefore, twelve to eighteen (12-18) of the forty-five to sixty (45-60) credit hours of required course work would be taken in non-major courses by a student entering a doctoral program with a baccalaureate degree. A Ph.D. candidate who has already earned a Master's degree would be expected to satisfactorily complete six (6) to twelve (12) of the twenty-six to thirty-six (26-36) credit hours of required course work in courses outside of the major field.

Because individual program requirements may exceed these minimum institutional guidelines, the student is urged to review carefully the curriculum for his or her field of study.

Supervision of the Doctoral Program

Until a student has earned the master's degree or accumulated a comparable number of credits, he/she will be subject to the regulations governing master's candidates regarding major professor, guidance committee, and course of study.

The study program of each doctoral student is under the supervision of a guidance committee consisting of a major professor, Graduate Office representative, and at least three (3) additional department and/or affiliate department members.

For transfer students entering directly into the doctoral program with a master's degree or its equivalent, the major professor will be selected and assigned as soon as practicable after registration, but no later than the midterm of the second semester of registration. In the interim, the department's/program's graduate advisor will assist with registration and initial programming.

The major professor is assigned by the chair/coordinator of the student's major department/program after consultation with and concurrence of the student and prospective major professor. If staff changes or other valid reasons dictate a change in major professor, such a transition can be made at the request of the student and with the consent of the student's committee, as evidenced by filing a revised Program of Study with the Graduate Office. A written appeal by a student for a change in major professor may be filed with the Committee for Graduate Education through the Dean of Graduate Education in contested cases. The decision by the Committee for Graduate Education is final.

The policies that govern membership on, selection of, and the formalization of the guidance committee for a transfer student are the same as those that apply to the student's advisory committee for a Master's program. Refer to "Supervision of Master's Programs."

If a master's candidate has expressed a desire to continue for a doctorate, then at some time during the semester in which he/she expects to attain thirty-six (36) credit hours beyond the baccalaureate degree, the student's department/program shall determine by qualifying examination or by review of his/her record to date whether the student shall be permitted to continue toward the doctoral degree.

Concurrently, the department chair or program coordinator, after consultation with the student and the existing guidance committee, shall expand the student's committee to a total of five (5) members by the addition of one or two (2) members of the faculty who may eventually be called upon to assist with the student's doctoral program. If there is an anticipated change in major professor for the doctoral program, one of the new members shall be the prospective major professor. If only one additional member from outside the major department/program is selected for the doctoral guidance committee, that person shall represent the field identified as the candidate's minor. The Graduate Office representative is appointed by the Dean of Graduate Education upon the recommendation of the major professor and with the concurrence of the department chair/program coordinator.

Program of Study

The guidance committee shall be charged with assisting the student to formulate a program of study leading toward the Ph.D. degree. The complete program of study including a statement of the language option selected (if any), the list of members of the guidance committee, and a brief description of the proposed research project shall be filed with the Graduate Office before the mid-term of the second semester of registration. The student's guidance committee shall have authority to approve subsequent modifications in the program, subject again to review and approval by the Graduate Dean. A copy of any amended program will be filed with the student and the Graduate Office. Each program of study, or amendment thereof, must have the signature approval of the student and all members of the student's guidance committee and, in the case of the MES program, of the Chair of the MES Advisory Council.

The Qualifying Examination

Doctoral students admitted into all Ph.D. disciplines must pass a qualifying examination, normally to be taken no later than the second semester of residence. A master's candidate who proposes to continue into a doctoral program should so advise his/her major professor. Thereupon, the student will be given an examination by the advisory committee to determine whether to permit the student to proceed to the doctoral level of graduate study. This qualifying examination may be scheduled in the semester during which it is expected that thirty-six (36) hours of credit beyond the B.S. degree, (which are deemed acceptable toward the student's doctoral program) will be accumulated. The examination for the master's degree may be used as the forum for the qualifying examination, at the discretion of the department/program.

The Comprehensive Examination

When the student's program of course work has been substantially completed and the language requirement satisfied, he/she will undertake the comprehensive examination for admission to candidacy. This examination will consist of written and oral examinations covering his/her field of study and related subjects. It will be prepared by the student's guidance committee, with potential suggestions from any faculty member from whom the student has taken a graduate course.

The student's guidance committee schedules and arranges the written and oral examinations. Review of the examinations will be accomplished as soon as possible by all members of the committee, and the results will be reported to the Dean of Graduate Education on the appropriate form supplied by the Graduate Office.

Satisfactory completion of the comprehensive examination requires that no more than one member of the guidance committee votes against passing. If the student passes with conditions, such as failure to pass a part of the examination, the committee shall inform him/her promptly as to how and when the conditions may be removed. If, in the opinion of two (2) or more members of the guidance committee, the student has failed the comprehensive examination, another such examination may not be attempted during the same semester. After failure to pass a second time, work toward the doctorate can be continued only with the consent of the guidance committee, the Committee for Graduate Education, and the Dean of Graduate Education.

The comprehensive examination should normally be passed at least five (5) months before the dissertation is defended.

Admission to Candidacy

Four months before the dissertation defense, the doctoral student should apply to his/her major professor for admission to candidacy on a form available from the Graduate Office. If the guidance committee and department chair/program coordinator approve the application by certifying that the candidate has passed the comprehensive examination, the signed form must be returned to the Dean of Graduate Education who, in turn, will admit the student to candidacy.

The Dissertation

It is expected that the dissertation will represent the culmination of at least the equivalent of one academic year of full-time research.

The dissertation need be of no specific length, but it must be written in grammatically proper English. It must also advance or modify knowledge and demonstrate the candidate's technical mastery of the field. The dissertation can consist of a compilation of published and/or submitted journal manuscripts that are derived from the candidate's doctoral research and are either authored or co-authored by the candidate. The more conventional dissertation format is also acceptable if recommended by the candidate's major department and the major professor. The final dissertation must be accompanied by an abstract of 250 to 600 words and vitae of the candidate.

The dissertation and abstract shall be approved by all members of the student's guidance committee, and a preliminary acceptance page of the dissertation shall bear the signed initials of each member of the committee.

The final draft of the dissertation, after all revisions recommended by the committee have been made, must be signed by the student and approved and signed by the major professor, the chair/coordinator of the student's major department/program, and the Dean of Graduate Education before final reproduction. The Dean of Graduate Education requires that the final draft of the dissertation must be delivered to the Graduate Office for a minimum of 21 days prior to graduation to allow adequate time for review and potential approval.

The institution requires five copies of the dissertation in final form: the original, unbound manuscript and one bound copy for the Devereaux Library; and two (2) bound copies for the student's major department/program, one of which will be forwarded to the major professor and one unbound security copy for the department. An electronic version should also be submitted to the Graduate Office in digital format. Contact the Graduate Office for guidance in regard to the required digital format.

A final draft of the dissertation must be submitted by the candidate to each member of his/her guidance committee a minimum of two (2) full weeks before the scheduled dissertation defense. Earlier submission deadlines may be required by the guidance committee.

Defense of the Dissertation

The defense of the dissertation is an oral examination open to the public except in proprietary programs. It will be scheduled at the convenience of the candidate's guidance committee at any time after the student has completed course work and after the major professor is satisfied that the dissertation is in an acceptable manuscript, both in terms of technical quality and proper expression. The student shall obtain and complete the Graduate Office form to schedule the defense. The major professor shall seek the approval of all committee members, and shall return the form to the Graduate Office no less than five (5) working days before the defense date. The Graduate Office will announce this exam information as appropriate.

While the student's committee determines the character and length of the examination, sufficient time should be devoted to a consideration of matters relating to the dissertation to test thoroughly the ability of the candidate to defend his/her work. Questions will, in general, be confined to the dissertation and to background material related to it.

Satisfactory completion of the final examination requires a "pass" vote from the Graduate Office representative and no more than one "fail" vote from the other members of the guidance committee. If the student fails, another examination can be scheduled only with the approval of the student's guidance committee and the Dean of Graduate Education.

Time Limitation

If the requirements for the Doctor of Philosophy degree are not completed within a maximum period of eight calendar years from the date of original enrollment in the doctoral program, the student's program is subject to review by the staff of the student's major department/program and the Dean of Graduate Education to determine whether a reduction in credits applicable toward the degree is justified before the student is permitted to proceed with the degree program. The procedures described under "Time Limitation" for M.S. degree candidates also apply here.

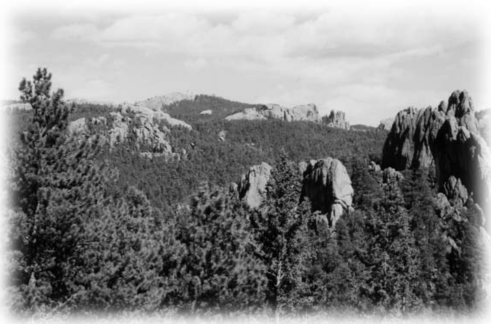


Photo Courtesy of SD Department of Tourism

Photo Courtesy of SRobb DeWall.

Mines Matters: Custer State Park in the Black Hills encompasses 71,000 acres of spectacular terrain and an abundance of wildlife. Crazy Horse Memorial offers visitors a look into the history and culture of the region.

Atmospheric and Environmental Sciences

CONTACT INFORMATION

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FACULTY

Associate Professor Price, Program Director; Professors Davis, Detwiler, Duke, Fox, Helsdon, Hjelmfelt, Mott, Stone, and Zimmerman; Associate Professors Capehart, Fontaine, Kenner, Riley, and Stetler; Assistant Professor Sundareshwar.

PROGRAM DESCRIPTION

Measuring, monitoring, and modeling earth and atmospheric systems increasingly demands an interdisciplinary approach, because problems in earth processes impacting society often cannot be solved by studying the atmosphere, hydrosphere, lithosphere, and/or biosphere in isolation. Managing wildfire potential, for example, includes components of atmospheric dynamics, precipitation patterns, vegetation distribution and condition, topographic factors, and more. The key to success lies in training scientists to form interdisciplinary teams that can simultaneously tackle the broad range of processes needed to achieve understanding and prediction of such complex phenomena.

The Atmospheric and Environmental Sciences program links expertise in atmospheric science, biogeochemistry, geology, and hydrology to address regional and local issues that may also be nationally or globally significant. The fundamental objective lies in developing the predictive capability to address linkages between earth system components and land management practices in a way that benefits decision-making at regional and national levels. We use the Black Hills of South Dakota and the surrounding Great Plains as a natural laboratory for the development of methodologies to link fundamental observations of the environment across a range of temporal and spatial scales, and integrate them with state-of-the-art modeling, visualization, and analysis.

Key interrelated research themes drive the research and teaching program, building on ongoing research and disciplinary strengths already present at SDSMT, including meteorology, biogeochemistry, ecology, geology, climatology, hydrology, remote sensing, and geographic information systems.

Specific examples include:

- Carbon cycling and the potential effects of local and regional climate change, including the frequency and severity of storms, drought cycles, and wildfire potential
- Water quality and quantity as it impacts regional growth and environmental systems
- Wildfire dynamics and associated issues related to fire prevention, suppression, and post-fire mitigation
- Physical meteorology and storm processes, including impacts on hydrology and fire issues.
- In situ atmospheric measurements of storms, aerosols, trace gas concentrations, etc. using specially adapted storm-penetrating aircraft

Many School of Mines faculty members who are actively involved in the AES program have externally funded research projects. These projects provide research assistantship opportunities for AES students. In addition to graduate research assistantships, support is also possible through graduate teaching assistantships and various fellowships and scholarships. AES students are strongly encouraged to work with their advisors and faculty colleagues to apply for research funding or fellowships to support their studies.

PROGRAM REQUIREMENTS

Degree candidates in AES are expected to complete an approved multidisciplinary program of course work and also perform original research in a focused area. A minimum total of eighty (80) semester credit hours beyond the Bachelor's degree is required. Students entering the AES program with a previous M.S. degree in a relevant discipline are allowed to apply a maximum of twenty-four (24) semester course credit hours in an appropriate field toward the course credit requirement and six (6) thesis research credits toward the research-credit requirement. There is no language requirement in the AES program. However, all AES students are expected to be proficient in speaking, understanding, and writing the English language. Graduate students who are enrolled full time in the AES program should be able to complete their degree requirements and graduate within three (3) to four (4) years starting with a master's degree, and four (4) to five (5) years starting from a bachelor's degree. The time required to complete the degree will vary depending on the transfer of previously earned credits, course work recommendations specified by the student's committee, and individual research requirements.

The following key learning outcomes will be developed in all students:

a. A core of basic and specialized scientific and technical knowledge;
b. An understanding of the basic scientific tools of measuring, monitoring, and modeling;
c. The ability to apply these tools to understand atmospheric and land-surface interactions;
d. The professional skills crucial to research, including obtaining and reviewing research literature, proposing research problems, critically evaluating their own work and the work of others, and communicating in writing and orally with their colleagues;
e. The understanding and application of professional methods and ethics in their work, and
f. The ability to form interdisciplinary teams to solve complex problems

Students entering the program will normally already possess a foundational degree (typically the M.S. degree) in atmospheric sciences, meteorology, geology, hydrology, or environmental sciences/engineering. Students will build on this foundation by pursuing elective courses that prepare them for advanced work in their chosen specialty. The student and his/her committee are charged to prepare a course of study that will help the student become proficient in a specific research area. Great emphasis is placed on the independent origination of a research problem that will yield a new, original scientific insight.

Ph.D. in Atmospheric and Environmental Studies	**Credit Hours**
M.S. academic core (24cr) and research (6 cr)	30

Required academic courses	10
Elective academic courses	13
Research credits	27
Total required for the degree	80

The required academic courses include:

AES 790 Seminar

This course builds professional communication skills, including writing and oral presentation, while exposing students to examples of disciplinary and interdisciplinary research. (one (1) credit)

AES 808 Fundamental Problems in Engineering and Science

This course trains students to identify and tackle fundamental research problems; it combines literature review, proposal development, critical thinking, and professional ethics, and leads to an actual proposal in the student's specialty for submission to a funding agency. (three (3) credits)

AES 792 Topics (Interdiscplinary Problems)

This innovative course brings together faculty and students to create a working group which selects an a research problem, studies the literature, and develops a research plan that integrates the multiple disciplines of all the participants. Students participate in this course for 1 credit in their first year, and repeat the course in the second year for two credits, taking a correspondingly greater role in the work of the group. This course is modeled after traditional disciplinary research working groups, but is intended to facilitate the emergence of cohesive interdisciplinary teams, and to provide an incubator for new research plans and funding proposals. (three (3) credits)

XXX Measuring/Modeling of Earth Systems

Students must complete at least one course in measuring and/or modeling techniques, to be selected by the student's committee. A selection of existing courses at SDSMT is available to fulfill this requirement. (three (3) credits)

A wide variety of courses are offered at School of Mines to fulfill the elective course requirement. These courses are offered by the Departments of Civil and Environmental Engineering, Geology and Geological Engineering, Atmospheric Sciences, Chemistry and Chemical Engineering, and Mathematics and Computer Sciences, and by other departments on campus as well. Listed below are examples of courses that might be included as electives in an AES program of study. These lists are intended as examples and are not at all intended to limit a student and committee as they construct an individual program.

Potential elective courses for AES:

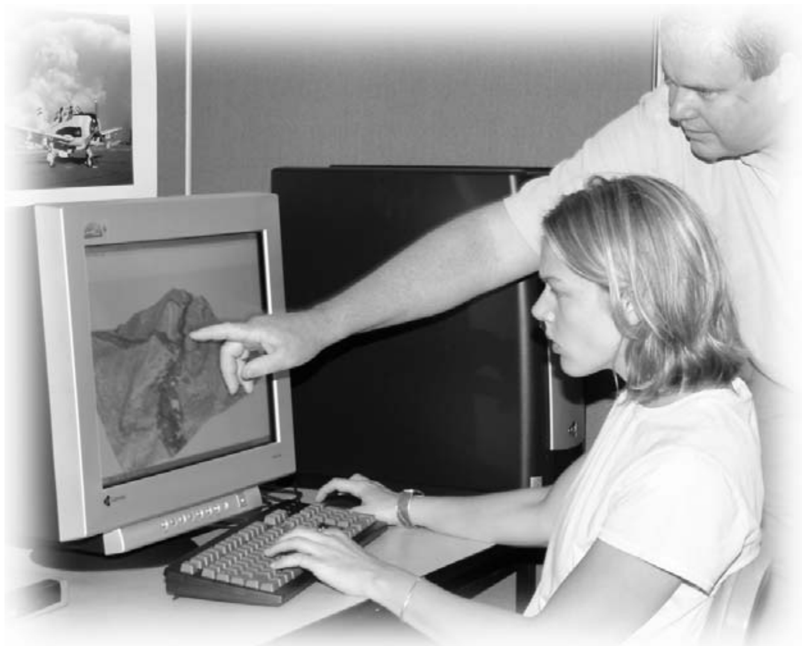
ATM 501 Atmospheric Physics
ATM 502 The Global Carbon Cycle
ATM 503 Biogeochemistry
ATM 505 Air Quality
ATM 510 Introduction to Environmental Remote Sensing
ATM 515 Earth Systems Modeling
ATM 520 Remote Sensing for Research I
ATM 530 Radar Meteorology
ATM 603 Biosphere-Atmosphere Interactions
ATM 540 Atmospheric Electricity
ATM 560 Atmospheric Dynamics
ATM 612 Atmospheric Chemistry
ATM 625 Scaling in Geosciences
CEE 634 Surface Water Hydrology
ATM 642 Physics and Dynamics of Clouds
ATM 643 Precipitation Physics and Cloud Modification
ATM 644 Numerical Dynamics and Prediction
ATM 660 Atmospheric Dynamics II
ATM 670 Boundary Layer Processes
ATM 673 Mesometeorology
CEE 521 Environmental Systems Analysis
CEE 526/526L Environmental Engineering Physical/Chemical Process Design
CEE 527/527L Environmental Engineering Biological Process Design
CEE 528 Advanced Treatment Plant Design
CEE 533 Open Channel Flow
ATM 620 Remote Sensing for Research II
CEE 628 Environmental Engineering Measurements
CEE/GEOE 692 Environmental Remediation Processes
CEE 723 Environmental Contaminant Fate and Transport
CEE 721 Principles of Environmental Engineering
CEE 733 Techniques of Surface Water Resource and Water Quality Investigations I
CEE 784 Modeling and Computation in Civil Engineering
CEE 785 Applications of Finite Element

Methods in Civil Engineering
GEOL 516/517/519 GIS I/II/III
GEOL 633 Sedimentation
GEOE 663 Ground-water Geochemistry
GEOE 682 Fluvial Processes

Student progress and mastery will be measured using the usual instruments in a doctoral program. A written or oral qualifying exam is used to assess the student's mastery of the M.S. coursework. A comprehensive examination is given to evaluate the student's ability to formulate a research problem based on substantive literature review, and to test the student's knowledge in the area of specialty. It is given in two parts: 1) a written examination consisting of a review paper in the student's field of study and a research proposal, and 2) an oral examination to evaluate the research proposal and verify the student's understanding of the basic sciences and specialized field of study. The dissertation forms the final test of the student's ability to perform and communicate research. The student must prepare a doctoral dissertation and successfully complete a public defense covering the scientific validity of the work, as well as the student's basic and specialized knowledge in the field of study.

Management of the AES Program
The AES program is managed by the Office of Graduate Education. A Program Committee composed of 3-5 faculty representing different disciplines oversees the program, including setting policies and reviewing the curriculum. The Program Committee will also take measures to facilitate interaction by all faculty and students participating in the program. A Program Coordinator chairs the Program committee, and provides oversight of student affairs, including meeting with new and exiting students, tracking student progress, and conducting orientations for new students.
The preceding committee is distinct from the graduate student advisory committees that provide guidance to individual AES students during the course of their academic studies. The graduate student's major advisor serves as the chair of this advisory committee.

Atmospheric Sciences



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FACULTY

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ATMOSPHERIC SCIENCES

The Department of Atmospheric Sciences offers advanced undergraduate and graduate courses leading to the Master of Science degree in Atmospheric Sciences with specializations in Meteorology or Earth Systems Science, and Doctor of Philosophy degree in Atmospheric and Environmental Sciences (AES). For more information on the AES program, see pp. 198 - 201 later in this catalog. Faculty in the Department of Atmospheric Sciences are members of the Institute of Atmospheric Sciences (IAS), an active research group that conducts research with sponsorship from the State of South Dakota and various federal agencies.

The primary objective of the atmospheric sciences graduate program is to give students a basic understanding of the factors influencing atmospheric phenomena, including solar and terrestrial radiation, the laws of fluid motion and thermodynamics, microphysical and electrical processes in clouds, ecology, atmospheric chemistry, and biogeochemistry. Instruction is offered in the interpretation of conventional weather data, satellite data, and radar data; observations collected by specially instrumented aircraft, trace-gas flux towers, tethered balloon systems, and laboratory gas analysis instrumentation; and output from numerical models of atmospheric processes. The graduate student is expected to carry out original research in the atmospheric sciences using some of these tools and resources. In addition, the student must successfully complete the coursework and program requirements enumerated below.

A student applying for admission to the Master's degree program in the Department of Atmospheric Sciences should have a baccalaureate degree in meteorology or atmospheric sciences, one of the biological or physical sciences, earth system sciences, mathematics, or engineering. It is desirable for applicants to have received undergraduate credit for mathematics through Calculus 2 (for the earth systems science specialization - see below) or ordinary differential equations (for the meteorology specialization). For the meteorology specialization, undergraduate physics is required, and for the earth systems specialization, undergraduate physics and chemistry are desirable. Experience with computer programming is recommended. Graduate Record Examination (GRE) scores from the General Test are optional. TOEFL scores are required of all applicants from colleges outside the U.S.

Course requirements for the M.S. degree

1. Fifteen (15) credit hours of course work in atmospheric sciences at the 500 level or above.
2. Nine (9) additional credit hours of non-atmospheric sciences electives at the 400 level or above (300 level non-atmospheric sciences courses can be accepted if approved by the Graduate Education and Research Council), , or atmospheric sciences electives at the 500 level.
3. Thesis research - six (6) credit hours. (Please note undergraduate credit limitations given under "M.S. Degree Requirements" (p. 188) for Master of Science degrees.)

Other program requirements

The following program requirements apply to all students in Atmospheric Sciences:

- At least one course at the 500/600 levels must be taken in each of the following core areas: Meteorology, Earth System Science, and Techniques. Course descriptions in the catalog describe the area to which each ATM course belongs.
- Satisfactory performance on a general coursework exam covering each of the core courses as well as selected elective course work.
- Registration in ATM 700 Graduate Research (thesis) each semester the student is receiving an assistantship, and in ATM 690 Graduate Seminar each spring semester.
- Completion of a master's thesis. The thesis must adhere to the format and content guidelines as set forth by the Graduate School, and be approved by the student's graduate committee and the Dean of Graduate Education.

In addition, there are requirements specific to the two (2) ATM MS specializations. Each student will choose one of these specializations. The requirements are:

Meteorology Specialization

Students entering the program with a Bachelor's degree in physics, mathematics, computer science, chemistry, or engineering must take the following courses: ATM 450 - Synoptic Meteorology I (not for graduate credit), ATM 550 - Synoptic Meteorology II, ATM 501 - Atmospheric Physics, and ATM 560 - Atmospheric Dynamics I.

Students entering the program with a Bachelor's degree in Atmospheric Sciences or Meteorology from another institution are required only to take ATM 501 (Atmospheric Physics), presuming that they have completed undergraduate work in the other areas listed in the preceding paragraph.

Earth System Science Specialization

All students will be required to take the following courses: ATM 502 - The Global Carbon Cycle, ATM 503 - Biogeochemistry, ATM 515 - Earth Systems Modeling. They also must complete at least one remote sensing course.

A specific plan of study will be determined on an individual basis with concurrence from the student's advisor and graduate committee members. In either specialization, exceptions to these departmental requirements may be granted by the student's committee for good cause.

Elective courses offered by other departments are encouraged as long as the fifteen (15) hours of course work in Atmospheric Sciences at the 500-level or above are completed as outlined in "Course requirements for M.S. degree." Graduate students may take electives in the fields of physics, mathematics, computer science, chemistry, engineering, technology management, social sciences, or the humanities to further integrate their coursework in the atmospheric sciences with knowledge in other technical fields and with the general concerns of society.

A student may choose the meteorology specialization with the intent to qualify for employment in the federal civil service as a meteorologist. Specific course distribution requirements to do so are listed on p. 141 earlier in this catalog within the general description of the Department of Atmospheric Sciences. Students in either specialization may pursue an M.S. degree in Atmospheric Sciences without satisfying these requirements and be qualified for careers in many non-federal and/or non-meteorological careers. Examples of such career options include research in and applications of remote sensing techniques; work in air quality either for non-federal government agencies, or for industry or the consulting firms industries often employ; research and applications in the environmental sciences with an emphasis on atmospheric issues, and further graduate work in atmospheric or environmental sciences.

Undergraduate students at School of Mines may decrease the time required to obtain a Master of Science degree in Atmospheric Sciences by taking as electives the preparatory undergraduate and entry-level graduate courses available to them or by completing the Bachelor of Science in Interdisciplinary Sciences program with an emphasis on atmospheric sciences. They may then enter the graduate program with the necessary background for graduate study in atmospheric sciences as above.

FACILITIES AND RESOURCES

Students typically work directly with faculty on externally-funded research projects. Graduate research assistantships associated with these projects are available that provide part-time employment for students during the academic months and possible full-time employment during the summer. Facilities and resources of the IAS are utilized in these research efforts. These facilities comprise various meteorological instrument platforms and packages including several automated surface weather stations, a tethered-balloon sampling system, an instrumented flux measurement tower in the Black Hills National Forest, portable equipment for land surface and plant canopy ecosystem studies, and atmospheric analytical chemistry field and laboratory instrumentation. Sophisticated computer facilities are available on campus, including a state-of-the-art 3-D computer visualization facility and a high-speed multiple-node computer cluster, with additional access to the larger computer complexes elsewhere.

FACULTY RESEARCH

Current research projects include field investigations of thunderstorms; applications of weather radar data to rainfall measurements and remote inference of cloud microphysical characteristics; numerical modeling of clouds ranging in size from small cumulus to severe storms including storm electrification, lightning, and lightning-influenced atmospheric chemistry; analysis of field observations and numerical simulations of lake effect snow storms; satellite remote sensing; land-surface/atmosphere exchange processes; fire weather prediction and modeling; biogeochemical cycling; trace-gas flux measurements; and carbon sequestration and ecological modeling. In addition, IAS scientists are currently involved in activities to disseminate scientific knowledge to wider audiences and improve and enhance scientific literacy and educational opportunities for the people of South Dakota.

Chemical Engineering

CONTACT INFORMATION

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FACULTY

Professor Winter, Chair; Professors Dixon, Pillay and Puszynski; Assistant Professors Gilcrease and Menkhaus; Emeritus Professors Bauer, Munro and Sandvig.

CHEMICAL ENGINEERING

The Department of Chemical and Biological Engineering offers programs of study leading to the Master of Science degree in Chemical Engineering. Students follow a thesis or non-thesis executive program option. A student who elects the thesis option will be required to present a thesis based upon an original investigation for which six (6) credits must be earned toward a total requirement of thirty (30) credits in an approved program of study. For the non-thesis Executive Program option, a student must earn thirty-two (32) credits in an approved program of study and complete a project. In the non-thesis Executive Program, which is oriented toward industrial needs, students take at least one course in technology management as part of their required courses for the M.S. in Chemical Engineering.

A chemical engineer with a M.S. degree obtains graduate education that provides the graduate with an in-depth understanding of the chemistry, mathematics, and physical laws describing systems at both the molecular level and the macroscopic level. With this knowledge, the chemical engineer is expected to be able to participate in interdisciplinary research, development, and implementation of new and improved technologies in areas such as: biotechnology, catalysis, chemical technology, combustion, , electronics, environmental issues, high-performance materials, and nanotechnology. A student who does not have a bachelor's degree in chemical engineering will be expected to makeup any deficiencies before pursuing graduate courses. The current research interest of the faculty can be found on the departmental webpage at www.hpcnet.org/sdsmt/department/chem.

Qualifying examinations may be required of entering graduate students. These examinations, if required, will be administered during a student's first semester of residence.

Written final examinations in Transport Phenomena, Thermodynamics, Reactor Design, and an optional area are required. An oral thesis defense, or oral project examination for the non-thesis degree is required.

A core curriculum required of all M.S. candidates in Chemical Engineering includes the following courses or approved substitutions:

CHE 550	Systems Analysis Applied to Chemical Engineering	3
CHE 612	Transport Phenomena: Momentum	3
CHE 613	Transport Phenomena: Heat	3
CHE 621	Advanced Chemical Engineering Thermodynamics I	3
Kinetics Elective1		3
Applied Computation Elective[2]		3

[1] Kinetics Elective: CHE 544 or MES 728

[2] Applied Computation Elective: CHE/ME 616, MATH 432, or IENG 485

In addition to the core curriculum, students pursuing the non-thesis option must complete a minimum of two (2) credits of non-thesis research, CHE 788, and three (3) credits in technology management.

Mines Matters: School of Mines students receive more than $11 million annually in financial aid and scholarships. Seventy percent of School of Mines students receive some form of financial aid, including more than 400 university scholarships.

Chemistry

CONTACT INFORMATION

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FACULTY

Associate Professor Heglund, Chair; Professors Arrington, Boyles; and Winter; Associate Professor Heglund; Assistant Professors Felling and Fong.

CHEMISTRY

Students interested in pursuing graduate studies focusing on chemistry of materials, especially organic, inorganic, and analytical chemistry, please see Master of Science in Materials Engineering and Science.

Civil Engineering

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FACULTY

Associate Professor Kenner, Chair; Professors Sangchul Bang, Hansen, Mott, and Preber; Associate Professors Fontaine and Klasi; Assistant Professors Maleck (Surovek), Patnaik, and Stone; Instructor Arneson-Meyer.

CIVIL ENGINEERING

The Department of Civil and Environmental Engineering offers graduate study programs leading to the Master of Science degree in Civil Engineering in the following specialties: Advanced Materials, Environmental Engineering, Geotechnical Engineering, Water Resources Engineering, and Structural Engineering. Any one of the above subject areas may be chosen as an area of emphasis. Additional courses can be taken from any one of the above subject areas.

Emphasis within the department is on the professional development of the student and mastery of the technical and applied aspects of his or her specialty. Both thesis and non-thesis options are available to candidates for the Master of Science degree in Civil Engineering. A minimum of thirty (30) credit hours are required for the thesis option of which six (6) credit hours of Graduate Research (CEE 798) and 24 credits of course work are required. Independent study (CEE 692) and non-thesis research (CEE 789) are not applicable toward the thesis option. The non-thesis option requires a total of thirty-two (32) credit hours of which five (5) credits can be a combination of non-thesis research (CEE 789) and Independent study (CEE 692). Modeling and Computation in Civil Engineering (CEE 784) is a required course for all MSCE students. Other specific course requirements may be applicable depending upon the student's area of specialization. Students who elect to major in Environmental Engineering or Water Resources

Engineering must complete CEE 521 and CEE 733. Students who select Geotechnical Engineering must complete CEE 643 and CEE 647. All rules and regulations of the Graduate Office, included elsewhere, apply to candidates for the degree of Master of Science in Civil Engineering.

The Department of Civil and Environmental Engineering has well equipped laboratories in concrete and advanced composite materials preparation, materials testing, bench and pilot-scale bridge testing, hydraulic engineering, soil mechanics, and water and wastewater analysis. These laboratories are available for student thesis research. Students will make considerable use of various computer labs for their course work and research. There are a number of computer labs open to all students as well as computers for departmental use.

Mines Matters: Does concrete float? School of Mines Concrete Canoe Team proved that concrete can indeed float by winning the 1995 National Concrete Canoe Competition in Washington D.C. School of Mines student chapter of the American Society of Civil Engineers (ASCE) has competed in ten of the twelve national concrete canoe competitions. School of Mines hosted the 1998 National Concrete Canoe Competition, placed fifth in the nation at the 1999 competition, 11th in the 2000 competition, and fifth in the 2001 competition, and seventh in the 2002 competition.

Computer Science

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FACULTY

Professors Carda, Corwin, Logar, and Penaloza; Associate Professors McGough, Weiss.; Assistant Professor Hansen; Emeritus Professor Opp.

COMPUTER SCIENCE

The Department of Mathematics and Computer Science offers a graduate program leading to the Master of Science degree in Computer Science. The prospective graduate student should have completed the equivalent of the South Dakota School of Mines and Technology Bachelor of Science degree in Computer Science and is strongly encouraged to provide Graduate Record Exam (GRE) scores from the General Test. At a minimum, all entering graduate students must have completed, or must complete in addition to their graduate program, the undergraduate courses listed below. Credit by examination is available.

- one year of calculus (e.g., MATH 123, 125)
- one semester of discrete mathematics (e.g. CSC 251)
- a CSC 1 course (e.g., CSC 150)
- a CSC 2 course (e.g., CSC 250)
- a data structures/algorithms course (e.g., CSC 300)
- an assembly language or computer organization course (e.g., CSC 314)
- an operating systems course (e.g., CSC 456)

All students who do not have a Computer Science degree from this institution will be required to take a placement exam before registering for classes. The placement exam will be given on registration day. Any student who fails to take the exam will be required to register for CSC 250 and will be required to take the sequence of make-up courses designated for the graduate program. Based on the results of the placement exam, a student will be assigned a deficiency program by the student's advisor. During registration, such students must give priority to courses in the deficiency program.

The Department of Mathematics and Computer Science offers three (3) options for the M.S. Computer Science degree: a thesis option, a non-thesis option, and a course work only option.

The candidate who qualifies for the **thesis option** must satisfy the following requirements:

1. After the first semester, the student may apply for the thesis option.
2. A minimum of thirty (30) credits is required for this option.
3. A minimum of six (6) credits of CSC 798, Master's Thesis, is required.
4. A minimum of eighteen (18) credits of Computer Science courses numbered 500 or above, exclusive of independent study, co-op., and CSC 798, is required.
5. A maximum of two (2) courses may be taken outside of the program. These courses must be at the 400 level or higher and must be approved by the academic advisor prior to registration.
6. A maximum of three (3) credits of co-op or

three (3) credits of independent study may be applied toward the degree. That is, the total number of independent study plus co-op credits must not exceed three (3) credits. The approval of the department co-op director, currently Dr. Penaloza, is required prior to enrolling in a co-op. The permission of the student's graduate committee is also required prior to enrolling in a co-op. A student must have the written permission of the faculty member supervising the independent study prior to registering for the course.

7. The student must pass an oral course work examination in the last semester of study. Additional information on the examination is found in the Graduate Handbook at http://www.mcs.sdsmt.edu
8. The student must present a formal defense of his or her research.

The candidate who qualifies for the **non-thesis option** must satisfy the following requirements:

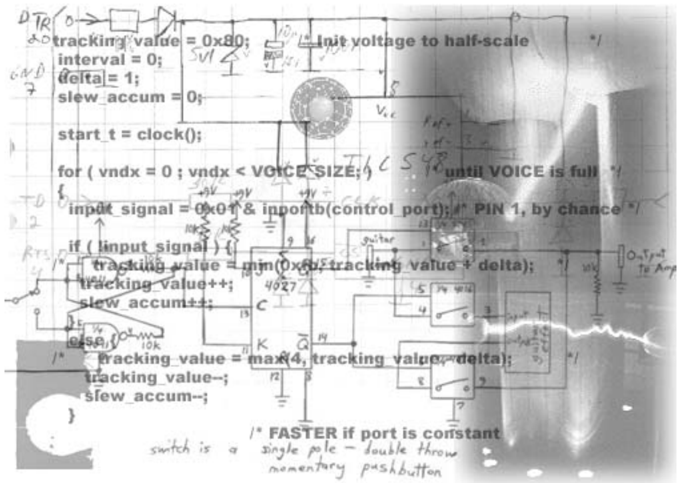
1. After the first semester, the student may apply for the non-thesis option.
2. The student must complete a minimum of thirty-two (32) credits.
3. A minimum of three (3) credits of CSC 788, Non-thesis Research, is required.
4. A minimum of twenty-four (24) credits of Computer Science courses numbered 500 or above, exclusive of independent study, co-op, and CSC 788, is required.
5. A maximum of two (2) courses may be taken outside of the program. These courses must be at the 400 level or higher and must be approved by the academic advisor prior to registration.
6. A maximum of three (3) credits of co-op may be applied toward the degree. The approval of the department co-op director, currently Dr. Penaloza, is required prior to enrolling in a co-op. The permission of the student's graduate committee is also required prior to enrolling in a co-op.
7. A maximum of three (3) credits of independent study may be applied toward the degree. A student must have the written permission of the faculty member supervising the independent study prior to registering for the course.
8. The student must pass an oral course work examination in the last semester of study. Additional information on the examination is found in the Graduate Handbook at http://www.mcs.sdsmt.edu
9. The student must present the non-thesis work in a department colloquium or formal defense.

The candidate who chooses the course work only option must satisfy the following requirements:

1. The student must complete a minimum of thirty-two (32) credits
2. A minimum of twenty-four (24) credits of Computer Science courses numbered 500 or above, exclusive of independent study or co-op, is required.
3. A maximum of two (2) courses may be taken outside of the program. These courses must be at the 400 level or higher and must be approved by the academic advisor prior to registration.
4. A maximum of three (3) credits of co-op may be applied toward the degree. The approval of the department co-op director, currently Dr. Penaloza, is required prior to enrolling in a co-op. The permission of the student's graduate committee is also required prior to enrolling in a co-op.
5. A maximum of three (3) credits of independent study may be applied toward the degree. A student must have the written permission of the faculty member supervising the independent study prior to registering for the course.
6. The student must pass a written comprehensive examination in the last semester of study. Additional information on the examination is found in the Graduate Manual at http://www.mcs.sdsmt.edu

School of Mines has a variety of computing platforms available. Resources include an extensive PC network, a Linux lab, and a lab equipped with SunRays tied to three Sun Enterprise 450 servers. Other computing resources may be accessed via the Internet. The institution encourages its students to use the computer facilities in the creative and efficient solution of scientific and engineering problems.

Electrical Engineering



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Faculty

Professor Hasan, Chair; Steven P. Miller Endowed Chair and Professor Whites; William J. Hoffert Professor Simonson; Professors and Batchelder; Associate Professor Hemmelman; Assistant Professors Chen, Montoya, and Zhang.

Electrical Engineering

The mission of the Electrical and Computer Engineering graduate program is to provide quality student learning at an advanced level and to disseminate new knowledge in Electrical Engineering, while at the same time working to increase resources in support of these objectives.

The graduate program in Electrical Engineering consists of research and study leading to the Master of Science degree in Electrical Engineering (M.S. EE) and a Ph.D. degree in Materials Engineering and Science. The Ph.D. degree candidate's program must emphasize Materials. In special cases, with the consent of the Graduate Committee of the Electrical and Computer Engineering Department, students may elect to do research in association with another engineering or science department.

The prospective student should have completed a baccalaureate degree in Electrical Engineering or Computer Engineering. Applicants from universities that are not accredited by the Accreditation Board for Engineering and Technology (ABET) are generally required to submit Graduate Record Exam (GRE) scores from the General Test with their application.

Depending on the student's undergraduate background, and at the discretion of the ECE Graduate Committee, graduates of other institutions may also be required to take one or more courses of preparatory undergraduate work in addition to their graduate program of study

The M.S. EE degree is available with Thesis and Non-Thesis tracks. The course requirements for these tracks are as follows:

Thesis option

The thesis M.S. EE degree consists of a program of graduate course work and thesis research. Candidature for the M.S. EE degree with Thesis is contingent on an aptitude to do research. A limited number of students are accepted into the M.S. EE Thesis option, on the recommendation of a major professor. The requirements for the M.S. EE Thesis degree are as follows:

1. A program of at least thirty (30) credit hours of course work and research.
2. At least fifteen (15) credit hours of graduate course work (500 level courses and above).
3. At least six (6) credit hours of thesis research. (No more than nine credit hours of thesis research will count toward degree requirements.)
4. A satisfactory thesis based upon individual research.
5. Meeting or exceeding prescribed academic standards.
6. Passing an examination on general knowledge and successfully defending the thesis.

Non-Thesis option

The non-thesis MSEE degree consists of a program of graduate course work. A project is not required and normally is not encouraged for the M.S. EE non-thesis option. The requirements for the M.S. EE Non-Thesis degree are as follows:

1. A program of at least thirty-two (32) credit hours of course work.
2. At least twenty (20) credit hours of graduate course work (500 level courses and above).
3. Meeting or exceeding prescribed academic standards.
4. Passing an examination on general knowledge in the field.

Language Requirements

1. Students whose native language is not English are generally required to take the Test of English as a Foreign Language Test (TOEFL).
2. Graduate students with a TOEFL score below 560 are required to attend a remedial course in English.
3. There is no foreign language requirement for the M.S. EE degree.

Graduate Credit Taken as an Undergraduate

Undergraduate students taking 600 level graduate courses and petitioning these courses for graduate credit should realize that application of these credits to the program of study is subject to the approval of the student's graduate committee. A student's graduate program will come under the control of the graduate committee at the time the student is accepted into the graduate program.

Graduate Committee and Program of Study

The ECE Graduate Committee is the graduate committee for all M.S. EE non-thesis degree students, with the Graduate Coordinator serving as the advisor. M.S. EE Thesis students form a graduate committee with a major professor who has agreed to supervise the research of the student. In both cases, the student must arrange to have a faculty member external to the Department of Electrical and Computer Engineering on his or her committee.

Each student must submit a program of study to the candidate's graduate committee by the end of the first semester of study. Approval of the program of study is necessary in order to register for the second and subsequent semesters.

The student's graduate committee has the right to disallow any course proposed in the student's program of study that they feel is not appropriate for the graduate degree in Electrical Engineering. A student accepted into the Ph.D. program in Materials Engineering and Science must have his or her program approved by the graduate committee responsible for that program.

Research Areas and Resources

The M.S. EE degree offers emphases in three (3) areas: Communications and Applied Electromagnetics, Digital Computers and VLSI, and Power and Control Systems. In addition to the more discipline-specific equipment listed below, the ECE Department has well-equipped laboratories of networked PCs and Sun workstations, general purpose test and measurement equipment such as high-speed oscilloscopes, arbitrary function generators, logic analyzers, and printed circuit board prototyping machines and software.

Research activities in the Communications and Signal Processing area include: compact antennas, electromagnetic propulsion of space sailcraft, engineered electromagnetic materials using active and passive circuit particles, ultrawideband and ground penetrating radar, and wavelet signal processing. Resources in support of this program include a number of vector network analyzers, impedance analyzers, Agilent Advanced Design System, Microwave Office, and Analog Devices DSP development tools. Additionally, the Steven P. Miller Endowed Chair in Electrical Engineering was recently established to support telecommunications in the ECE department.

Research activities in the Digital Computers and VLSI area include: neural network and fuzzy logic chips, intelligent systems, deep-submicron ASIC design, FPGA- and CPLD-based embedded system design, radiation-hardened VLSI design, fault tolerant computer systems, residue and psuedo-floating point number architectures, and voice recognition. Resources in support of this program several logic analyzers, a variety of microcontroller and microprocessor development systems, FPGA and CPLD prototyping boards, multiple VHDL and Verilog compilers, Mentor Graphics Computer Aided Design Toolset, a variety of microchip fabrication equipment, and printed circuit board manufacturing equipment.

Research activities in the area of Power and Control systems include: modeling of power systems, power systems stability, generator dynamics, six-phase power system analysis, fault analysis, isolated power system operation and control, wind power, machine control, fuzzy logic control, nonlinear and adaptive control. Additionally, a number of robotics projects are performed in association with the School of Mines Center of Excellence in Advanced Manufacturing and Production (CAMP).

M.S. E.E. Course Offerings

Each area of emphasis is supported by the following courses:

Communication Systems and Signal Processing:

EE 612	High-Speed Digital Design
EE 621	Information and Coding Theory
EE 622	Statistical Communication Systems
EE 623	Random Signals and Noise
EE 624	Advanced Digital Signal Processing

Digital Computers and VLSI:

EE 641	Digital Systems Design
EE 642	Digital Systems Theory
EE 643	Advanced Digital Systems
EE 644	Fault Tolerant Computing
EE 645	Adv Digital System/VLSI Testing
EE 647	HDL Design
EE 648	Advanced VLSI Design

Power and Control Systems:

EE 618	Instrumentation Systems
EE 633	Power System Analysis I
EE 634	Power System Analysis II
EE 651	Digital Control Systems
EE 652	Nonlinear and Optimal Control Systems

Geology and Geological Engineering

CONTACT INFORMATION

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GEOLOGY FACULTY

Professors Fox, Bishop, Duke, Lisenbee, and Paterson; Associate Professor Price.

GEOLOGICAL ENGINEERING FACULTY

Professor Davis, Chair; Professor Roggenthen; Associate Professor Stetler.

GEOLOGY AND GEOLOGICAL ENGINEERING

The Department of Geology and Geological Engineering offers opportunities for advanced study leading to an M.S. degree in Geology and Geological Engineering and a Ph.D. degree in Geology and Geological Engineering. These are provided in the form of two (2) specializations:

Geology Specialization
Six options are available:
1. Petroleum Geology
2. Environmental/Exploration Geophysics
3. Ground Water Geology
4. Mineral Deposits/Mineralogy/Petrology
5. Sedimentation/Stratigraphy/Paleontology
6. Structural Geology

Geological Engineering Specialization
Three options are available:
1. Ground water and environmental (with emphases in digital modeling and geochemistry)
2. Geomechanics and engineering geology (with emphases in geomorphology surficial processes, and engineering geophysics) and
3. Energy and mineral resources (with emphases in drilling engineering, petroleum production, reservoir engineering, and minerals)

Candidates for the M.S. or the Ph.D. must have had or shall complete the same undergraduate courses in the basic sciences, mathematics, and engineering as those required for the equivalent B.S. degree in the department. Changes in make-up requirements must be approved by the student's graduate committee and the Department Chair.

The Graduate Record Examination (GRE) is required of all applicants except School of Mines graduates. Applicants who have not taken the GRE can be accepted on a provisional basis subject to satisfactory completion of the examination in the first year of the program. The TOEFL exam is required for students whose native language is not English.

Master's Program

The M.S. degree program consists of research and study in various fields depending on the student's interests. The M.S. thesis option includes six to eight (6-8) credits of thesis research and one (1) credit of graduate seminar in fulfilling requirements of the Graduate Office, as well as twenty-three to twenty-five (23-25) credits of course work. The non-thesis option is reserved for students who have had extensive professional experience after the B.S. degree.

Candidates for the M.S. degree must fulfill all degree requirements of the Graduate Office and also the program requirements. Geological engineering students are expected to have had or shall take the equivalent of undergraduate courses in engineering geology, ground water, structural geology, stratigraphy/sedimentation, field geology, and engineering. Geology students are expected to have had or shall take the equivalent undergraduate courses for the B.S. in Geology. Minor adjustments in course equivalency may be permitted by the candidate's graduate committee, but shall be recorded by letter during the first semester of graduate enrollment and approved by the Department Chair.

All entering graduate students are expected to take a core curriculum, which includes GEOL 633 (Sedimentation). In addition, Geological Engineering students take GEOE 766 (Digital Modeling of Ground-Water Flow Systems), and Geology students take GEOL 604 (Advanced Field Geology). Other courses appropriate to the area of specialization are selected by the student and the graduate committee. Geological Engineering students are encouraged to take additional graduate courses in other engineering departments.

Additional requirements are specified in the departmental graduate handbook, which all students may pick up from the departmental office.

Master's Degree in Paleontology. See separate Paleontology section in this bulletin.

Doctoral Program

The course of study leading to the Ph.D. degree is developed by the student in conjunction with his or her committee and must prepare the candidate fully in basic geology/engineering in order to provide the foundation and academic background for doctoral research. Candidates must fulfill all requirements of the Graduate Office as well as the program requirements. Dissertation research topics will vary, depending on the interests of the student, but must have the approval of the student's committee. A qualifying examination is required and will be developed on the basis of the student's academic background and professional experience. All students must take the core course GEOL 808 (Fundamental Problems in Geology and Geological Engineering).

Progress toward the Ph.D. degree is undertaken in several parts including completion of the curriculum, a qualifying exam, a language component, a dissertation proposal defense, the preparation of a dissertation, a comprehensive examination, and the defense of the dissertation. The following section outlines the general requirements for all students and lists the specific requirements for the separate options in Geology and Geological Engineering.

Background Requirements

Geology Specialization:

1. All incoming students with a degree in a geological science shall have completed the equivalent of this department's undergraduate requirements in geology, chemistry, physics, and mathematics.
2. Students without a geology-related

undergraduate degree are expected to complete the undergraduate requirements of this department in mathematics, physics, and chemistry and to take courses or show proficiency in:
- Physical Geology
- Historical Geology
- Petrology
- Mineralogy
- Structural Geology
- Field Geology
- Ground Water
- Paleontology

Geological Engineering Specialization:

1. All incoming students are expected to have completed the equivalent of the department's undergraduate requirements in basic engineering.
2. All incoming students are expected to be proficient in geological engineering and are encouraged to become registered professional engineers. They are expected to take courses or show proficiency in:
   - Physical Geology
   - Mineralogy
   - Stratigraphy and Sedimentation
   - Structural Geology
   - Engineering Field Geology
   - Statics
   - Mechanics of Materials
   - Fluid Mechanics
   - Geotechnical Engineering
   - Rock Mechanics
   - Engineering/Environmental Geology
   - Ground Water

Qualifying Exam

To monitor progress and to assess suitability of the candidate for continuation in the Ph.D. program, all Ph.D. students are expected to take a qualifying exam.

The examination will be taken before the end of the first month of the third semester of residence at School of Mines unless specific permission is received to delay the examination; such permission must be sought from the department chair upon the recommendation of the student's major advisor.

Format and timing will be negotiated between the student and the committee, but at least part of the examination will be oral.

Dissertation Proposal Defense

For geology students, the student is required to prepare a research proposal. The proposal is due one month prior to the week of the proposal examination. This is necessary so that the candidate's committee may review the proposal to assure that it is defensible. The proposal is defended for scientific merit and thoroughness in an oral examination, before the student commences dissertation research. The committee must pronounce that the proposal is of sufficient quality to be defensible. If not, then the student will have an opportunity to resubmit, although this may alter the final date of the examination.

For geological engineering students, the dissertation proposal defense is part of the comprehensive examination.

Language Requirements

The student, working with his/her graduate committee, may select one of the following four options:

1. A reading knowledge of two (2) foreign languages (standardized test).
2. A reading, writing, and speaking competence in one foreign language pertinent to the field of study (standardized test).
3. A reading knowledge of one foreign language plus nine semester hours of course work in a collateral field such as computer science, credit for which may not be applied toward the degree. A list of collateral courses will be prepared by the student, approved by the dissertation committee, and submitted to the Graduate Division.
4. Competence in at least two (2) computer languages and in software pertinent to the student's field of study (e.g., Geographic Information Systems software). Competence in computer languages shall be determined by a qualified faculty member from outside of the department. Documentation of this competence shall be approved by the dissertation committee and submitted to the Graduate Office.

Curriculum

A minimum of eighty (80) credit hours are required beyond the B.S. degree. At least fifty (50) of these credits must be for course work.

Up to thirty (30) course credits from the M.S. degree can be applied toward this requirement if the student's committee agrees. It is recommended that six (6) to twelve (12) hours of course work be taken outside the department. All students are expected to show competence in the Geology or Geological Engineering core curriculum.

Ph.D. Course Work Requirements for Geology Specialization

Core Courses:

GEOL 633	Sedimentation	3
GEOL 604	Advanced Field Geology	3
GEOL 790	Seminar	1
GEOL 808	Fundamental Problems in GEOL/GEOE	3

One course from:

GEOL 516	GIS I: Intro to GIS	3
GEOE 766	Digital Modeling of Ground-Water Flow Systems	3
MEM 533	Computer Applications in Geoscience Modeling	4

One course from:

GEOL 621	Advanced Structural Geology	3
GEOL 622	Geotectonics	3

One course from:

GEOE 626	Environmental Geophysics	3
GEOE 641	Geochemistry	3
GEOE 664	Advanced Ground Water	3
GEOL 652	Problems in Ore Deposits	3

Optional courses:

Minimum of 10 credit hours in courses related to student's research/specialty.

Ph.D. Course Work Requirements for Geological Engineering Specialization

All Ph.D. students in the Geological Engineering option are expected to follow the course outline for one of the tracks below.

Required of all GEOE students:

GEOE 766 Digital Modeling of Ground-Water Flow Systems
GEOL 633 Sedimentation
GEOE 790 Graduate Seminar

GEOL 808 Fundamental Problems in GEOL/GEOE

Ground Water and Environmental Option:

Required:
GEOE 664 Advanced Ground Water
GEOE 641 Geochemistry
GEOE 663 Ground-Water Geochemistry
CEE 634 Surface Water Hydrology[1]
CEE 523 Environmental Systems Analysis[2]

Electives:
GEOL 516 GIS I: Intro to GIS
CEE 730 Statistical Methods in Water Resources
CEE 731 Current Topics in Water Quality Assessment
CEE 526 Environmental Engineering Physical/Chemical Process Design
CEE 723 Environmental Contaminant Fate and Transport
CHEM 480 Toxicology

Geomechanics Option:

Required:
GEOE 668 Engineering Geology of Surficial Deposits
CEE 647 Earth Structures
CEE 646 Stability of Soil and Rock Slopes
CEE 643 Advanced Soil Mechanics I
MEM 550 Rock Slope Engineering
MINE 512 Rock Mechanics III

Electives:
GEOE 664 Advanced Ground Water
CEE 645 Advanced Foundations
CEE 648 Theory and Application of Earth
CEE 784 Modeling and Comp in Civil Engr

Energy and Mineral Resources Option:

Required:
GEOE 525 Engineering Geophysics II
GEOE 531 Principles of Well Logging[3] or
GEOE 552 Geochemical Exploration[4]
GEOE 661 Petroleum Geology[3] or
GEOL 652 Problems in Ore Deposits[4]

Electives:
GEOL 513 Ore Microscopy
GEOE 626 Environmental Geophysics
GEOE 641 Geochemistry
MEM 533 Computer Applications in Geoscience Modeling
GEOE 665 Bioremediation of Hazardous Materials
GEOE 663 Ground-Water Geochemistry
CEE 725 Treatment, Disposal, and Management of Hazardous Waste
GEOL 650 Seminar in Ore Deposits
CEE 784 Modeling and Comp in Civil Engr

[1] Suitable hydrology courses can be substituted with the approval of the student's graduate committee.

[2] Suitable environmental engineering courses can be substituted with the approval of the student's graduate committee.

[3] Energy Emphasis

[4] Minerals Emphasis

Comprehensive Examination: Summary of Rules and Organizations

Prior to completion and acceptance of the Ph.D. dissertation and admission to the Ph.D. candidacy, the student must demonstrate his or her ability by successfully completing a comprehensive examination. This examination is open to any faculty member, but must include the candidate's full committee.

If the student has not completed all requirements for the Ph.D. degree by the fifth year following the comprehensive examination, his/her active status will be automatically terminated and the comprehensive examination must be repeated.

1. No later than two (2) months prior to the examination date the student must make a request to the student's committee to take the Comprehensive Examination.
2. The examination will consist of four parts, all of which must be completed within one working week.
3. The written examinations will be graded prior to the oral examination.
4. The examination may be scheduled for spring and fall semesters only, but not during the week of final examinations and the last week of classes.
5. Details for each specialization follow:

Geology Specialization:

General Geology (written)	25%
Specific Topic (written)	25%
Specific Topic (written)	25%
Oral Examination	25%

Each part of the written examination, in general, will be three (3) hours in length. Specific topics will be chosen from the following list:

- Structural geology
- Sedimentation/stratigraphy
- Paleontology
- Igneous/metamorphic petrology
- Economic geology/mineral exploration
- Crystal chemistry/mineralogy
- Geomorphology
- Geophysics
- Glacial and Pleistocene Geology

The oral examination will be on General Geology, and the two (2) specific topics chosen for the written examination.

Geological Engineering Specialization:

Geological Engineering, General Geology, and Fundamentals of Engineering (written)	25%
Chosen Topic (written)	25%
Chosen Topic (written)	25%
Oral Defense of Dissertation Proposal	25%

Each part of the written examination, in general, will be three (3) hours in length. Chosen topics will be from the following list:

- Ground Water
- Engineering Geology
- Petroleum Engineering
- Minerals
- Hydrology and Hydraulic Engineering
- Geophysical Exploration
- Geochemistry
- Geomorphology
- Rock Mechanics
- Geotechnical Engineering

A student may substitute successful completion of the Fundamentals of Engineering (F.E.) examination for one of these three (3) fields. A student also may propose hybrid fields with other disciplines if approved by his or her graduate committee.

The oral defense of the dissertation proposal may follow the completion of the written examinations.

Materials Engineering and Science

CONTACT INFORMATION

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STEERING COMMITTEE

Professor Boyles, Program Coordinator and Steering Committee Chair; Professors Foygel; and Distinguished Professor Han.

FACULTY

Distinguished Professor Han; Robert L. Sandvig Professor Puszynski; Professors Arrington, Bang, Boyles, Foygel, Howard, Medlin, Fuerstenau Professor Kellar, Marquis, and Petukhov; Associate Professors Corey, Heglund, and Sobolev; Assistant Professor Fong; Instructor Cross; Emeritus Professor Stone.

MASTER OF SCIENCE IN MATERIALS ENGINEERING AND SCIENCE

This interdisciplinary degree program, introduced during the 1996-1997 academic year, combines the formerly separate M.S. in Chemistry, M.S. in Metallurgical Engineering, and M.S. in Physics. These three (3) disciplines reside within the College of Materials Science and Engineering, which directs study leading to the Master of Science degree in Materials Engineering and Science (M.S./MES). The program works in concert with other colleges and the Doctor of Philosophy in Materials Engineering and Science (Ph.D./MES).

The M.S./MES degree offers an education in the broad area of materials. Students pursuing this degree will expand their knowledge and understanding of the science and technology of materials synthesis, behavior, and production. Graduates of the program formulate solutions to materials problems through the use of multi-disciplinary approaches made possible with a broad background in basic materials science and engineering coupled with an area of specialization.

Two options are available in this degree program: one option involves a thesis component and the other option involves course work only. In the thesis option, twenty-four (24) hours of course work and a minimum six (6) credit hours of thesis research are required. With the second option, thirty-two (32) hours of course work must be taken. In the latter option however, the students are required to undertake a project under the supervision of a faculty member. The program is administered by the Chairs of the three (3) representative departments with the Chair of M.S./MES Steering Committee serving as Program Coordinator.

Because students graduating with this degree are expected to have a broad-based fundamental knowledge in both materials engineering and materials science, every student is required to take the following core courses.

MES 601	Fundamentals of Materials Engineering (4 cr.hr.)
MES 603	Condensed Matter Physics (4 cr.hr.)
MES 604	Chemistry of Materials (4 cr.hr.)

Areas of research currently carried out include inorganic, organic, and biological behavior/synthesis/treatments of materials, polymer chemistry, solid state physics, interfacial chemistry/physics, thermal, magnetic and transport properties of semiconductors, superconductors, metals and alloys, dielectric and composite materials, recovery and processing of minerals/materials/scrap, process simulation and optimization, thermodynamics of various materials, corrosion and corrosion inhibition, strengthening mechanisms, deformation induced transformation plasticity, artificial intelligence, kinetics of leaching and cementation processes, and behavior/properties/synthesis of composites.

Undergraduate Degrees That Prepare Students for the M.S./MES Program

The breadth of the field of materials engineering and science is such that graduates from any of the following disciplines should be prepared for graduate study in the M.S/MES program: chemistry, physics, metallurgical engineering, chemical engineering, materials engineering, mechanical engineering, civil engineering, electrical engineering, and mining engineering. Students with baccalaureate degrees in other disciplines may gain admission to the program but may require remedial undergraduate work prior to beginning their graduate course work.

Materials Engineering and Science

CONTACT INFORMATION

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ADVISORY COUNCIL

Distinguished Professor Han, Program Coordinator; Professors Boyles, and Winter; Associate Professor Sobolev; Assistant Professors Hemmelman, Fong and Patnaik; Research Scientist Sears.

MATERIALS ENGINEERING AND SCIENCE

The Doctor of Philosophy Program in Materials Engineering and Science (MES) offers a student the opportunity to expand his/her knowledge and understanding of the science and technology of materials production, behavior, and applications. The student will undertake multidisciplinary approaches, combining the basic elements of both engineering and science, to the solution of materials-related problems. Because such problems are found in every science and engineering discipline, the degree applicant has considerable flexibility in the selection of the department in which to pursue dissertation research, within the confines of the applicant's academic preparation and interests. Candidates will study either a science or engineering emphasis within the MES Ph.D. program. For example, research emphasis may be placed on improving processes for the production of metallic, polymeric, ceramic, or other structural or electronic materials. Alternatively, the degree candidate may investigate mechanisms for improving material properties, which in turn, could lead to new or better applications. Classroom and individualized instruction will provide the necessary theory to complement such creative activities.

Example areas of specialization include but are not limited to:
• Activities of Multicomponent Systems
• Computational Modeling

- Concrete Technology
- Corrosion Inhibition
- Development of Multiphase Materials
- Fiber Reinforced Composites
- Geotechnology
- Magnetic Nanocomposites
- Nanoscale Electronic Materials
- Polymer Matrix Composites
- Reaction Kinetics
- Semiconductor Materials and Devices
- Strengthening Mechanisms
- Surface Chemistry of Flotation
- Thermophysical Properties
- Thin Films

The program is administered directly by the Dean of Graduate Education and Sponsored Programs, with the Chair of the MES Ph.D. Advisory Council serving as Program Coordinator. The Advisory Council currently comprises faculty members from the Departments of Civil and Environmental, Electrical, Mechanical, Materials and Metallurgical Engineering, and the Departments of Physics, Chemistry, and Chemical Engineering.

The Graduate Record Examination (GRE), three (3) letters of recommendation, and a GPA of 3.00 or better are required of all applicants for the MES Ph.D. program. The TOEFL exam is required for students whose native language is not English.

All candidates for the MES Ph.D. program are required to successfully complete the following minimum credits and earn a grade of "C" or better, except for a final grade of "S" in MES 800:

Category	**Credits**
Analytical Mathematics	3
Numerical Mathematics	3
Program Major Emphasis (Engineering or Science)	44-54
Dissertation Research	20-30
Total beyond the B.S. degree	80

General Program Requirements

(Minimum program requirements: eighty (80) credits)

M.S. Degree (twenty-four (24) credits)

Programs-major courses may be used to satisfy course work hour requirements for analytical mathematics, numeral mathematics, or fundamental science courses taken in the M.S. program of study (subject to approval).

Analytical Mathematics (three (3) credits)

ME 673	(3-0)	Applied Engineering Analysis I
PHYS 671	(3-0)	Mathematical Physics I
PHYS 673	(3-0)	Mathematical Physics II

Numerical Mathematics (three (3) credits)

CEE 784	(3-0)	Modeling and Computation in Civil Engineering
CEE 785	(3-0)	Applications of Finite Element Methods in Civil Engineering
MATH 687	(3-0)	Statistical Design and Analysis of Experiments
ME 773	(3-0)	Applied Engineering Analysis II
MET 614	(3-0)	Advanced Metallurgical Simulation Techniques
MineE 533	(3-1)	Computer Applications in Geoscience Modeling

Program Emphasis (thirty (30) credits)

Two program emphasis areas are available: Materials Science and Materials Engineering. See sections below.

Research (twenty (20) credits)

MES 898	(19)	Dissertation
MES 890	(1-0)	Seminar

A maximum of ten (10) additional research credits may be included within the hours specified for the program major, subject to approval by the student's advisory committee. The courses listed in Sections II and III below are suggested courses for the science of engineering emphasis, but students are not limited to this selection. Students may take courses out of each emphasis when developing their programs of study.

SCIENCE EMPHASIS REQUIREMENTS

(Minimum program requirements: thirty (30) credits)

Thermodynamics of Solids (3 credits)

MES 712	(3-0)	Interfacial Phenomena
MET 636	(3-0)	Thermodynamics of Solids

MET 638 (3-0) Solid State Phase Transformations
PHYS 743 (3-0) Statistical Mechanics
Transport in Solids (three (3) credits)
CHE 613 (3-0) Transport Phenomena: Heat
CHE 614 (3-0) Transport Phenomena: Mass
MES 728 (3-0) Heterogeneous Kinetics

Crystal Structure/Chemistry of Solids (three (3) credits)
CHEM 455/555 (3-0) Advanced Inorganic Chemistry
MES 603 (4-0) Condensed Matter Physics
MES 604 (4-0) Chemistry of Materials
MES 737 (3-0) Solid State Physics I
PHYS 777 (3-0) Quantum Mechanics I
PHYS 779 (3-0) Quantum Mechanics II

Bulk or Surface Analysis (three (3) credits)
GEOL 643 (2-1) Intro to Microbeam Instruments
MES 708L (1-2) Experimental Advanced Instrumental Analysis

Fundamental Engineering Mechanics (six (6) credits)

Courses from the Engineering emphasis section can also be used to fulfill this requirement.

ME 424 (3-0) Fatigue Design of Mechanical Components
ME 425 (3-0) Probabilistic Mechanical Design
ME 442 (3-0) Failure Modes of Engineering Materials
MET 440/540 (3-0) Mechanical Metallurgy
ME/MET 443 (3-0) Composite Materials
MET 625 (3-0) Strengthening Mechanisms in Materials

Dissertation Related Topics (twelve (12) credits)

ENGINEERING EMPHASIS REQUIREMENTS

(minimum program requirements: thirty (30) credits)

ANALYTICAL MECHANICS
ME 623 (3-0) Advanced Mechanical Vibrations
ME 613 (3-0) Advanced Heat Transfer
MES 713 (3-0) Adv Solid Mechanics I
MES 770 (3-0) Continuum Mechanics

ELASTICITY/PLASTICITY
CEE 643 (3-0) Advanced Soil Mechanics I
CEE 644 (3-0) Advanced Soil Mechanics II
CEE 646 (3-0) Stability of Soil and Rock Slopes
CEE 749 (1-2) Experimental Soil Mechanics
MES 713 (3-0) Advanced Solid Mechanics I
MINE 412/512 (3-0) Rock Mechanics III
MINE 450/550 (3-0) Rock Slope Engineering

FAILURE ANALYSIS FRACTURE MECHANICS
CEE 616 (3-0) Advanced Engineering Materials Technology
MES 614 (3-0) Mechanics of Composite Materials

Fundamental Materials Science (six (6) credits)

Courses from the Science Emphasis section can also be used to fulfill this requirement.

CHEM 420 (3-0) Organic Chemistry III
CHEM 452/552 (3-0) Inorganic Chemistry
CHEM 426/526 (3-0) Polymer Chemistry
MES 603 (4-0) Chemistry of Materials
MES 601 (4-0) Fundamentals of Materials Engineering
MES 604 (4-0) Condensed Matter Physics
CHE 474/574 (2 to 3) Polymer Technology
PHYS 439 (4-0) Solid State Physics
MET 445/545 (3-0) Oxidation and Corrosion of Metals
MET 421/521 (3-0) Refractories and Ceramics

An assessment of the student's qualifications will be undertaken early in their program. The assessment is comprised of performance in pre-determined courses and a dissertation proposal. Further information is available in the South Dakota Tech Materials Engineering and Science Ph.D. Handbook.

Each student is also required to pass a comprehensive examination. There is no language requirement for the MES doctoral program.

For program supervision purposes, the MES Ph.D. Program Coordinator is the Graduate Advisor until the Major Professor is appointed. The Major Professor is the person responsible for the student's dissertation research. The Graduate Office representative on the student's dissertation committee must be selected from outside of the department with which the Major Professor is affiliated, and should also be a member of the MES Ph.D. Advisory Council. The MES Ph.D. Advisory Council must approve all programs of study. It is not necessary that the student be associated with the department of affiliation of his or her major professor. The detailed information on examination policy, admission to candidacy, and defense of dissertation are included in the School of Mines Materials Engineering and Science Ph.D. Handbook.

Mines Matters: School of Mines students design, build, and race vehicles such as the Mini-Indy, Mini-Baja, Human-Powered Vehicle, Solar Car, Unmanned Aerial Vehicle, Remote-Controlled Airplane, and others. The teams give students the chance to apply the skills they learned in the classroom while gaining leadership and teamwork skills. The School of mines Unmanned Aerial Vehicle Team placed third in the 2004 National Competition as a rookie team.

Mechanical Engineering

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FACULTY

Professor Kalanovic, Chair; Professors Dolan, Kjerengtroen, Krause, Langerman and Yoon; Associate Professors Buck, Korde, and Muci-Kuchler; Professor Emeritus Pendleton.

MECHANICAL ENGINEERING

The Department of Mechanical Engineering offers a graduate program leading to the Master of Science degree in Mechanical Engineering. The primary goals of the program are to develop the scholastic ability, independent creativity, and professional competence of an individual to a higher level than is possible in an undergraduate program.

The graduate program offers opportunities for instruction and research in manufacturing, vibrations, compliant structures, controls, experimental mechanics, fracture mechanics, composite materials, finite element analysis, advanced materials processing, micro machines, probabilistic design, transport phenomena, hydrodynamic stability, computational methods in heat transfer and fluid mechanics, multiphase thermal-hydraulic systems, and geothermal energy systems. The graduate program features courses in continuum mechanics, advanced mechanical vibrations, advanced mechanical system control, statistical approaches to reliability, advanced solid mechanics, integrated manufacturing systems, robotics, applied intelligent control, theory of materials behavior, composite materials, and computational methods in transport phenomena.

The Mechanical Engineering Department is one of the largest programs on campus and has well-equipped laboratories. The Center of Excellence for Advanced Manufacturing and Production (CAMP) has Advanced Manufacturing, Advanced Composites, and

Electrical and Computer Engineering as its components. The department has a strong relationship with the Institute for Multi-Scale Materials. Other labs include the Compliant Structures Lab, Vibrations Lab, Neural Networks and Controls Lab, Micromechanics Lab, and Fluid Mechanics and Heat Transfer Lab. The campus fosters interdisciplinary research, and state-of-the-art equipment such as an electron microscope, atomic force microscope, x-ray diffractometer, Raman spectrometer, laser Vibration Pattern Imager, FADAL VMC40 Vertical Machining Center, Bridgeport Romi CNC lathe, Coordinate Measuring Machine, Injection Molding Machine, IBM 7540 Industrial Robot, and Universal Testing Machines are available in the department or on the campus. Graduate research laboratories also include: advanced workstation computer facilities; equipment for modern digital controls, machine vision, and image analysis; structural dynamics; computational solid mechanics; and computational fluid mechanics and heat transfer codes on the workstation system.

The graduate program in Mechanical Engineering can be pursued using either of two (2) equal options. They are:

1. **Non-Thesis:**

Total credit hours required	32
Seminar ME 790	1
Project ME 788	6
Remaining 25 hours are taken	
maximum at the 400[1]/500 level	9
minimum at the 600/700 level	16

2. **Thesis:**

Total credit hours required	30
Seminar ME 790	1
Thesis ME 798	6
Remaining 23 hours are taken	
maximum at the 400[1]/500 level	9
minimum at the 600/700 level	14

Curriculum Notes

[1] 300 level acceptable if outside department and on approved blanket waiver list.

It is the belief and policy of the Mechanical Engineering Department that these two (2) options are equivalent in educational value to the student. Within the first semester in residence, each student is requested to carefully evaluate their preference after discussion with the Mechanical Engineering faculty, and a decision must be made shortly after the beginning of the second semester in residence. In either case the student must by then choose a Major Professor, and with the Major Professor's assistance develop a plan of study. The plan is due by the end of the first full calendar month of the student's second semester (end of September or end of January) in residence. The plan will be submitted to:

1. Graduate Office
2. The Department Chair
3. Major Professor
4. Copy to the student

Each Master's Degree candidate must select a guidance committee. In addition to the candidate's major professor, the committee must consist of at least one other Mechanical Engineering professor and a Graduate Office representative. The Graduate Office representative, whose appointment must be approved by the Graduate Dean, must be selected from outside of the Mechanical Engineering Department. The student and his/her supervising professor will nominate the out-of-department committee member after the student has received the nominee's consent.

The core curriculum required of all M.S. students includes:

ME 673	Applied Engineering Analysis I
ME 773	Applied Engineering Analysis II
MES 770	Continuum Mechanics

In addition, students should select one course from each of the three (3) areas listed below (or approved substitutions) for a total of six core courses.

Thermal Sciences

ME 616	Computations in Transport Phenomena
ME 612	Transport Phenomena: Momentum
ME 613	Transport Phenomena: Heat

Mechanical Systems

ME 623	Advanced Mechanical Vibrations

ME 722	Advanced Mechanical Design
EM 680	Advanced Strength of Materials
MES 713	Advanced Solid Mechanics I

Manufacturing and Controls

ME 683	Advanced Mechanical System Control
ME 781	Robotics
ME 782	Integrated Manufacturing Systems

The details of the actual course selections must be developed by the student, the student's academic advisor, and the student's committee. Although there is a fair degree of flexibility, it is assumed that the program will have some meaningful focus. Students should consult the ME Department Graduate Studies Policy Manual for additional important details.

Entering students usually have a bachelor's degree in Mechanical Engineering. Qualifying examinations may be required of entering students. A minimum GPA of 3.00 is expected for regular (non-probationary) admission. Applicants who are graduates of institutions that are not accredited by the Accreditation Board of Engineering and Technology (ABET) are required to sit for the Graduate Record Exam and have their scores submitted prior to consideration for admission.

For current School of Mines undergraduates, a "Fast-Track" process is available, which helps to streamline the attainment of the M.S. degree. Fast-track options include:

- Dual-enrolling as a graduate student during the final undergraduate semester
- Extension of the senior design project to a graduate project.

FINAL EXAMINATION THESIS PROGRAM

Upon completion of the thesis, Mechanical Engineering graduate students electing this option will be examined orally over the written thesis and course work as prescribed in the Graduate section. A Mechanical Engineering graduate student with an accumulated GPA of 3.4 or better in those courses in their graduate program will have their course work exam combined with the thesis defense. For students having an accumulated GPA of less than 3.4 in courses in their graduate program, a separate focused course work oral examination will be administered by the student's graduate committee. The GPA will be computed using midterm grades for the semester in which the student is currently enrolled. The course work examination will examine primarily concepts and fundamentals of those courses selected, rather than the mechanics of problem solution and will, in general, attempt to establish the student's in-depth knowledge of the course content. The student's graduate committee will select specific courses from the student's graduate program in which the student has indicated possible deficiencies. The Major Professor will inform the student no less than three (3) weeks prior to the examination what courses have been selected. However, it is the student's responsibility to secure this information from the major professor.

FINAL EXAMINATION NON-THESIS OPTION

Mechanical Engineering graduate students selecting a non-thesis option will be required to pursue a special investigation under the direction of a faculty member. The report on this study will be written and formal although not of thesis quality nor extent. Upon the completion of the special investigation and with the approval of the directing faculty member, the student will be given a formal oral examination over the investigation. Rules concerning an oral examination over course work taken by the student in their graduate program will be identical to the rules stipulated above for those students taking the thesis option.

Metallurgical Engineering

CONTACT INFORMATION

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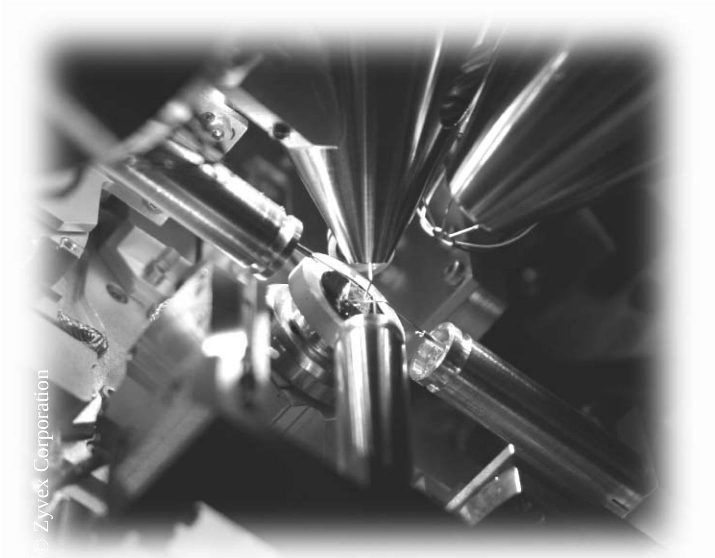
FACULTY

Douglas W. Fuerstenau Professor Kellar, Chair; Distinguished Professor Han; Professors Howard and Marquis; Associate Professor Medlin; Research Scientists Cross, Hong, and Anderson.

METALLURGICAL ENGINEERING

Students interested in pursuing graduate studies focusing on materials science, please see Master of Science in Materials Engineering and Science.

Nanoscience and Nanoengineering



CONTACT INFORMATION

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ADVISORY COUNCIL

Distinguished Professor Han, Program Coordinator; Professors Boyles, and Kalanovic; Douglas Fuerstenau Professor Kellar, Sandvig Professor Puszynski and Miller Professor Whites; Associate Professor Corey; Assistant Professor Patnaik; Center for Accelerated Applications at the Nanoscale (CAAN) Director Decker

NANOSCIENCE AND NANOENGINEERING

The Doctor of Philosophy Program in Nanoscience and Nanoengineering is a cross-disciplinary degree in the emerging interdisciplinary fields of nanoscience and nanotechnology. The PhD curriculum integrates the fundamental science principles with the cross-cutting fields of nanoscience, nanoengineering, and nanotechnology.

The foci of the program align with the aims of the State's 2010 Center for Accelerated Applications at the Nanoscale (CAAN). The PhD program is oriented toward focused applications of nanoscience, including nanoscale utilization of regional minerals. Faculty expertise exists in (i) theory and modeling and computational physics; (ii) the theory and applications of nanocomposite materials; (iii) direct-write fabrication of sensors utilizing nano-inks; and (iv) synthesis and processing of inorganic and organic nano-scaled materials. The curriculum capitalizes on existing faculty talents and expertise, the research thrusts of CAAN, the economic development needs of the region, and the availability of facilities and equipment.

Students in the program will take four science-based core courses that will be complemented by extensive laboratory work focused on hands-on applications. Students will select additional courses specifically focused on nanoscience and nanoengineering.

The program is administered directly by the Dean of Graduate Education who serves as the Program Coordinator of the NANO Ph.D. Advisory Council. The Advisory Council currently comprises faculty members from the Departments of Civil and Environmental, Electrical and Computer, Mechanical, Materials and Metallurgical Engineering, Physics, Chemistry and Chemical Engineering, and CAAN.

Students with an MS degree in science or engineering are eligible for admission. However, students with a BS degree only will also be considered for admission when the student has proven to possess exceptional qualifications. The Graduate Record Examination (GRE), three (3) letters of recommendation, and a GPA of 3.00 or better are required of all applicants for the Ph.D. program. The TOEFL exam is required for students whose native language is not English.

All candidates for the Ph.D. program are required to successfully complete the following minimum credits and earn a grade of "C" or better, except for a final grade of "S" in NANO 898:

The Program of Study must be filed with the Program Coordinator before midterm of the second semester of residence, and again before the comprehensive exam. Below is the summary of the required course of study.

Category	**Credits**
NANO 701 Nano Materials	3
NANO 702 Theory and Applications of Nanoscale Material Systems	3
NANO 703 Instrumentation and Characterization of Nano-Materials	5
NANO 890 Seminar	3
Program Major Emphasis	36-46
Dissertation Research	30-20
TOTAL	**80**

General Program Requirements

(Minimum program requirements: (eighty (80) credits)

M.S. Degree (twenty-four (24) credits)

Students entering the PhD program with a previous M.S. degree in a relevant discipline are allowed to apply a maximum of twenty-four (24) semester course credit hours toward the course credit requirements subject to approval of the Advisory Council.

The following is a list of electives for each focus area of the program. Graduate level courses which serve the needs of our other graduate programs are also available as electives.

Category	**Credits**
NANO 711: Introduction to Direct Write Technology	3
NANO 712: Electromagnetic Properties of Heterogeneous Materials	3
NANO 713: Dielectric and Magnetic Properties of Nano-Scale Materials	3
NANO 714: Functional Fillers and Nanoscale Minerals	3
NANO 716: Nanotechnology of Engineering and Construction Materials	3
NANO 718: Small Scale Mechatronics	3
NANO 719: Atomic Force Microscopy/ Nano-Mechanics	3
NANO 720: Contemporary Condensed Matter Physics	3

An assessment of the student's qualifications will be undertaken early in his or her program. The assessment is comprises preliminary and qualifying examinations. Further information is available in the Handbook of Nanoscience and Nanoengineering.

Each student is also required to pass a comprehensive examination. There is no language requirement for the PhD program.

For program supervision purposes, the NANO Ph.D. Program Coordinator is the Graduate Advisor until the Major Professor is appointed. The Major Professor is the person responsible for the student's dissertation research. The Graduate Office representative on the student's dissertation committee must be selected from outside of the department with which the Major Professor is affiliated, and should also be a member of the NANO Ph.D. Advisory Council. The NANO Ph.D. Advisory Council must approve all programs of study. It is not necessary that the student be associated with the department of affiliation of his or her major professor. Detailed information on examination policy, admission to candidacy, and defense of dissertation are included in the School of Mines Nanoscience and Nanoengineering Ph.D. Handbook.

Paleontology

CONTACT INFORMATION

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FACULTY

Professor Davis, Chair; Professors Bishop, Fox; Professor Emeritus Martin.

PALEONTOLOGY

The master's program in Paleontology emphasizes the opportunity for combining field work in western South Dakota with study of the extensive collections of the Museum of Geology. A student may enter this program with an undergraduate degree in geology or in one of the biological sciences.

Candidates for the M. S. degree must fulfill all degree requirements of the Graduate Office. The thesis option is the only option for the M.S. in Paleontology.

The prospective student in Paleontology should have completed as part of his/her undergraduate training a minimum of one year in chemistry and one semester in physics and calculus. A course in statistics is required. No graduate credit will be granted for making up deficiencies.

Applicants who have not taken the GRE can be accepted on a provisional basis subject to satisfactory completion of the examination in the first year of the program. The TOEFL exam is required for students whose native language is not English.

The following geology courses, or their equivalents, must be presented by the candidate either as part of the undergraduate record or taken as a graduate student in the M.S. program in Vertebrate Paleontology:

- Elementary Petrology
- Field Geology
- Physical Geology
- Historical Geology
- Invertebrate Paleontology
- Mineralogy and Crystallography
- Museum Conservation and Curation

- Sedimentation
- Stratigraphy and Sedimentation
- Structural Geology
- Vertebrate Paleontological Techniques and Exhibit Design

The courses listed above are in the course section in this catalog. Thirty-two (32) semester credits are required for the M.S. degree.

The following courses must be taken as part of the graduate program of study:

GEOL 631	Rocky Mountain Stratigraphy I
or 632	Rocky Mountain Stratigraphy II
GEOL 633	Sedimentation
PALE 671	Advanced Field Paleontology
PALE 673	Comparative Osteology
PALE 676	Vertebrate Paleontology
PALE 678	Vertebrate Biostratigraphy
PALE 798	Master's Thesis (a minimum of six (6) credits)
PALE 770	Seminar in Vertebrate Paleontology
PALE 790	Seminar

The following courses are recommended:

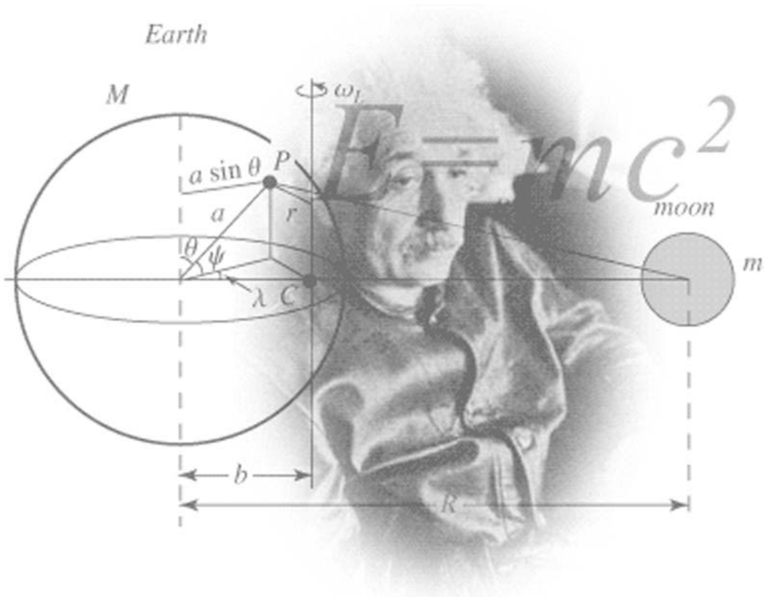
GEOL 517	GIS I: Spacial Database Development
GEOL 643	Intro to Microbeam Instruments
PALE 672	Micropaleontology
PALE 684	Paleoenvironments
GEOL 604	Advanced Field Geology or other appropriate courses in geology.

The candidate will pass a reading examination in one of the following languages: French, German, Spanish, or Russian.

All thesis samples, specimens, and their documentation collected while at School of Mines must be curated into the systematic collections of the Museum of Geology for future students, scientists, and technologies.

Mines Matters: The School of Mines Museum of Geology houses more than 300,000 specimens. Skeletons from the Oligocene of the Big Badlands and the Upper Cretaceous of Western South Dakota are displayed and give a vivid impression of Dakota life long ago. Other special exhibits feature fluorescent minerals, lapidary specimens of local agates, and native gold.

Physics



CONTACT INFORMATION

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FACULTY

Associate Professor Corey, Chair; Professors Foygel and Petukhov; Associate Professor Sobolev.

PHYSICS

Students interested in pursuing graduate studies focusing on solid state physics, please see Master of Science and Ph.D in Materials Engineering and Science as well as Ph.D in Nanoscience and Nanoengineering.

Technology Management

CONTACT INFORMATION

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SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY FACULTY

Ervin Pietz Professor Kellogg, Program Coordinator; Associate Professors Kerk and Matejcik; Assistant Professor Karlin.

TECHNOLOGY MANAGEMENT

The M.S. degree in Technology Management is designed to provide a program of advanced study in technically oriented disciplines for candidates anticipating a managerial career. As a cooperative program with the University of South Dakota (USD), it combines both technically oriented courses and courses in business and management.

Application should be made through the graduate office at School of Mines. Alternatively, students may apply for the program online by visiting School of Mines website at http://ie.sdsmt.edu/tmweb/tm.htm. All candidates for this degree must possess a Bachelor's degree from a four-year accredited institution, in which satisfactory performance has been demonstrated. In addition to these requirements, the following minimum bachelor's level credits shall have been completed:

1. Mathematics one year minimum, to include algebra and basic calculus (Equivalent to School of Mines MATH 123).
2. Six (6) semester hours of natural and physical science (fields of geology, astronomy, biology, meteorology, chemistry, and physics) and which must include at least three (3) credit hours of chemistry or physics.
3. Three (3) semester hours each of Probability and Statistics. (Students may complete prerequisite requirements in probability and statistics through an Internet Based study option. Students

desiring this option should contact the program coordinator.)

In addition, individual elective courses may have additional prerequisite requirements. A maximum of twelve (12) semester hours of credit may be transferred into the candidate's program from another institution. This must be from a regionally accredited institution. Application materials will be evaluated by an admission committee composed of the program director and such other faculty as deemed appropriate for the review. Recommendations from this committee will be made to the Dean of Graduate Education and Research at School of Mines.

Requirements for the degree include the completion of a minimum of twenty-four (24) credits of course work and six (6) credits of research for the thesis option, or thirty-two (32) credits of course work for the non-thesis option. A cumulative GPA of 3.0 must be obtained by the end of the program of study and other general and master's level grade requirements must be maintained as specified in this catalog. The probation policy outlined in this catalog applies to all credits taken.

The continuing registration requirement may be satisfied at either the School of Mines campus or at the USD campus (including the PMB/USD facility).

In the early stages of the candidate's program, a student advisor will be appointed by the Program Director of School of Mines. The advisor will meet with the student to prepare a program along the direction of the specific emphasis desired. The advisor and student will then organize a guidance committee, and file their committee program of study with the School of Mines Graduate Office according to the directions specified under "Supervision of the Master's Program" of the MASTER OF SCIENCE PROGRAMS section of this catalog.

CORE COURSE REQUIREMENTS

A minimum of three (3) semester hours of required coursework must be completed in each of four (4) discipline areas. Discipline areas and allowable courses are shown below.

Business/Finance

TM 661	Engineering Economics for Managers
TM 740	Business Strategy
ECON 782[1]	Managerial Economics
BADM 710[1]	Business Finance

Management

TM 742	Engineering Management & Labor Relations
TM 665	Project Management
BADM 761[1]	Organizational Theory and Behavior

Quantitative Methods

TM 631	Optimization Techniques
TM 732	Stochastic Models in Operations Research
BADM 720[1]	Quantitative Analysis

Production Management

TM 663	Operations Planning
BADM 760[1]	Production Operations

[1] USD courses approved for satisfying core requirements.

RECOMMENDED ELECTIVE COURSES

Any core course not used to satisfy core requirements may be used as an elective. Students may use any graduate School of Mines course provided it is approved by their committee. TM courses are available in distance learning mode and are listed below.

School of Mines Courses

TM 640	Business Strategies	3
TM 650	Safety Management	3
TM 720	Quality Management	3
TM 745	Forecasting for Business and Technology	3
TM 792	Advanced Topics in Technology Management	3
MATH 486	Statistical Quality and Process Control	3

USD Courses

BAD 611	Investments	3
BAD 701	Readings and Business Problems	3
BAD 722	Advanced Information Systems	3
BAD 726	Decision Support Systems	3

BAD 727	Database Management Administration	3
BAD 728	Microcomputers and Small Business Management Systems	3
BAD 761	Organizational Theory and Behavior	3
BAD 762	Business and its Environment	3
BAD 770	Marketing Administration	3
BAD 780	Administrative Policy	3
BAD 781	Managerial Accounting	3
BAD 794	Research Problems	3

The following are sample programs for the thesis option for a student with a mining engineering degree (Student A), and a non-thesis option for a student contemplating a career as a laboratory manager in a government laboratory (Student B).

Student A

TM 661	Engineering Economics for Managers	3
TM 742	Engineering Management and Labor Relations	3
TM 665	Project Planning and Control	3
TM 663	Operations Planning	3
TM 631	Optimization Techniques	3
ECON 782	Managerial Economics	3
TM 720	Quality Management	3
TM 732	Stochastic Models in Operations Research	3
TM 650	Safety Management	3
TM 745	Forecasting for Business and Technology	3
TM 791	Independent Study	2
TOTAL		**32**

Student B

TM 661	Engineering Economics for Managers	4
TM 742	Engineering Management and Labor Relations	3
TM 665	Project Planning and Control	3
TM 663	Operations Planning	3
TM 631	Optimization Techniques	3
ECON 782	Managerial Economics	3
MATH 486	Statistical Quality and Process Control	3
TM 720	Quality Management	3
ME 685	Statistical Approaches to Reliability	4
MATH 687	Statistical Design and Analysis of Experiments	3
TM 791	Independent Study	1
TOTAL		**33**

Mines Matters: The Mini-Baja is one of many opportunities for School of Mines students to apply their academic abilities outside the classroom. School of Mines Mini-Baja team competed in the 2005 Mini-Baja 100 Competition. Mini-Baja judges evaluate each team on standards of engineering design, technical inspection and safety, and sales presentation and cost analysis. In addition to acceleration and braking, maneuverability, and hill climb events, the vehicles also compete in a four-hour, off-road endurance race over rugged terrain to determine dependability.

DEFINITIONS OF ABBREVIATIONS USED IN Course Descriptions

Abbreviation	Definition
ACCT	Accounting
AEWR	Atmospheric and Environmental Sciences
ANTH	Anthropology
ART	Art
ARTH	Art History
ATM	Atmospheric Sciences
BADM	Business Administration
BIOL	Biology
CEE	Civil and Environmental Engineering
CENG	Computer Engineering
CHE	Chemical Engineering
CHEM	Chemistry
CP	Career Planning
CSC	Computer Science
ECON	Economics
EE	Electrical Engineering
EG	Engineering Graphics
EM	Engineering Mechanics
ENGL	English
ENTR	Entrepreneurship
ENVE	Environmental Engineering
FREN	French
GE	General Engineering
GEOE	Geological Engineering
GEOG	Geography
GEOL	Geology
GER	German
GES	General Engineering and Science
HIST	History
HUM	Humanities
IENG	Industrial Engineering
IS	Interdisciplinary Sciences
JAPN	Japanese
LAKL	Lakota
LAW	Law
MATH	Mathematics
ME	Mechanical Engineering
MEM	Mining Engineering and Management
MES	Materials Engineering and Science
MET	Metallurgical Engineering
MINE	Mining Engineering
MSL	Military Science
MUAP	Applied Music
MUEN	Music Ensemble
MUS	Music
PALE	Paleontology
PE	Physical Education
PHIL	Philosophy
PHYS	Physics
POLS	Political Science
PSYC	Psychology
REL	Religion
SOC	Sociology
SOCW	Social Work
SPAN	Spanish
SPCM	Speech
TM	Technology Management
TTL	Technology for Teaching and Learning

Courses above 400 level are normally reserved for graduate studies; however, in some cases, undergraduate students may take graduate level courses.

COURSES

ACCT 210 PRINCIPLES OF ACCOUNTING I
(3-0) 3 credits each. Prerequisite: Sophomore standing or permission of instructor. A study of fundamental accounting principles and procedures such as journalizing, posting, preparation of financial statements, and other selected topics. Accounting is emphasized as a service activity designed to provide the information about economic entities that is necessary for making sound decisions. This course cannot count as social science/humanities credit.

ACCT 211 PRINCIPLES OF ACCOUNTING II
(3-0) 3 credits each. Prerequisite: ACCT 210. A continuation of ACCT 210 with emphasis on partnership and corporate structures, management decision-making, cost control, and other selected topics. This course cannot count as social science/humanities credit.

ACCT 406/506 ACCOUNTING FOR ENTREPRENEURS
(3-0) 3 credits. Accounting concepts and practices for entrepreneurs/small business owners. Emphasis given to the use of accounting tools to solve small business problems. Students enrolled in ACCT 506 will be held to a higher standard than those enrolled in ACCT 406. This course is cross-listed with BADM 406/506 and ENTR 406/506. This course cannot count as a social science/humanities credit.

AES 790 SEMINAR
(1-0) 1 credit. Not to exceed one credit toward fulfillment of Ph.D. degree requirements. Preparation, oral presentation, and group discussion of a research problem. Enrollment required of all graduate students in residence.

AES 791 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor.

AES 792 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

AES 808 FUNDAMENTAL PROBLEMS IN ENGINEERING AND SCIENCE
(3-0) 3 credits. The course, available only for doctoral candidates, involves description, analysis, and proposed methods of attack of long-standing, fundamental problems in science and engineering. Independent work is emphasized with goals of understanding these basic questions and proposing practical designs and experiments for the solution. This course is cross-listed with GEOL 808.

AES 898 DISSERTATION
Credit to be arranged; not to exceed 12 credits toward fulfillment of Ph.D. degree requirements. Open only to doctoral candidates. Supervised original research investigation of a selected problem, with emphasis on independent work, culminating in an acceptable dissertation. Oral defense of dissertation and research findings is required.

ANTH 210 CULTURAL ANTHROPOLOGY
(3-0) 3 credits. Introduces the nature of human culture as an adaptive ecological and evolutionary system, emphasizing basic anthropological concepts, principles, and problems. Draws data from both traditional and industrial cultures to cover such concepts as values and beliefs, social organization, economic and political order, science, technology, and aesthetic expression.

ART 111/111A DRAWING I
(3-0) 3 credits. Introduces various drawing concepts, media, and processes developing perceptual and technical skills related to accurate observing and drawing.

ART 112/112A DRAWING II
(3-0) 3 credits. Prerequisite: ART 111. Emphasizes the continuing development of essential drawing skills and perceptual abilities as drawing concepts, compositional complexity, and creativity gain importance.

ART 491 INDEPENDENT STUDY
1 to 12 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

ARTH 211 HISTORY OF WORLD ART I
(3-0) 3 credits. Art and architecture in the historical and contextual development of the role of visual arts, including crafts, drawing, painting, sculpture and architecture, in the historical and cultural development of world civilization from prehistory through the 14th century.

ARTH 321 MODERN AND CONTEMPORARY ART
(3-0) 3 credits. An exploration of technological and cultural influences on materials and content of art from the late 1800s to the present.

ARTH 491 INDEPENDENT STUDY
1 to 9 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

ARTH 492 TOPICS
1 to 6 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six (6) credits of special topics will be allowed for degree credit.

ATM 301 INTRODUCTION TO ATMOSPHERIC SCIENCES
(3-0) 3 credits. Prerequisite: PHYS 111 or PHYS 113 or equivalent. Basic physical principles are applied to the study of atmospheric phenomena. Topics covered include the structure of the atmosphere, radiative processes, atmospheric motions, meteorological processes, air masses, fronts, weather map analysis, weather forecasting, and severe storms including thunderstorms, hail, tornadoes, hurricanes, and blizzards.

ATM 391 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting frequency depends upon the requirements of the topic. May be repeated to a total of six credit hours.

ATM 392 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. May be repeated to a total of six credit hours.

ATM 401/501 ATMOSPHERIC PHYSICS
(3-0) 3 credits. Prerequisites: PHYS 213, MATH 321, or equivalent. An introduction to physical processes that govern the behavior of the atmosphere. Topics will include atmospheric thermodynamics; absorption, scattering and radiative transfer; convective motion, tropospheric chemistry, cloud and precipitation development; and atmospheric electricity. Satisfies the Meteorology distribution requirement for the ATM M.S. program. Students enrolled in ATM 501 will be held to a higher standard than those enrolled in ATM 401.

ATM 402/502 THE GLOBAL CARBON CYCLE
(3-0) 3 credits. Prerequisite: One semester each of college level biology, chemistry, and physics. The fundamental processes that describe the keystone position of carbon and life in the earth system will be covered in detail. The majority of the course will focus upon photosynthesis and respiration on land and in the oceans, and how these processes have shaped earth's evolution. The interrelationships of the biogeochemical cycles that couple photosynthesis and respiration will be introduced. Topics will cover scales from sub-cellular to global in scope. ATM 502 satisfies the Earth Systems distribution requirement for the ATM M.S. program. Students enrolled in ATM 502 will be held to a higher standard than those enrolled in ATM 402.

ATM 403/503 BIOGEOCHEMISTRY
(3-0) 3 credits. Prerequisite: ATM 402/502 or permission of instructor. The earth system is tightly connected through biogeochemical interactions. This course will present a multi-disciplinary array of intermediate and advanced topics in terrestrial, aquatic, and atmospheric biogeochemistry. Instantaneous to decadal time-scale interactions of carbon, water, and multiple nutrient cycles will be discussed, and a critical survey of the state-of-the-art field, modeling, and remote sensing methods for studying biogeochemical cycles will be presented. ATM 503 satisfies the Earth Systems distribution requirement for the ATM M.S. program. Students enrolled in ATM 503 will be held to a higher standard than those enrolled in ATM 403.

ATM 405/505 AIR QUALITY
(3-0) 3 credits. Prerequisites: Math 125 or equivalent and one semester of college chemistry. Up-to-date problems and trends in urban air quality, global effects of environmental pollution, effects of air pollutants on weather processes, the technology of pollutant production, and pollutant dispersal. A treatment of the chemistry and physics of reactions involving primary air pollutants is included. Satisfies the Earth Systems distribution requirement for the ATM M.S. program. Students enrolled in ATM 505 will be held to a higher standard than those enrolled in ATM 405.

ATM 406 GLOBAL ENVIRONMENTAL CHANGE
(3-0) 3 credits. Prerequisite: CHEM 112 or equivalent, PHYS 111 or PHYS 113, BIOL 311, or permission of instructor. Major global environmental changes will be addressed using an interdisciplinary approach. Topics will include basic processes and principles of ecosystems, biogeochemical cycles, major climate controls, atmospheric chemistry and feedbacks between climate and various earth system processes. This course is cross-listed with BIOL 403.

ATM 410/410L/510/510L INTRODUCTION TO ENVIRONMENTAL REMOTE SENSING
(2-1) 3 credits. Prerequisites: MATH 123 and PHYS 113 or permission of instructor. An introduction to the theory and applications of remote sensing. Students will study the electromagnetic spectrum as it applies to remote sensing as well as the physical principles of imaging system technologies. Imaging and applications of visible, near-infrared, thermal infrared, and microwave band remote sensing are discussed. Environmental remote sensing applications to be covered include terrestrial and ocean ecology, resource exploration, land use and land cover change, natural hazards, and atmospheric constituents. Image processing techniques will be introduced. This course is the first remote sensing course in the Remote Sensing/GIS study sequence. Students enrolled in ATM 510 will be held to a higher standard than those enrolled in ATM 410. ATM 510/510L satisfies the Techniques distribution requirement for the ATM M.S. program.

ATM 450/450L SYNOPTIC METEOROLOGY I
(2-1) 3 credits. Prerequisite: ATM 301. Analysis of surface synoptic weather, upper air, and vertical temperature-moisture soundings; the structure of extratropical storms, synoptic-scale processes responsible for development of precipitation and severe weather phenomena.

ATM 460/560 ATMOSPHERIC DYNAMICS
(3-0) 3 credits. Prerequisites: MATH 321 and PHYS 211. Equations of motion, kinematics of fluid flow, continuity equation, vertical motion, theorems of circulation and vorticity, quasi-geostrophic systems, and wave motions in the atmosphere. Satisfies the

Meteorology distribution requirement for the ATM M.S. program. Students enrolled in ATM 560 will be held to a higher standard than those enrolled in ATM 460.

ATM 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting frequency depends upon the requirements of the topic. May be repeated to a total of three (3) credit hours.

ATM 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. May be repeated to a total of five (5) credit hours.

ATM 515/515L EARTH SYSTEMS MODELING
(2-1) 3 credits. Prerequisite: MATH 125 or equivalent. This course provides the background for earth systems and climate modeling, with student projects on 0-D, 1-D, and 2-D models. The course will cover: radiation balance, climate feedback mechanisms, greenhouse gases, biogeochemical coupling, land and ocean surface processes, ecosystems, ocean circulations, and sea ice. Course will include familiarization of systems modeling using the STELLA modeling package. Students will also collaborate to develop components of a larger modeling project. Satisfies the Techniques distribution requirement for the ATM M.S. program.

ATM 520/520L REMOTE SENSING FOR RESEARCH
(2-1) 3 credits. Prerequisites: Math 125 or equivalent, CSC 150 or equivalent, or permission of instructor. Radiative transfer with respect to satellite remote sensing. Basic IDL programming. Image processing. Image enhancement. Image classification and interpretation. Satellite operations. Overview of operational and research satellite platforms and select applications. The remote sensing of surface and atmospheric features. Labs and student projects. Satisfies the Techniques distribution requirement for the ATM M.S. program.

ATM 530 RADAR METEOROLOGY
(3-0) 3 credits. Prerequisites: MATH 123 or equivalent. Fundamentals of radar, scattering of electromagnetic waves by water drops and other hydrometeors, radar equations and the quantitative study of precipitation echoes, hydrometeor size distributions, Doppler weather radars, and applications of radar in meteorology. Satisfies the Techniques distribution requirement for the ATM M.S. program.

ATM 540 ATMOSPHERIC ELECTRICITY
(3-0) 3 credits. Prerequisites: PHYS 213 or equivalent or permission of instructor. This course will cover topics in fair weather electricity including ions, conductivity, currents, and fields making up the global circuit. In addition, topics in thunderstorm electricity including charge separation theories and the microphysical and dynamic interactions responsible for charging, current balances, and the lightning discharge will be introduced. Satisfies the Meteorology distribution requirement for the ATM M.S. program.

ATM 550/550L SYNOPTIC METEOROLOGY II
(2-1) 3 credits. Prerequisites: ATM 450 and concurrent enrollment in corresponding laboratory module, or permission of instructor. Study and application of modern techniques for forecasting the development and movement of weather systems and for forecasting various weather phenomena. Includes discussion of numerical weather prediction and suite of forecasting models run daily by the National Centers for Environmental Prediction; use of current software packages such as McIDAS and GEMPAK for analyzing observed data and model output: interpreting weather phenomena in terms of dynamical theories; forecasting of convective weather phenomena; understanding the use of Model Output Statistics (MOS). Satisfies the Meteorology distribution requirement for the ATM M.S. program.

ATM 570 WILDFIRE METEOROLOGY
(3-0) 3 credits. Prerequisite: ATM 301 or equivalent. In this course students will learn about basic physical processes related to fire behavior and fire weather. Topics include combustion and heat, forest fuels, fire danger, fire behavior and spread, fire spread models, smoke management, prescribed fire, and case studies of significant large wildfires in recent history. Some outdoor field instruction is included.

ATM 591 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor.

ATM 592 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

ATM 601 ADVANCED PHYSICAL METEOROLOGY
(3-0) 3 credits. Prerequisite: Permission of instructor. Thermodynamics and kinetics of homogeneous and heterogeneous nucleation processes primarily involving the various water phases. Physics and chemistry of atmospheric reactions involving natural and artificial aerosols. Satisfies the Meteorology distribution requirement for the ATM M.S. program.

ATM 603 BIOSPHERE-ATMOSPHERE INTERACTIONS
(3-0) 3 credits. Prerequisite: Permission of instructor. The biosphere and the atmosphere are intimately connected. In this course, the biogeochemical sources and sinks of a wide range of gases affecting atmospheric chemistry, climate, and ecosystem health are examined in detail. Microbial, plant, and animal processes relating to nitrogen, sulfur, and carbon trace gas production and consumption will be covered in detail. Relevant biophysical phenomena occurring in vegetation canopies, soils, wetlands, and oceans will be discussed. The role of humans in altering these natural processes will be revisited throughout the course, and overviews of trace gas measurement techniques will be presented. Satisfies the Earth Systems distribution requirement for the ATM M.S. program.

ATM 608/608L AIR QUALITY MODELING
(2-1) 3 credits. Prerequisites: MATH 125 or equivalent. A treatment of diffusion and dispersion modeling for point and area emissions. Gaussian diffusion, climatological screening techniques, dispersion in complex terrain, and physical basis of dispersion model will be treated. Current EPA regulatory models will be emphasized. Some knowledge of computer programming is desirable. Satisfies the Techniques distribution requirement for the ATM M.S. program.

ATM 612 ATMOSPHERIC CHEMISTRY
(3-0) 3 credits. Prerequisite: One year of college chemistry. Radiative, chemical, and biological processes associated with formation of stratospheric ozone, tropospheric ozone, biogenic emissions and human-caused emissions, “greenhouse” effects, and aqueous-phase equilibria in clouds. The approach will include aspects of classical chemistry, nucleation, instrumentation, and modeling of effects of chemical pollutants on cloud microphysics. Interactions of biological and human-caused emission of trace gases with radiation and oxidant balance of the earth’s atmosphere. Topics to be addressed include; stratospheric ozone formation and the “ozone hole,” Tropospheric ozone formation, field techniques to measure chemical fluxes, and photochemistry of the remote troposphere. Satisfies the Earth Systems distribution requirement for the ATM M.S. program.

ATM 625/625L SCALING IN GEOSCIENCES
(2-1) 3 credits. Prerequisites: MATH 125, CSC 150, or equivalent; MATH 441/442 or equivalent. Issues regarding the scaling of geophysical processes across various problem domains in the geosciences will be presented and explored through lectures, labs and course projects. Topics include Fourier Analysis, Taylor/Moment Expansion, Fractals, Power Laws, and Upscaling/Downscaling Techniques. Applications include Climate, Turbulence, Weather and Climate Prediction, Remote Sensing and GIS, Ecosystem Studies, Geology, and Hydrology. Satisfies the Techniques distribution requirement for the ATM M.S. program.

ATM 640 ADVANCED ATMOSPHERIC ELECTRICITY
(3-0) 3 credits. Prerequisites: ATM 540, ATM 642. This course is a continuation of ATM 540 and will include a more in-depth look at the processes involved in thunderstorm electrification. Various charge separation mechanisms will be examined through a review of the literature. The modeling of storm electrification and lightning will also be presented. Satisfies the Meteorology distribution requirement for the ATM M.S. program.

ATM 642 PHYSICS AND DYNAMICS OF CLOUDS
(3-0) 3 credits. Prerequisite: ATM 501. Thermodynamics and dynamics of clouds and convective storms. Buoyancy, effects of ice formation, shear-buoyancy relations and convective storm structure. Storm dynamics and microphysical processes. Numerical cloud models. Structure and dynamics of severe storms, stratiform, and mesoscale cloud systems. Satisfies the Meteorology distribution requirement for the ATM M.S. program.

ATM 643 PRECIPITATION PHYSICS AND CLOUD MODIFICATION
(3-0) 3 credits. Prerequisite: ATM 501 or equivalent. Aerosols, condensational drop growth, growth of ice particles by deposition of vapor, accretion, and cloud modification techniques. Emphasis on problem solving with aid of computers. Satisfies the Meteorology distribution requirement for the ATM M.S. program.

ATM 644 NUMERICAL DYNAMICS AND PREDICTION
(3-0) 3 credits. Prerequisite: ATM 560. Basic governing equations; wave motions; baroclinic instability; numerical methods; numerical prediction models; boundary layer; moisture and radiation parameterization, and data assimilation. Satisfies the Techniques distribution requirement for the ATM

M.S. program.

ATM 651/651L MEASUREMENT AND INSTRUMENTATION
(2-1) 3 credits. Prerequisite: Permission of instructor. An overview of the principles of measurement will be covered, in combination with detailed investigations into instruments designed to measure some of the following phenomena: radiation, temperature, humidity, wind, precipitation, photosynthesis, surface reflectance, and concentrations and fluxes of trace gases. Multiple scale measurement techniques will be addressed. Students will learn to collect, log, and download field data using both manual and automatic methods. An integral part of the course will be a field-based measurement project. The topics covered in this course will vary depending on the research interests of students enrolled and the contributing professors. Satisfies the Techniques distribution requirement for the ATM M.S. program.

ATM 660 ATMOSPHERIC DYNAMICS II
(3-0) 3 credits. Prerequisite: ATM 560. Derivation, solution, and physical interpretation of the fundamental hydrothermodynamic equations as applied to atmospheric waves, mesoscale motions, atmospheric energetics, general circulation, tropical and stratospheric flows. Introduction to numerical prediction. Satisfies the Meteorology distribution requirement for the ATM M.S. program.

ATM 662 GENERAL (GLOBAL) CIRCULATION
(3-0) 3 credits. A study of the general circulation of the atmosphere including quasi-geostropic equations; planetary waves; geostropic adjustment; barotropic, baroclinic instability; frontogenesis; and tropical cyclones. Satisfies the Meteorology distribution requirement for the ATM M.S. program.

ATM 670 BOUNDARY LAYER PROCESSES
(3-0) 3 credits. Prerequisites: ATM 501, ATM 560, or permission of instructor. Atmospheric structure and processes near the ground. Turbulence and the closure problem, buoyancy and stress-driven mixed layers, mixed layer growth, heat, moisture, and momentum transfer, surface balance of radiation, heat and moisture, parameterization, and modeling of the boundary layer. Satisfies the Meteorology distribution requirement for the ATM M.S. program.

ATM 673 MESOMETEOROLOGY
(3-0) 3 credits. Prerequisites: ATM 560 or permission of instructor. Observations and analysis of basic meteorological fields on the mesoscale. Dynamics, phenomenology, and forecasting of mesoscale weather phenomena: Internally generated circulations, mesoscale convective systems, externally forced circulations. Mesoscale modeling and nowcasting. Satisfies the Meteorology distribution requirement for the ATM M.S. program.

ATM 690 SEMINAR
(1-0) 1 credit. Not to exceed one credit toward fulfillment of M.S. degree requirements. Enrollment required of all graduate students in residence each spring semester.

ATM 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor.

ATM 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

ATM 798 MASTER'S THESIS
Credit to be arranged. Not to exceed six credits towards fulfillment of M.S. degree requirements. Open only to students admitted to the ATM M.S. program. Supervised original or expository research culminating in an acceptable thesis. Oral defense of thesis and research findings are required. Graduate research assistants and students under faculty supervision for their research are required to enroll in this course each semester.

BADM 101 SURVEY OF BUSINESS
(3-0) 3 credits. This course is an introduction to the basic business disciplines and the organization and management of the American enterprise system. It also introduces students to the necessary college level skills of critical thinking, effective communication and cooperative and effective learning. This course cannot count as social science/humanities credit.

BADM 221 MANAGERIAL STATISTICS
(3-0) 3 credits. Prerequisite: MATH 281. The course is designed to provide students with an understanding of the computations and subsequent application of statistical methods used in business management and economics. Particular emphasis is placed on such areas as: sampling methods (e.g. estimates for simple random, stratified, cluster, and systematic sampling), Total Quality Management (e.g. statistical process control and its application to monitoring process variables), times series analysis and forecasting, smoothing techniques, and multiple regression techniques. This course cannot count as social science/humanities credit.

BADM 293 WORKSHOP
1 to 3 credits. Prerequisite: Permission of instructor. Special, intense sessions in specific topic areas.

Approximately 45 hours of work is required for each hour of credit. Workshops may vary in time range but typically use a compressed time period for delivery. They may include lectures, conferences, committee work, and group activity. This course cannot count as social science/humanities credit.

BADM 310 BUSINESS FINANCE
(3-0) 3 credits. Prerequisites: ACCT 211. Business finance is an overview of financial theory including the time value of money, capital budgeting, capital structure theory, dividend policies, asset pricing, risk and return, the efficient markets hypothesis, bond and stock valuation, business performance evaluation, and other financial topics. This course cannot count for humanities/social science credit.

BADM 336 ENTREPRENEURSHIP I
(3-0) 3 credits. This course is an introduction to the concepts, terminology, and process of new venture creation, operation and growth, as well as the introduction of entrepreneurial management practices into existing businesses. New ventures include public and non-profit institutions as well as for profit businesses. This course will assist in the identification of entrepreneurial opportunities and strategies and the role of personal factors (including creativity). Legal, ethical, and social responsibilities are emphasized. This course is cross-listed with ENTR 336. This course cannot count as a social science/humanities credit.

BADM 345 ENTREPRENEURSHIP
(4-0) 4 credits. Prerequisites: ACCT 211 and IENG 301 or IENG 302 or permission of instructor. Covers topics on the legal aspects, management skills, business plans, and sources of capital as well as case studies of successful and unsuccessful entrepreneurial initiatives. This course is cross-listed with IENG 345. This course cannot count as social science/humanities credit.

BADM 350 LEGAL ENVIRONMENT OF BUSINESS
(3-0) 3 credits. This is a study of legal topics as they apply to the business environment. Topics include an introduction to the law, the U.S. court system, legal process, government regulation, and criminal, tort, and contract issues.

BADM 360 ORGANIZATION AND MANAGEMENT
(3-0) 3 credits. This course is a study of management, including the planning, directing, controlling and coordinating of the various activities involved in operating a business enterprise.

BADM 370 MARKETING
(3-0) 3 credits. This course introduces the student to the basic concepts and practices of modern marketing. Topics include marketing and its linkages to business, consumer behavior, marketing research, strategy and planning, product and pricing decisions, distribution and promotion decisions, marketing management, and evaluation and control aspects for both consumer and industrial goods. This course cannot count as social science/humanities credit.

BADM 406/506 ACCOUNTING FOR ENTREPRENEURS
(3-0) 3 credits. Accounting concepts and practices for entrepreneurs/small business owners. Emphasis given to the use of accounting tools to solve small business problems. Students enrolled in BADM 506 will be held to a higher standard than those enrolled in BADM 406. This course is cross-listed with ACCT 406/506 and ENTR 406/506. This course cannot count as a social science/humanities credit.

BADM 438/538 ENTREPRENEURSHIP II
(3-0) 3 credits. This course focuses on the process of screening an opportunity, drafting a personal entrepreneurial strategy, and understanding the business plan writing process. Building the entrepreneurial team and the acquisition and management of financil resources are emphasized along with venture growth, harvest strategies, and valuation. Students enrolled in BADM 538 will be held to a higher standard than those enrolled in BADM 438. This course is cross-listed with ENTR 438/538. This course cannot count as a social science/humanities credit.

BADM 489 BUSINESS PLAN WRITING AND COMPETITION
(1-0) 1 credit. Students will write a business plan and present it to a panel of faculty and business community members. The top three business plan presenters will more on to a statewide competition. This course is cross-listed with ENTR 489.

BADM 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. This course cannot count as social science/humanities credit.

BADM 493 WORKSHOP
1 to 3 credits. Special, intense sessions in specific topic areas. Approximately 45 hours of work is required for each hour of credit. Workshops may vary in time range but typically use a compressed time period for delivery. They may include lectures, conferences, committee work, and group activity.

This course cannot count as social science/humanities credit.

BIOL 121 BASIC ANATOMY
(3-0) 3 credits. Anatomy of the human body to include basic biological principles and medical nomenclature. This course is specifically designed for students in the pre-nursing curriculum.

BIOL 121L BASIC ANATOMY LAB
(0-1) 1 credit. Prerequisite or corequisite: BIOL 121. Laboratory experience that accompanies BIOL 121. Exercises to complement material in BIOL 121 with special emphasis on the anatomy of the cat.

BIOL 123 BASIC PHYSIOLOGY
(3-0) 3 credits. The physiology of the human body. This course is specifically designed for students in a pre-nursing curriculum.

BIOL 123L BASIC PHYSIOLOGY LAB
(0-1) 1 credit. Prerequisite or corequisite: BIOL 123. Laboratory exercises to accompany BIOL 123 including non-invasive experimentation and computer demonstration materials.

BIOL 151 GENERAL BIOLOGY I
(3-0) 3 credits. The introductory course for those majoring in biology and microbiology. Presents the concepts of cell biology, evolution, heredity, molecular genetics, and ecology.

BIOL 151L GENERAL BIOLOGY I LAB
(0-1) 1 credit. Prerequisite or corequisite: BIOL 151. Laboratory experience that accompanies BIOL 151. Laboratory exercises designed to reinforce subject material covered in BIOL 151 lectures.

BIOL 153 GENERAL BIOLOGY II
(3-0) 3 credits. Prerequisite: BIOL 151. A continuation of BIOL 151, the introductory course for those majoring in biology and microbiology. Presents the concepts of animal and plant structure and function, energetics, and reproduction.

BIOL 153L GENERAL BIOLOGY II LAB
(0-1) 1 credit. Prerequisite or corequisite: BIOL 153. Laboratory experience that accompanies BIOL 153. Laboratory exercises designed to reinforce subject material covered in BIOL 153 lectures.

BIOL 231 GENERAL MICROBIOLOGY
(3-0) 3 credits. Prerequisites: CHEM 106. Principles of basic and applied microbiology. Topics covered are bacteriology, virology, microbial genetics, immunology, and disinfection.

BIOL 231L GENERAL MICROBIOLOGY LAB
(0-1) 1 credit. Prerequisites: CHEM 106/106L. Prerequisite or corequisite: BIOL 231. Laboratory experience that accompanies BIOL 231. Basic laboratory skills necessary for general microbiology. Emphases are made on techniques of aseptic bacterial transfer, serial dilutions in bacterial cell counts, bacterial staining, and serology.

BIOL 298 UNDERGRADUATE RESEARCH
1 to 3 credits. Prerequisite: Permission of instructor. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical.

BIOL 311 PRINCIPLES OF ECOLOGY
(3-0) 3 credits. Basic principles of ecology including the subdisciplines of physiological ecology, population ecology, community ecology, evolutionary ecology, and ecosystems ecology from both a theoretical and applied aspect.

BIOL 330 ENVIRONMENTAL SCIENCE
(3-0) 3 credits. Prerequisites: CHEM 114, and one semester of college physics. Environmental science discussing concepts pertaining to environmental problems and their possible solutions. This course is cross-listed with CHEM 330.

BIOL 341 MICROBIAL PROCESSES IN ENGINEERING AND NATURAL SCIENCES
(3-0) 3 credits. Prerequisite: CHEM 112. This course introduces and develops important fundamental topics including: microbial structure and chemistry; cellular metabolism; and intercellular processes and extracellular conditions that control microbial behavior, leading to applications such as biocatalysis, biofuels production, environmental bioremediation, food processing, microbial ecology, pharmaceuticals production, environmental microbiology, and wastewater renovation.

BIOL 371 GENETICS
(3-0) 3 credits. Principles governing the nature, transmission and function of hereditary material with application to plants, animals, humans, and microorganisms.

BIOL 403 GLOBAL ENVIRONMENTAL CHANGE
(3-0) 3 credits. Prerequisite: CHEM 112 or equivalent, PHYS 111 or PHYS 113, BIOL 311, or permission of instructor. Major global environmental changes will be addressed using an interdisciplinary approach. Topics will include basic processes and principles of ecosystems, biogeochemical cycles, major climate controls, atmospheric chemistry, and feedbacks between climate and various earth system

processes. This course is cross-listed with ATM 406.

BIOL 423 PATHOGENEPATHOGENESIS
(3-0) 3 credits. Prerequisites: BIOL 231and CHEM 112. Lecture/discussion course on principles of medical microbiology including the molecular basis of pathogensis, host-parasite relationship, and pathology of animal and human diseases. Emphasis on current literature in pathogensis.

BIOL 423L PATHOGENESIS LAB
(0-1) 1 credit. Prerequisites: BIOL 231L or equivalent; pre- or corequisite: BIOL 423. Basic laboratory skills necessary for pathogenic microbiology. Emphasis is on bacteriological, biochemical and serological tests of medically important pathogens.

BIOL 431 INDUSTRIAL MICROBIOLOGY
(3-0) 3 credits. Prerequisite: BIOL 231 or equivalent. The roles of microbes in nature, industry, and public health are considered. Application of microbiology to engineering is emphasized. Concurrent registration in BIOL 431L recommended but not required.

BIOL 431L INDUSTRIAL MICROBIOLOGY LABORATORY
(0-1) 1 credit. Prerequisites: BIOL 231L or equivalent; pre- or corequisite: BIOL 431. Basic laboratory skills necessary for applied environmental microbiology. Emphasis is on sampling of environmental microorganisms, bacterial growth curve, analysis of water quality, isolation of coliphages, and Ames test for chemical mutagens.

BIOL 491 INDEPENDENT STUDY
1 to 4 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

BIOL 492 TOPICS
1 to 5 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

BIOL 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory, or field work, and preparation of papers, as agreed to in advance, by student and instructor.

BIOL 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

CEE 117/117L COMPUTER AIDED DESIGN AND INTERPRETATION IN CIVIL ENGINEERING
(1-1) 2 credits. Students will learn to construct drawing documents using AutoCAD, the use of engineering and architectural scales, lettering practices, geometric construction (manually and AutoCAD), and the ability to visualize in three dimensions.

CEE 206/206L CIVIL ENGINEERING PRACTICE AND ENGINEERING SURVEYS I
(2-2) 4 credits. Prerequisite: An acceptable score on the Trigonometry Placement Examination; or trigonometry completed with a grade of "C" or better; or permission of instructor. An orientation to the civil engineering profession including historical development, civil engineering careers, professional practice and ethics, and specialties in the profession. Mensuration with the application of surveying techniques; basic surveying computations and field practice; theory of error propagation and its analysis; fundamental concepts of horizontal, angular, and vertical measurements; control systems related to engineering-construction surveys. Horizontal and vertical curves. Traverse computations.

CEE 284/284L DIGITAL COMPUTATION APPLICATIONS IN CIVIL ENGINEERING
(3-1) 4 credits. Prerequisite: MATH 123. A one semester introductory course in programming with a language (Visual Basic) and with a spread sheet and MathCad. Elementary numerical methods and their application to civil engineering problems will be illustrated by the programming technique.

CEE 316/316L ENGINEERING AND CONSTRUCTION MATERIALS
(2-1) 3 credits. Prerequisites: Preceded by or concurrent with EM 321, and CEE 284. Principles that govern physical and mechanical properties of ferrous and nonferrous metals, plastics, bituminous materials, portland cement, aggregates, concrete, and timber. Laboratory exercises to demonstrate basic principles and standard laboratory tests (ASTM Standards) of structural materials. Computer-aided graphics and word processing are required for lab reports. This course is cross-listed with MINE 316/316L.

CEE 326 ENVIRONMENTAL ENGINEERING PROCESS FUNDAMENTALS
(3-0) 3 credits. Prerequisites: CHEM 114, EM 331, and CEE 284. The first course in the theory and practice of Environmental Engineering. Emphasis is on the mass-balance approach to problem solving with consideration of water chemistry, environmental process kinetics, ideal reactors, and biological process fundamentals. This course is cross-listed with ENVE and MINE 326.

CEE 327/327L INTRODUCTORY ENVIRONMENTAL ENGINEERING DESIGN
(2-1) 3 credits. Prerequisites: CEE/ENVE/MINE 326 or permission of instructor. A second course in the theory and practice of Environmental Engineering. Emphases are on the applications of environmental engineering principles in the design and analysis of water and wastewater treatment, and solid and hazardous waste disposal. Laboratory exercises will be completed and reports with computer-generated text tables and figures are required. This course is cross-listed with ENVE 327/327L.

CEE 336/336L HYDRAULIC SYSTEMS DESIGN
(2-1) 3 credits. Prerequisites: EM 331 and CEE 284. Analysis of flow in pipe systems, open channels, measuring devices, and model studies. Design of hydraulic systems associated with water supply, flood control, water storage and distribution, sewer systems, and other water resources.

CEE 337 ENGINEERING HYDROLOGY
(3-0) 3 credits. Prerequisite: CEE 336 or EM 327 or permission of instructor. A quantification study of the components of the hydrologic cycle with emphasis on engineering applications involving the design of water supplies, reservoirs, spillways, floodways, and urban drainage with computer applications. This course is cross-listed with ENVE 337.

CEE 346/346L GEOTECHNICAL ENGINEERING
(2-1) 3 credits. Prerequisites: EM 321. Composition, structure, index, and engineering properties of soils; soil classification systems; introduction to soil engineering problems involving stability, settlement, seepage, consolidation, and compaction; and laboratory work on the determination of index and engineering properties of soils. Computer-aided graphics and word processing required for lab reports. This course is cross-listed with MINE 346/346L.

CEE 347 GEOTECHNICAL ENGINEERING II
(3-0) 3 credits. Prerequisite: CEE/MINE 346. Composition of soils, origin, and deposition, exploration, frost problems, swelling of soils, erosion protection, soil improvement, groundwater flow and dewatering, slope stability of retaining structures, and rigid and flexible pavement design. The application of these topics to highway engineering will be stressed. This course is cross-listed with MINE 347.

CEE 353 STRUCTURAL THEORY
(3-0) 3 credits. Prerequisites: EM 321 and CEE 284. Basic concepts in structural analysis of beams, trusses, and frames. Determination of governing load conditions for moving loads by use of influence lines. Development of basic virtual work concept to obtain deflections for beams, trusses, and frames. Introduction to approximate analysis.

CEE 357/357L THEORY AND DESIGN OF METAL STRUCTURES I
(2-1) 3 credits. Prerequisite: CEE 353. Correlation of analysis and design using the current building code requirements for steel structures. Design techniques are formulated for axial, transverse and combined loading conditions, for individual members and for connections between components of a structure. Comparisons between design requirements of materials to illustrate relative benefits in structural systems.

CEE 358 APPLIED STRUCTURAL DESIGN
(3-0) 3 credits. Prerequisite: CEE 353 or permission of instructor. Elements of structural design utilizing concrete, steel, or wood. Applied methods emphasizing practical, conservative, and economical solutions will be emphasized. Intended for students who will take no other structural design course.

CEE 421/521 ENVIRONMENTAL SYSTEMS ANALYSIS
(3-0) 3 credits. Prerequisites: CHEM 114 or permission of instructor. Applications of fundamental physical and chemical principles in the examination of solution phase behavior of organic and inorganic substances in Environmental Engineering systems. Analytical and computer solutions are performed. Students enrolled in CEE 521 will be held to a higher standard than those enrolled in CEE 421. This course is cross-listed with ENVE 421/521.

CEE 426/526 ENVIRONMENTAL ENGINEERING PHYSICAL/CHEMICAL PROCESS DESIGN
(3-0) 3 credits. Prerequisites: CEE/ENVE 326 and CEE/ENVE 327, graduate standing, or permission of instructor. A third course in the theory and practice of Environmental Engineering. Emphases are on the design and analysis of physical/chemical environmental engineering unit operations and processes. Students enrolled in CEE 526 will be

held to a higher standard than those enrolled in CEE 426. This course is cross-listed with ENVE 426/526.

CEE 426L/526L ENVIRONMENTAL PHYSICAL/CHEMICAL PROCESS LABORATORY
(0-1) 1 credit. Prerequisite or corequisite: CEE/ENVE 426/526 or permission on instructor. A laboratory course to accompany CEE/ENVE 426/526. Examination of processes employed in design of environmental physical and chemical systems for renovation of contaminated waters and soils. Various bench-scale experiments will be performed with laboratory analysis using standard environmental web chemical and instrumental analytical techniques. Laboratory reports employing word processing, numerical and statistical analysis, and interpretation of process performance data will be written. Students enrolled in CEE 526L will be held to a higher standard than those enrolled in CEE 426L. This course is cross-listed with ENVE 426L/526L.

CEE 427/527 ENVIRONMENTAL ENGINEERING BIOLOGICAL PROCESS DESIGN
(3-0) 3 credits. Prerequisites: CEE/ENVE/MINE 326 and CEE/ENVE 327, graduate standing, or permission of instructor. A fourth course in the theory and practice of Environmental Engineering. Emphases are on the design and analysis of biological environmental engineering unit operations and processes. Students enrolled in CEE 527 will be held to a higher standard than those enrolled in CEE 427. This course is cross-listed with ENVE 427/527.

CEE 427L/527L ENVIRONMENTAL BIOLOGICAL PROCESS LABORATORY
(0-1) 1 credit. Prerequisite or corequisite: CEE/ENVE 427/527 or permission of instructor. A laboratory course to accompany CEE/ENVE 427/527. Examination of processes employed in design of environmental biological systems for renovation of contaminated waters and soils. Various bench-scale experiments will be performed with laboratory analysis using standard environmental web chemical, microbiological, and instrumental analytical techniques. Laboratory reports employing word processing, numerical and statistical analysis, and interpretation of process performance data will be written. Students enrolled in CEE 527L will be held to a higher standard than those enrolled in CEE 427L. This course is cross-listed with ENVE 427L/527L.

CEE 428/528 ADVANCED TREATMENT PLANT DESIGN
(3-0) 3 credits. Prerequisites: CEE 327, CEE 336, and CEE 426, or permission of instructor. Advanced topics relating to the design of systems for the renovation of contaminated waters. Several major design problems will be completed. Students enrolled in CEE 528 will be held to a higher standard than those enrolled in CEE 428. This course is cross-listed with ENVE 428/528.

CEE 433/533 OPEN CHANNEL FLOW
(3-0) 3 credits. Prerequisite: CEE 336. Application of continuity, momentum, and energy principles to steady flow in open channels; flow in the laminar and transition ranges; specific energy and critical depth; energy losses; channel controls; gradually and rapidly varied flow; and high velocity flow. Students enrolled in CEE 533 will be held to a higher standard than those enrolled in CEE 433.

CEE 437/437L/537/537L WATERSHED AND FLOODPLAIN MODELING
(2-1) 3 credits. This course will consist of the application of the HEC-HMS Flood Hydrograph Package and HEC-RAS Water Surface Profiles computer programs. Each model is applied to an actual watershed and conveyance channel. The student is responsible for two (2) project reports, one for each model application. Data compilation and model development and execution will be conducted in the lab portion of the class. Development of the model inputs will include review of hydrologic and hydraulic processes relating to model options. Students enrolled in CEE 537/537L will be held to a higher standard then those enrolled in CEE 437/437L.

CEE 447/547 FOUNDATION ENGINEERING
(3-0) 3 credits. Prerequisite: CEE 346. Application of the fundamental concepts of soil behavior to evaluation, selection, and design of shallow and deep foundation systems. Related topics such as temporary support systems for excavations and pile driving are also included. Students enrolled in CEE 547 will be held to a higher standard than those enrolled in CEE 447.

CEE 448/548 APPLIED GEOTECHNICAL ENGINEERING
(3-0) 3 credits. Prerequisites: CEE 346 and CEE 347. Content will include the application of principles taught in CEE 346 and 347 to practical geotechnical engineering problems in the Civil Engineering Profession, such as exploration, pavement design, slope stability, geosynthetics, geotechnical problems unique to the region, and dam design. Students enrolled in CEE 548 will be held to a higher standard than those enrolled in CEE 448.

CEE 453/453L DESIGN OF METAL STRUCTURES II
(2-1) 3 credits. Prerequisite: CEE 357. Analysis and design of structural elements and connections for buildings, bridges, and specialized structures that

utilize structural metals. Behavior of structural systems under elastic and plastic design.

CEE 456/456L CONCRETE THEORY AND DESIGN
(2-1) 3 credits. Prerequisite: CEE 353. Properties and behavior of concrete and reinforcing steel. Analysis and design of structural slabs, beams, girders, columns, and footings with use of strength methods. Deflection of flextural members. Development of reinforcement.

CEE 457/457L INDETERMINATE STRUCTURES
(2-1) 3 credits. Prerequisite: CEE 353. Analysis of indeterminate structures by classical and matrix methods. The classical methods are the force method, the slope-deflection equations and the moment-distribution method. The classical methods also are used to determine influence lines for inderterminate structures. Stiffness matrices for truss and beam elements are derived and used to analyze trusses, beams, and frames.

CEE 463 CIVIL ENGINEERING PROFESSION
(1-0) 1 credit. Prerequisite: Senior in Civil Engineering. Lecture and discussion with emphasis on current civil engineering topics with emphasis on professional, personal, and ethical development.

CEE 464 CIVIL ENGINEERING CAPSTONE DESIGN I
(0-1) 1 credit. Prerequisite: Senior standing or permission of instructor. Content will include major engineering design experience integrating fundamental concepts of mathematics, basic science, engineering science, engineering design, communications skills, humanities, and social science.

CEE 465 CIVIL ENGINEERING CAPSTONE DESIGN II
(0-2) 2 credits. Prerequisite: CEE 464. Content will include major engineering design experience integrating fundamental concepts of mathematics, basic science, engineering science, engineering design, communications skills, humanities, and social science.

CEE 474/574 ENGINEERING PROJECT MANAGEMENT
(3-0) 3 credits. Prerequisite: Senior standing or permission of instructor. Study of owner, engineer, and contractor organizational structures, project work break down structures, resource and asset allocation, computer and non-computer scheduling by Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT). Students enrolling will be required to perform an engineering project with written and oral presentations. Students enrolled in CEE 574 will be held to a higher standard than those enrolled in CEE 474. This course is cross-listed with MINE 474/574.

CEE 475/475L HIGHWAY ENGINEERING
(2-1) 3 credits. Prerequisite: Senior standing. This course is an introduction to the principles of highway engineering. The course will cover the integration of various levels of governmental transportation systems along with aspects of safety and vehicle performance. Laboratory and lecture experiences will be provided in geometric design and materials selection, design and rehabilitation. Traffic planning methods and life cycle cost analysis in highway engineering will also be covered.

CEE 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

CEE 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

CEE 498 UNDERGRADUATE RESEARCH/SCHOLARSHIP
1 to 6 credits. Prerequisite: Permission of instructor. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical.

CEE 616 ADVANCED ENGINEERING MATERIALS TECHNOLOGY
(3-0) 3 credits. Prerequisite: Permission of instructor. Structure behavior correlation of modern structural materials. Microstructure and failure criteria. Morphology of deformation. Review of recent developments in concrete technology. Assessment of the required properties of fresh and hardened concrete and their measurements. Quality control including the use of statistics and their relation to current specifications. Polymers, both artificial (plastic) and natural (wood). Nature and properties of special steels and aluminum alloys.

Composite materials. Nondestructive testing of materials.

628/628L ENVIRONMENTAL ENGINEERING MEASUREMENTS
(2-1) 3 credits. Prerequisite: Senior or graduate standing. It is highly recommended that the student have completed CEE 421 or CEE 521 or an equivalent course prior to enrolling in this course. Topics include: methods employed in assessment of environmental contamination and remediation effectiveness; methods used in obtaining and handling of water and soil samples; applications of analytical instrumentation (GC, LC, AAS, UV/Vis, and total carbon) to assays of environmental samples; field and lab QA/QC; preparation of investigative reports.

CEE 634 SURFACE WATER HYDROLOGY
(3-0) 3 credits. Prerequisites: CEE 337 or permission of instructor. Review and advanced study of hydrologic cycle including precipitation, infiltration, evapotranspiration, and runoff. Applications to analysis and design of water supplies, reservoirs, spillways, floodways, urban runoff, and protection systems.

CEE 635 WATER RESOURCES ENGINEERING
(3-0) 3 credits. Prerequisite: Senior or graduate standing. Principles of water resource use objectives, law, economics, government policies, planning, management, conservation, and engineering practices.

CEE 643 ADVANCED SOIL MECHANICS I
(3-0) 3 credits. Prerequisite: CEE 346 or permission of instructor. One- and two-dimensional consolidation theory; field consolidation behavior; anisotropic consolidation; geotechnical material failure criteria; constitutive laws for geotechnical materials; flexible and rigid beams on elastic foundations; analysis of single and group piles under various loadings; stress development in soil mass.

CEE 644 ADVANCED SOIL MECHANICS II
(3-0) 3 credits. Methods of geotechnical analysis; composite finite element method; movement dependent lateral earth pressure development; limiting equilibrium method of soil-structure analysis for bearing capacity, slope stability and retaining structures; and earth reinforcing techniques.

CEE 645 ADVANCED FOUNDATIONS
(3-0) 3 credits. Prerequisites: CEE 284 and CEE 346 or permission of instructor. Application of the principles of soil mechanics to foundation engineering; subsurface exploration; lateral earth pressures and retaining structures; bearing capacity and settlement of shallow and deep foundations; field instrumentation and performance observation; and case studies.

CEE 646 STABILITY OF SOIL AND ROCK SLOPES
(3-0) 3 credits. Prerequisite: CEE 346 or permission of instructor. Geologic aspects of slope stability; shear strength of geologic materials; soil and rock mechanics approaches to slope stability analysis; two-dimensional limiting equilibrium methods of slope stability analysis including sliding block methods, Fellenius' and Bishop's methods of slices, and the Morgenstern-Price method of slices; introduction to three-dimensional methods of stability analysis; field instrumentation and performance observations; and case studies.

CEE 647 EARTH STRUCTURES
(3-0) 3 credits. Prerequisite: CEE 346 or permission of instructor. Engineering properties of compacted soils; use of the triaxial test in soil stability problems; methods of slope stability analysis with emphasis on Bishop's simplified method of slices; design considerations for earth embankments; field instrumentation and performance observations; and case studies.

CEE 648 THEORY AND APPLICATION OF EARTH RETAINING STRUCTURES
(3-0) 3 credits. Prerequisite: CEE 346 or permission of instructor. Application of principles of geotechnical engineering to the design of retaining structures. Areas covered are lateral earth pressure theories, rigid and flexible retaining walls, anchored bulkheads, cofferdams, earthquake induced earth pressures, braced excavations, and underground structures. Stabilization of slopes and reinforced earth applications are also treated.

CEE 652 PRESTRESSED CONCRETE
(3-0) 3 credits. Prerequisite: CEE 358 or CEE 456 or permission of instructor. Principles of linear and circular prestressing. Behavior of steel and concrete under sustained load. Analysis and design of pretensioned and post-tensioned reinforced concrete members and the combination of such members into an integral structure.

CEE 653 REINFORCED CONCRETE DESIGN
(3-0) 3 credits. Prerequisite: CEE 456. Design for torsion, simple space structural elements such as corner beams, curved beams, and free-standing staircases. Yield line theory and design of two-way reinforced slabs and floor systems. Design of a multi-story frame building system.

CEE 655/655L APPLIED COMPOSITES
(2-1) 3 credits. Prerequisite: CEE 353 or permission of instructor. Basic properties and principles of advanced composite materials such as fiberglass and

graphite, and aramic design and testing of primary structural members including prestressing elements. Application of composite materials to engineering.

CEE 656/656L ADVANCED STRUCTURAL ANALYSIS
(2-1) 3 credits. Prerequisite: Senior or graduate standing. Analysis of statically indeterminate structural systems. Flexibility and stiffness methods of analysis for two- and three-dimensional orthogonal and non-orthogonal structures with reference to digital computer procedures. Special solution procedures including use of substructures. Energy methods of structural analysis and introduction to finite element method.

CEE 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Senior or graduate standing and permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor. A description of the work to be performed must be filed in the department office.

CEE 692 TOPICS
1 to 3 credits. Prerequisite: Senior or graduate standing. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

CEE 721 PRINCIPLES OF ENVIRONMENTAL ENGINEERING
(3-0) 3 credits. This course is a study of the relationship of the environment to human health from an engineering perspective.

CEE 723 ENVIRONMENTAL CONTAMINANT FATE AND TRANSPORT
(3-0) 3 credits. Prerequisites: CEE 421 or CEE 521 or permission of instructor. Mathematical analysis of the processes governing the fate and movement of anthropogenic contaminants in natural systems. Topics include: liquid-solid, vapor-solid, and vapor-liquid partitioning; liquid and vapor phase convection and diffusion; biotic and abiotic transformations; and mathematical modeling of coupled processes.

CEE 725 TREATMENT, DISPOSAL, AND MANAGEMENT OF HAZARDOUS WASTE
(3-0) 3 credits. Study of the types, sources and properties of hazardous waste generated from various industrial plants. Engineering systems and technologies for hazardous waste including: on-site handling, storage and processing; transfer and transportation; treatment and reuse; and ultimate disposal and destruction. Federal regulations, especially those developed under the Resource Conservation and Recovery Act will be described.

CEE 730 STATISTICAL METHODS IN WATER RESOURCES
(3-0) 3 credits. Stochastic process, probability and statistics applied to hydrologic problems. Data synthesis, frequency analysis, correlation, time series, and spectral analysis.

CEE 731 CURRENT TOPICS IN WATER QUALITY ASSESSMENT
(3-0) 3 credits. Prerequisite: Permission of instructor. A review and discussion of federal programs concerning water quality and of current literature on national and regional water-quality assessments. Technical subjects covered may include but are not limited to: hydrologic and hydraulic modeling of watersheds, numerical water quality modeling, and total maximum daily loads (TMDL's); eutrophication; urban runoff; non-point-source pollution. Oral presentations, detailed literature review, and term paper are required.

CEE 733/733L TECHNIQUES OF SURFACE WATER RESOURCE AND WATER QUALITY INVESTIGATIONS I
(1-2) 3 credits. Prerequisites: CEE 326, CEE 327 and CEE 336 or permission of instructor. A study of the theory, design and techniques used in hydrologic and water quality investigations by environmental engineers, hydrologists, and hydraulic engineers. Topics to be covered include, but are not limited to: surface water streamflow measurements and records compilation, water quality monitoring, stormwater runoff sampling and permit process, bioassessment of water quality, sediment sampling, lake water quality assessment, and non parametric statistics.

CEE 749/749L EXPERIMENTAL SOIL MECHANICS
(1-2) 3 credits. Prerequisite: CEE 346 or permission of instructor. Laboratory determination of soil properties with emphasis on experimental techniques; index properties and classification tests; one-dimensional consolidation tests; controlled gradient consolidation test; unconsolidated-undrained, consolidated-undrained, and consolidated-drained triaxial compression tests; vacuum triaxial test; direct shear tests; CBR test; and field boring test.

CEE 784 MODELING AND COMPUTATION IN CIVIL ENGINEERING
(3-0) 3 credits. Prerequisite: CEE 284 or permission of instructor. Applications of statistical and advanced numerical and digital computation methods to various problems in all disciplines of civil engineering.

CEE 785 APPLICATIONS OF FINITE ELEMENT METHODS IN CIVIL ENGINEERING
(3-0) 3 credits. An introduction to the basic concepts including: interpolation functions, element stiffness and load matrices, assembly of element matrices into global matrices, and solution techniques. Several one and two dimensional elements are studied and used to solve problems in solid mechanics, soils, and fluid mechanics using the variational method and Galerkin's method.

CEE 788 MASTER'S RESEARCH PROB/PROJECTS
Credit to be arranged; not to exceed three (3) credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the M.S. non-thesis option. Directed research investigation of a selected problem culminating in an acceptable written report. Oral defense of the report and research findings are required.

CEE 790 SEMINAR
(1-0) 1 credit. May not be repeated for degree credit. Preparation and presentation of oral seminar. Group discussion of a research problem or current civil engineering project.

CEE 791 INDEPENDENT STUDY
1 to 3 credits; not to exceed three (3) credits toward fulfillment of M.S. degree requirements. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor. A description of the work to be performed must be filed in the department office.

CEE 792 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

CEE 798 MASTER'S THESIS
Credit to be arranged; not to exceed six credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the M.S. thesis option. Supervised original or expository research culminating in an acceptable thesis. Oral defense of the thesis and research findings are required.

CENG 244/244L INTRODUCTION TO DIGITAL SYSTEMS
(3-1) 4 Credits. This course is designed to provide Computer Engineering, Electrical Engineering, and Computer Science students with an understanding of the basic concepts of digital systems and their hardware implementation. Topics covered include combinational logic circuits, sequential logic circuits, and CPU control.

CENG 291 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. A maximum of six credits of independent studies is allowed for degree credits.

CENG 292 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six credits of special topics is allowed for degree credits.

CENG 314/314L ASSEMBLY LANGUAGE
(1.5-1.5) 3 credits. Prerequisite: CSC 250. A thorough introduction to assembly language programming and processor architecture. A study of low-level programming techniques, and the layout of a typical computer. The student will gain insight into the memory layout, registers, run-time stack, and global data segment of a running program. This course is cross listed with CSC 314/314L. Graduation credit will not be allowed for both this course and CSC 314/314L.

CENG 342/342L DIGITAL SYSTEMS
(3-1) 4 credits. Prerequisite: CENG 244. Presents the basic concepts and mathematical tools that are applicable to the analysis and design of digital systems, particularly state machines and digital processing systems. The VHDL hardware description language is also introduced as a design tool. (Design content - two (2) credits)

CENG 391 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. A maximum of six credits of special topics is allowed for degree credits.

CENG 392 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six credits of special topics is allowed for degree credits.

CENG 420/420L DESIGN OF DIGITAL SIGNAL PROCESSING SYSTEMS
(3-1) 4 credits. Prerequisite: EE 312. An introduction to the design of digital signal processing systems. Topics include discrete-time signals and systems, the Z transform, infinite impulse-response digital filters, finite impulse-response digital filters, discrete Fourier transforms, fast Fourier transforms. (Design content - two (2) credits)

CENG 440/440L VLSI DESIGN
(3-1) 4 credits. Prerequisite: EE 320. Provides an introduction to the technology and design of VLSI integrated circuits. Topics include MOS transistors, switch and gate logic, scalable design rules, speed and power considerations, floorplanning, layout techniques, and design tools. (Design content - two (2) credits)

CENG 442/442L MICROPROCESSOR-BASED SYSTEM DESIGN
(3-1) 4 credits. Prerequisite: CENG 342. Presents the concepts required for the design of microprocessor-based systems. Emphasis is given to the problems of system specification, choice of architecture, design trade-offs and the use of development tools in the design process. Design projects will be implemented in the laboratory. (Design content - two (2) credits)

CENG 444/444L COMPUTER NETWORKS
(3-1) 4 credits. Prerequisite: CENG 244, MATH 381 or MATH 441. This course presents the basic principles of computer networks design and analysis. Topics covered include the layers of the OSI reference model. Current and proposed implementations of local, metropolitan and wide area networks are presented; inter-networking is discussed. The different implementations are compared and their performance evaluated. Graduation credit will not be allowed for both this course and CSC 463. (Design content - two (2) credits)

CENG 446/446L ADVANCED COMPUTER ARCHITECTURES
(3-1) 4 credits. Prerequisite: CENG 342. This course covers the basic principles of pipelining, parallelism and memory management. Topics covered include cache and virtual memory, pipelining techniques and vector processors, multiprocessors and distributed computing systems. Graduation credit will not be allowed for both this course and CSC 440. (Design content - two (2) credits)

CENG 447/447L EMBEDDED AND REAL-TIME COMPUTER SYSTEMS
(3-1) 4 credits. Prerequisites: EE 351 and CSC 150. This course provides an introduction to programming embedded and real-time computer systems. It includes design of embedded interrupted driven systems and the use of commercial (for example: QNX) or open-source (for example: Linux RT) RTOS operating systems. (Design content - two (2) credits)

CENG 456 OPERATING SYSTEMS
(3-0) 3 credits. Prerequisites: CSC 300, CENG 314 or permission of instructor. This course will cover operating systems principles for memory management, job scheduling, device management, paging, concurrent processing, and virtual systems. Graduation credit will not be allowed for both this course and CSC 456.

CENG 464 COMPUTER ENGINEERING DESIGN I
(2-0) 2 credit. Prerequisites: CENG 342, EE 320. Prerequisite or corequisite: EE 311, EE 312, CSC 470, and ENGL 289. This course will focus on the design process and culminate with the faculty approval of design projects (including schematics and parts list) for CENG 465. Typical topics included are the development of a product mission statement, identification of the customer and customer needs, development of target specifications, consideration of alternate designs using a decision matrix, project management techniques, legal and ethical issues, FCC verification and certification, use of probability and statistics for reliable design, interpretation of data sheets, and component selection. (Design content - two (2) credits)

CENG 465 COMPUTER ENGINEERING DESIGN II
(2-0) 2 credits. Prerequisite: CENG 464. The course requires students to conduct their own design projects in a simulated industrial environment. Requirements include detailed laboratory notebook, periodic written and oral progress reports, and a written and oral presentation of a final project report. (Design content - two (2) credits)

CENG 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study

Courses

which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. A maximum of six credits of special topics is allowed for degree credits.

CENG 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six credits of special topics is allowed for degree credits.

CENG 498 UNDERGRADUATE RESEARCH/SCHOLARSHIP
Credits to be arranged; not to exceed four credits towards fulfillment of B.S. degree requirements. Prerequisite: Permission of instructor. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical.

CHE 111 INTRODUCTION ENGINEERING MODELING
(0-1) 1 credit. Prerequisite or corequisites: CHEM 112. The primary objectives of this course are: introduction to mathematical modeling of physical and chemical systems; verification of mathematical models by experiment; development and interpretation of engineering drawings, process flow diagrams (PFD's), and piping and instrumentation diagrams (P&ID's); use of a drawing program, such as Visiotec; and an introduction to the process simulator AspenPlus.

CHE 117 PROFESSIONAL PRACTICES IN CHEMICAL ENGINEERING
(2-0) 2 credits. Prerequisite or corequisite: MATH 123. An introduction to chemical engineering through the development of computational and laboratory skills. The extended use of spreadsheets, programming, and computational software packages will be covered. Elementary numerical methods will be utilized in process modeling and laboratory experiments.

CHE 200 UNDERGRADUATE RESEARCH
1 to 3 credits. Prerequisite: Permission of instructor and freshman or sophomore standing. Directed research or study of a selected problem culminating in an acceptable written report.

CHE 217 CHEMICAL ENGINEERING I
(3-0) 3 credits. Prerequisites or corequisite: CHEM 114, GES 115 and PHYS 211. The first course on the theory and practice of Chemical Engineering with emphasis on material and energy balances. This course is cross-listed with ENVE 217.

CHE 218 CHEMICAL ENGINEERING II
(3-0) 3 credits. Prerequisites: CHE 217, MATH 125. The second course on the theory and practice of Chemical Engineering with emphasis on momentum transfer.

CHE 222 CHEMICAL ENGINEERING THERMODYNAMICS I
(3-0) 3 credits. Prerequisites: CHE 217, concurrent registration in MATH 225. A study of the principles and applications of thermodynamics with emphasis on the first law, the energy balance.

CHE 250 COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING
(2-0) 2 credits. Prerequisites: CHE 117, CHE 217, concurrent with MATH 321 or permission of instructor. The application of digital computer techniques to the solution of chemical engineering problems.

CHE 317 CHEMICAL ENGINEERING III
(3-0) 3 credits. Prerequisites: CHE 217, concurrent registration in MATH 321. The third course on the theory and practice of Chemical Engineering with emphasis on heat transfer. Heat transfer by conduction, convection, and radiation is studied. This course is cross-listed with ENVE 317.

CHE 318 CHEMICAL ENGINEERING IV
(3-0) 3 credits. Prerequisite: CHE 317. The fourth course on the theory and practice of Chemical Engineering with emphasis on molecular diffusion, membranes, convective mass transfer, drying, humidification, and continuous gas-liquid separation processes. This course is cross-listed with ENVE 318.

CHE 321 CHEMICAL ENGINEERING THERMODYNAMICS II
(3-0) 3 credits. Prerequisite: CHE 222. A continuation of CHE 222 with emphasis on the second and third laws of thermodynamics. Emphasis on thermodynamic properties of fluids, flow processes, phase and chemical equilibria.

CHE 333 PROCESS MEASUREMENTS AND CONTROL
(1-0) 1 credit. Prerequisite: CHE 218 or permission of instructor. A study of the equipment and techniques used in monitoring process measurements and the design of feedback control systems.

CHE 343 CHEMICAL KINETICS AND REACTOR DESIGN
(3-0) 3 credits. Prerequisites: CHE 217, CHE 321. A study of chemical kinetics and reactor design, including techniques for analyzing kinetic data, choosing reactor operating parameters, economic optimization of homogeneous reactions, and reactor modeling.

CHE 361 CHEMICAL ENGINEERING LABORATORY II
(0-2) 2 credits. Prerequisite or corequisite: CHE 218 and CHE 333. Laboratory experiments in process measurements, feedback control loops, industrial data acquisition and control, fluid flow, fluid flow measurements, and design of fluid handling systems.

CHE 362 CHEMICAL ENGINEERING LABORATORY III
(0-1) 1 credit. Prerequisite: CHE 317. Laboratory experiments on heat transfer.

CHE 417 CHEMICAL ENGINEERING V
(2-0) 2 credits. Prerequisite: CHE 321. The fifth course on the theory and practice of Chemical Engineering with emphasis on equilibrium staged separations.

CHE 433 PROCESS CONTROL
(3-0) 3 credits. Prerequisite: MATH 321 and senior standing. Analysis and design of process control systems for industrial processes, including controller tuning and design of multivariable control schemes. This course is cross-listed with MET 433.

CHE 434/434L DESIGN OF SEPARATION PROCESSES
(1-1) 2 credits. Prerequisite: CHE 318. Separation technology and processes are studied with application to current industrial design problems. Topics and design case studies may include: absorption, adsorption, biological separations, crystallization, distillation, environmental separations, ion exchange, membrane separations, molecular distillation, pervaporation, solid separations, supercritical extraction, thermal stripping, and others.

CHE 444/544 REACTOR DESIGN
(3-0) 3 credits. Prerequisites: CHE 343, CHE 250. Applications of chemical engineering principles to reactor design. Emphasis includes: non-isothermal reactor modeling, homogeneous and heterogeneous reactors, economic and performance optimization, catalysis, and computer simulation. Students enrolled in CHE 544 will be held to a higher standard than those enrolled in CHE 444.

CHE 445/545 OXIDATION AND CORROSION OF METALS
(3-0) 3 credits. Prerequisites: MET 232, MET 320, or CHE 222 or ME 312 or permission of instructor. Initially, the thermodynamics of electrochemical processes are covered; use of the Nernst equation and Pourbaix diagram is presented in this material. Fundamentals of electrode kinetics are then discussed with special emphasis on the derivation of the Butler-Volmer equation and application of the Evan’s diagram. Following presentation of these fundamental concepts, phenomena observed in corrosion and oxidation such as uniform attack, pitting, stress corrosion cracking, and corrosion fatigue are discussed. Finally, selection of materials for site specific applications is covered. Students enrolled in CHE 545 will be held to a higher standard than those enrolled in CHE 445. This course is cross-listed with ENVE 445/545, MET 445/545, and ME 445/545.

CHE 450/550 SYSTEMS ANALYSIS APPLIED TO CHEMICAL ENGINEERING
2 to 3 credits. Prerequisite or corequisites: CHE 417, CHE 433, or permission of instructor. The development of mathematical models for dynamic and steady state chemical engineering systems; simulation of these complex systems using computers and software, such as AspenPlus; estimation of physical and equilibrium properties; and analysis of results. Students enrolled in CHE 550 will be held to a higher standard than those enrolled in CHE 450.

CHE 455/555 POLLUTION PHENOMENA AND PROCESS DESIGN
(3-0) 3 credits. Prerequisites: CHE 218, CHE 317, and CHE 417, or equivalent, or permission of instructor. The study of the industrial sources of and treatment of air, water, and land pollutants. The chemical and physical phenomena operating in pollution control equipment and the design of pollution control equipment will be examined. Waste minimization and pollution prevention strategies will be considered. Students enrolled in CHE 555 will be held to a higher standard than those enrolled in CHE 455. This course is cross-listed with ENVE 455/555.

CHE 461 CHEMICAL ENGINEERING LABORATORY IV
(0-1) 1 credit. Prerequisite: CHE 318. Laboratory experiments on mass transfer.

CHE 464 CHEMICAL ENGINEERING DESIGN I
(4-0) 4 credits. Prerequisites: CHE 317, CHE 318. A comprehensive treatment of problems involved in the design of a chemical process plant. The design of plant equipment with emphasis upon the selection

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of materials and the elements of cost. Overall plant design with consideration of economics, political, and personnel factors.

CHE 465 CHEMICAL ENGINEERING DESIGN II
(3-0) 3 credits. Prerequisite: CHE 464. A continuation of CHE 464.

CHE 474/574 POLYMER TECHNOLOGY
2 to 3 credits. Prerequisite: Senior standing or permission of instructor. A study of the engineering aspects of polymer synthesis and reactor design, polymer testing, polymer characterization, rheology, macro-properties, and fabrication. Students may enroll for two (2) or three (3) credits, depending upon the particular level of course matter that matches their interest. Students taking two (2) credits will take two-thirds of the course material. The instructor, in conjunction with the Department Chair, will monitor student credit hours. Course is not repeatable for credit. Students enrolled in CHE 574 will be held to a higher standard than students enrolled in CHE 474.

CHE 474L/574L EXPERIMENTAL POLYMER TECHNOLOGY
(0-1) 1 credit. Prerequisite or corequisite: CHE 474 or 574. Laboratory experiments in polymer synthesis, chemical and mechanical property testing, extrusion, and modeling. Students enrolled in CHE 574L will be held to a higher standard than students enrolled in CHE 474L.

CHE 484/584 FUNDAMENTALS OF BIOCHEMICAL ENGINEERING
(3-0) 3 credits. Prerequisite: CHE 343 and BIOL 231 or BIOL 341. An introduction to the characterization of microorganisms, fermentation pathways, unit processes in fermentation, biochemical kinetics, and batch and continuous fermentation. The basic engineering concepts of fermentation, separation, control, and operations will be discussed. Students enrolled in CHE 584 will be held to a higher standard than those enrolled in CHE 484.

CHE 484L/584L BIOCHEMICAL ENGINEERING LABORATORY
(0-1) 1 credit. Corequisite: CHE 484/584. Laboratory experiments in biochemical engineering. May include fermentation, dissolved oxygen mass transfer measurements, bioseparations, and other experiments to correlate with selected lecture topics. Students enrolled in CHE 584L will be held to a higher standard than those enrolled in CHE 484L.

CHE 487 GLOBAL AND CONTEMPORARY ISSUES IN CHEMICAL ENGINEERING
(1-0) 1 credit. Prerequisite or corequisite: CHE 465. A study of contemporary global and societal issues in the field of chemical engineering.

CHE 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

CHE 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six (6) credits of special topics will be allowed for degree credit.

CHE 498 UNDERGRADUATE RESEARCH/SCHOLARSHIP
Credit to be arranged. Prerequisite: Permission of instructor. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical. A maximum of six (6) credits of undergraduate research will be allowed for degree credit.

CHE 612 TRANSPORT PHENOMENA: MOMENTUM
(3-0) 3 credits. Introduction to momentum transport. Equations of continuity and motion. Velocity distributions. Boundary layer theory. Turbulent transport compressible flow. This course is cross-listed with ME 612.

CHE 613 TRANSPORT PHENOMENA: HEAT
(3-0) 3 credits. Prerequisites: ME 313, MATH 373 (concurrent). An in-depth study of the fundamental laws of heat transfer. Major areas considered are: heat conduction, free and forced convection, and radiative heat transfer. Emphasis is placed on the formulation and solution of engineering problems by analytical and numerical methods. This course is cross-listed with ME 613.

CHE 614 TRANSPORT PHENOMENA: MASS
(3-0) 3 credits. Prerequisite: Permission of instructor. Includes classification and mechanical behavior of composite materials, macromechanical

behavior of lamina, and laminates. Course emphasizes study of advance composite laminates including failure theories, experimental methods, stresses, strains, and deformations. This course is cross-listed with MES 614.

CHE 616 COMPUTATIONS IN TRANSPORT PHENOMENA
(3-0) 3 credits. Prerequisite: MATH 373 or permission of instructor. Various computerized techniques, including finite difference and finite element, will be used to solve transient and steady state heat transfer problems involving conduction and convection. This course is cross-listed with ME 616.

CHE 621 ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS I
(3-0) 3 credits. Prerequisite: CHE 321 or permission of instructor. A mathematical development of fundamental laws of thermodynamics and their application to chemical engineering operations and processes. Equilibrium and thermal effects in homogeneous and heterogeneous systems.

CHE 676 ADHESION AND SURFACE ENGINEERING IN POLYMER COMPOSITES
(1-0) 1 credit. Prerequisites: Permission of instructor. The study of the scientific fundamentals leading to adhesion in polymer composites and engineering of surface phenomena to improve polymer composite properties. This course is cross-listed with MET 676.

CHE 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor.

CHE 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. A maximum of six (6) credits of advanced special topics will be allowed for degree credit.

CHE 788 MASTER'S RESEARCH PROB/PROJECTS
Credit to be arranged; not to exceed six (6) credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the M.S. non-thesis option. Directed research investigation of a selected problem culminating in an acceptable written report. Oral defense of the report and research findings are required.

CHE 798 MASTER'S THESIS
Credit to be arranged; not to exceed six (6) credits toward fulfillment of M.S. degree requirements. Prerequisite: Approval of advisor. An original investigation of a chemical engineering subject normally presented as a thesis for the Master of Science degree in Chemical Engineering.

CHEM 106 CHEMISTRY SURVEY
(3-0) 3 credits. Prerequisite: MATH 101. A one-semester survey of chemistry. Not intended for those needing an extensive chemistry background. Introduction to the properties of matter, atomic structure, bonding, stoichiometry, kinetics, equilibrium, states of matter, solutions, and acid-base concepts. May not be used for credit toward an engineering or science degree (except Interdisciplinary Science and Associate of Arts).

CHEM 106L CHEMISTRY SURVEY LAB
(0-1) 1 credit. Prerequisite or corequisite: CHEM 106. Laboratory designed to accompany CHEM 106. May not be used for credit toward an engineering or science degree (except Interdisciplinary Science and Associate of Arts).

CHEM 108 ORGANIC AND BIOCHEMISTRY
(4-0) 4 credits. Prerequisites: CHEM 106. A survey of the chemical principles important to biological systems. For students who do not plan to take additional chemistry. Not a prerequisite for any 200 level and above course. May not be used for credit toward an engineering or science degree (except Interdisciplinary Science and Associate of Arts).

CHEM 108L ORGANIC AND BIOCHEMISTRY LAB
(0-1) 1 credit. Prerequisite: CHEM 106, Prerequisite or corequisite: CHEM 108 Laboratory designed to accompany CHEM 108. May not be used for credit toward an engineering or science degree (except Interdisciplinary Science and Associate of Arts).

CHEM 112 GENERAL CHEMISTRY I
(3-0) 3 credits. Prerequisite or corequisite: MATH 102. An introduction to the basic principles of chemistry for students needing an extensive background in chemistry (including chemistry majors, science majors, and pre-professional students). Completion of a high school course in chemistry is recommended.

CHEM 112L GENERAL CHEMISTRY I LAB
(0-1) 1 credit. Prerequisite or corequisite: CHEM 112. Laboratory designed to accompany CHEM 112.

CHEM 114 GENERAL CHEMISTRY II
(3-0) 3 credits. Prerequisite: CHEM 112 and MATH 102. A continuation of CHEM 112. An introduction to the basic principles of chemistry for students needing an extensive background in chemistry.

CHEM 114L GENERAL CHEMISTRY II LAB
(0-1) 1 credit. Prerequisite: CHEM 112L, Prerequisite or corequisite: CHEM 114. A laboratory designed to accompany CHEM 114. Qualitative analysis of cations and anions, pH and redox measurements, synthesis and properties of organics, polymers, and transition metal compounds.

CHEM 182 CHEMICAL COMPUTATIONS
(2-0) 2 credits. Prerequisite or corequisite: CHEM 114. Data acquisition and analysis, instrument interfacing, and chemical computations (including but not limited to molecular modeling, kinetic analysis, thermochemical calculations, and structure drawing.) This course may also be applicable to degrees other than chemistry. Students in other departments should consult their advisor.

CHEM 200 INTRODUCTION TO RESEARCH
1 to 3 credits. Prerequisite: Permission of instructor. Directed research in chemistry including library and laboratory work supplemented with conferences with the instructor.

CHEM 220 EXPERIMENTAL ORGANIC CHEMISTRY IA
(0-1) 1 credit. Prerequisite: CHEM 114L. A one-semester laboratory course. Experiments demonstrating techniques for the separation, characterization and synthesis of organic compounds are performed. Functional groups are derivatized.

CHEM 230 ANALYTICAL CHEMISTRY FOR ENGINEERS
(2-0) 2 credits. Prerequisite: CHEM 114. An introduction to modern analytical chemistry. Topics include the theory and application of acid-base and solubility equilibria, titrimetric and gravimetric analysis, statistical treatment of data, and an introduction to spectroscopy (UV-Vis, IR, and AA).

CHEM 252 SYSTEMATIC INORGANIC CHEMISTRY
(3-0) 3 credits. Prerequisite: CHEM 114. A systematic survey of the chemistry of elements. Periodic properties of the elements; fundamental chemical bonding and structure; acid-base and redox reactions; solid state chemistry; nonaqueous solvents; introduction to materials science.

CHEM 282/282L CHEMISTRY OUTREACH
(0.5-0.5) 1 credit. Prerequisite: CHEM 106L or CHEM 112L. This course affords students the opportunity to pursue individual chemistry demonstrations, projects, experiments, or presentations for community outreach in schools and organizations, including specific times such as National Chemistry Week. The course is repeatable for up to four total credits toward the B.S. in Chemistry.

CHEM 290 SEMINAR
(.5-0) .5 credits. A highly focused, and topical course. The format includes student presentations and discussions of reports based on literature, practices, problems, and research. Seminars may be conducted over electronic media such as internet and are at the upper division or graduate levels. Enrollment is generally limited to fewer than 20 students.

CHEM 316 FUNDAMENTALS OF ORGANIC CHEMISTRY
(3-0) 3 credits. Prerequisite: CHEM 114. A one-semester introductory course in organic chemistry. Functional classes of organic compounds are discussed in terms of characteristic functional group, properties, structure, nomenclature, synthesis, and reactivity.

CHEM 326 ORGANIC CHEMISTRY I
(3-0) 3 credits. Prerequisite: CHEM 114. A systematic treatment of the chemistry of carbon compounds, including nomenclature, structure-reactivity relationships, reaction mechanisms, synthesis, and spectroscopy.

CHEM 326L ORGANIC CHEMISTRY I LAB
(0-2) 2 credits. Prerequisites or corequisites: CHEM 114L and CHEM 326. A laboratory designed to accompany CHEM 326. Introduction to organic functional groups and methods for the separation and purification of organic compounds.

CHEM 328 ORGANIC CHEMISTRY II
(3-0) 3 credits. Prerequisite: CHEM 326. A continuation of CHEM 326. A systematic treatment of the chemistry of carbon compounds, including nomenclature, structure-reactivity relationships, reaction mechanisms, synthesis, and spectroscopy.

CHEM 328L ORGANIC CHEMISTRY II LAB
(0-2) 2 credits. Prerequisite: CHEM 326L, Prerequisite or corequisite: CHEM 328. Laboratory designed to accompany CHEM 328. Syntheses of organic compounds. Structural characterization is performed by instrumental methods of analysis including infrared and nuclear magnetic resonance spectrometry.

CHEM 332 ANALYTICAL CHEMISTRY
(3-0) 3 credits. Prerequisite: CHEM 114. Fundamental concepts and principles of quantitative chemical analysis including quantitative chemical equilibrium calculations and error analysis applied to the evaluation of experimental measurements and data.

CHEM 332L ANALYTICAL CHEMISTRY LAB
(0-1) 1 credit. Prerequisite or corequisites: CHEM 114L and CHEM 332 or CHEM 230. Laboratory to

accompany CHEM 332 and CHEM 230. Experimental methods and techniques of gravimetry, titrimetry, pH, and UV-Vis and AA spectrometry.

CHEM 340 FUNDAMENTALS OF PHYSICAL CHEMISTRY
(3-0) 3 credits. Prerequisites: CHEM 114 and either PHYS 111 or PHYS 211. A survey from a non-calculus point of view of the fundamental principles of physical chemistry including aspects of relevance to the life, environmental, materials sciences. Topics to be discussed include the states of matter, the laws of thermodynamics, and colligative properties.

CHEM 341 PHYSICAL CHEMISTRY FOR ENGINEERS I
(2-0) 2 credits. Prerequisite: CHE 222. Prerequisite or corequisite: PHYS213. Physical transformations of pure substances; simple mixtures and phase diagrams; chemical equilibrium and equilibrium electrochemistry. Duplicate credit for CHEM 341 and CHEM 342 not allowed.

CHEM 342 PHYSICAL CHEMISTRY I
(3-0) 3 credits. Prerequisites: CHEM 114 and MATH 225. Prerequisite or corequisite: PHYS 213. A study of the fundamental principles governing the behavior of chemical systems. Topics covered in the two-semester sequence include thermodynamics, chemical kinetics, quantum mechanics, and statistical mechanics. Properties of gases; first and second laws of thermodynamics; physical transformations of pure substances; simple mixtures and phase diagrams; chemical equilibrium and equilibrium electrochemistry. Duplicate credit for CHEM 341 and CHEM 342 not allowed.

CHEM 343 PHYSICAL CHEMISTRY FOR ENGINEERS II
(2-0) 2 credits. Prerequisites:PHYS 213 and CHEM 341 or CHEM 342. Kinetic theory of gases; statistical thermodynamics and properties of solids; chemical kinetics and kinetics at interfaces. Duplicate credit for CHEM 343 and CHEM 344 not allowed.

CHEM 344 PHYSICAL CHEMISTRY II
(3-0) 3 credits. Prerequisites: CHEM 342 and PHYS 213. A continuation of Physical Chemistry I. A study of the fundamental principles governing the behavior of chemical systems. Kinetic theory of gases; statistical thermodynamics and properties of solids; chemical kinetics and kinetics at interfaces; quantum mechanics and spectroscopy. Duplicate credit for CHEM 343 and CHEM 344 not allowed.

CHEM 345 PHYSICAL CHEMISTRY FOR ENGINEERS I AND II LAB
(0-1) 1 credit. Prerequisites: CHEM 220, CHEM 332L, and CHEM 341. Corequiesite: CHEM 343. Experimental methods used in modern physical chemistry. Spectroscopic, kinetic, thermostatic, and electrochemical techniques are studied.

CHEM 346L PHYSICAL CHEMISTRY I AND II LAB
(0-2) 2 credits. Prerequisites: CHEM 326L, CHEM 332L, and CHEM 342. Prerequisite or corequisite: CHEM 344. Experimental methods used in modern physical chemistry. Spectroscopic, kinetic, thermostatic, and electrochemical techniques are studied.

CHEM 370 CHEMICAL LITERATURE
(1-0) 1 credit. Prerequisites: CHEM 230 or CHEM 332 and CHEM 252 . Prerequisite or corequisite: CHEM 328. The use of the chemical library. Character of the various chemical journals, dictionaries, reference books, computer literature searching, and other sources of information. Written reports on chemical literature.

CHEM 420/520 ORGANIC CHEMISTRY III
(3-0) 3 credits. Prerequisite: CHEM 328. Advanced considerations of organic chemistry. Case studies in the synthesis of complex organic molecules are drawn from historical and recent organic chemical literature, which exemplify particular conformational, synthetic, and technical challenges to the organic student. Students enrolled in CHEM 520 will be held to a higher standard than those enrolled in CHEM 420.

CHEM 421/521 SPECTROSCOPIC ANALYSIS
(3-0) 3 credits. Prerequisites: CHEM 328 and CHEM 230 or CHEM 332. Determination of the structure of organic compounds using spectroscopic methods. Problems involving library and laboratory work. Students enrolled in CHEM 521 will be held to a higher standard than those enrolled in CHEM 421.

CHEM 426/526 POLYMER CHEMISTRY
(3-0) 3 credits. Prerequisites: CHEM 328 and CHEM 340 or CHEM 342. An introduction to the fundamental chemistry, characterization, and fabrication of polymeric substances. Students enrolled in CHEM 526 will be held to a higher standard than those enrolled in CHEM 426.

CHEM 434 INSTRUMENTAL ANALYSIS
(3-0) 3 credits. Prerequisites: CHEM 230 or CHEM 332 and CHEM 342. Theory and application of modern instrumental methods to chemical analysis.

CHEM 434L INSTRUMENTAL ANALYSIS LAB
(0-2) 2 credits. Prerequisite or corequisite: CHEM 434. The laboratory designed to accompany CHEM 434. This laboratory includes an introduction to laboratory methods and techniques of potentiometry, conductimetry, electrogravimetry, voltametry, TLC, GC, and HPLC.

CHEM 446/546 INDUSTRIAL ORGANIC CHEMISTRY
(3-0) 3 credits. Prerequisites: CHEM 328 and CHEM 340 or CHEM 342. A survey of industrial organic chemistry including characteristics of the United States and international chemical industry, global market forces affecting the industry, standard industrial classifications and sectors of the chemical industry, upstream and downstream source and applications markets, raw materials processing and chemical transformations, fuels, and major commodity and fine organic chemical sectors. Students enrolled in CHEM 546 will be held to a higher standard than those enrolled in CHEM 446.

CHEM 448/548 HETEROCYCLIC ORGANIC CHEMISTRY
(3-0) 3 credits. Prerequisites: CHEM 328 or permission of instructor, and CHEM 340 or CHEM 342. The nomenclature and chemistry of heterocyclic organic compounds. Emphasis is on systems of nomenclature leading to knowledge for chemical literature access to information on synthesis, properties, and reactions of mono- and polycyclic fused, bridged, and spiro compounds. Students enrolled in CHEM 548 will be held to a higher standard than those enrolled in CHEM 448.

CHEM 452/552 INORGANIC CHEMISTRY
(3-0) 3 credits. Prerequisites: CHEM 252, CHEM 328, CHEM 342. Theoretical and periodic aspects of inorganic chemistry. Discussion of the important models and concepts of modern inorganic chemistry. Students enrolled in CHEM 552 will be held to a higher standard than those enrolled in CHEM 452.

CHEM 452L/552L INORGANIC CHEMISTRY LAB
(0-1) 1 credit. Prerequisites: CHEM 328L, Prerequisite or corequisite: CHEM 452. Synthesis and characterization of inorganic compounds. Laboratory techniques in inorganic chemistry including: synthesis of air-sensitive compounds, transition metal complexes and silicon polymers, chemical characterization of inorganic compounds using spectroscopic, magnetic and analytical approaches. Students enrolled in CHEM 552L will be held to a higher standard than those enrolled in CHEM 452L.

CHEM 455/555 ADVANCED INORGANIC CHEMISTRY
(3-0) 3 credits. Prerequisites: CHEM 252 and CHEM 342. Contemporary inorganic chemistry; emphasis placed on compounds of the mail group elements and industrial inorganic chemical processes. Students enrolled in CHEM 555 will be held to a higher standard than those enrolled in CHEM 455.

CHEM 460/560 BIOCHEMISTRY
(3-0) 3 credits. Prerequisite: CHEM 328. A one-semester course in biomolecules, metabolism, and transmission of genetic information. The structures, properties, and biochemical functions of mono- and polysaccharides, lipids, amino acids, proteins, and nucleic acids are introduced. Metabolic pathways and cycles for the catabolism and anabolism of sugars, triglycerides, steroids, amino acids, proteins, and polynucleotides are detailed. Energetics, the potential fates of chemical intermediates, and information storage and transmission are studied. Students enrolled in CHEM 560 will be held to a higher standard than those enrolled in CHEM 460.

CHEM 480/580 TOXICOLOGY
(3-0) 3 credits. Prerequisite: CHEM 316 or CHEM 328 and CHEM 340 or CHEM 344. An in-depth investigation into the classifications, mechanisms of action, and risk assessment associated with toxic chemicals. Topics include: absorption, distribution, and elimination mechanisms, metabolism of toxicants, chronic and acute toxicity, target organ toxicity and terminology, and methods used in testing/risk assessment. Students enrolled in CHEM 580 will be held to a higher standard than those enrolled in CHEM 480.

CHEM 482/582 ENVIRONMENTAL CHEMISTRY
(3-0) 3 credits. Prerequisites: CHEM 316 or CHEM 328. Examination of the chemistry and chemical processes of the environment, including the role of chemistry in current environmental issues. Students enrolled in CHEM 582 will be held to a higher standard than those enrolled in CHEM 482.

CHEM 482L/582L ENVIRONMENTAL CHEMISTRY LAB
(0-1) 1 credit. Prerequisite or corequisite: CHEM 482 or CHEM 582. Laboratory to accompany CHEM 482 and CHEM 582. Experimental methods and techniques used by the modern environmental chemist. Specific topics include sample preparation, environmental waste, determination of inorganic and organic compounds in natural and anthropogenic waters. Students enrolled in CHEM 582L will be held to a higher standard than those enrolled in CHEM 482L.

CHEM 490 SEMINAR
(.5-0) .5 credits. A highly focused, and topical course. The format includes student presentations and discussions of reports based on literature, practices, problems, and research. Seminars may be conducted over electronic media such as internet and are at the upper division or graduate levels. Enrollment is generally limited to fewer than 20 students. Repeatable for a maximum of two (2) credits.

CHEM 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. A maximum of six (6) credits of special topics and independent study credits will be allowed for degree credit.

CHEM 492 TOPICS
1 to 3 credits. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. A maximum of six (6) credits of special topics and independent study credits will be allowed for degree credit.

CHEM 498 UNDERGRADUATE RESEARCH/SCHOLARSHIP
1 to 3 credits. Prerequisite: Permission of instructor. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical. A maximum of six (6) credit hours of undergraduate research will be allowed for degree credit.

CHEM 620 ADVANCED TOPICS IN ORGANIC CHEMISTRY
1 to 3 credits. Prerequisites: CHEM 328 and CHEM 340 or CHEM 344. Topics selected to broaden the background of the individual student.

CHEM 630 ADVANCED TOPICS IN ANALYTICAL CHEMISTRY
1 to 3 credits. Prerequisites: CHEM 344 and CHEM 434 or permission of instructor. A thorough study of any of the specialized fields of analytical chemistry such as optical methods of analysis, radiochemistry, and spectral interpretation.

CHEM 640 ADVANCED TOPICS IN PHYSICAL CHEMISTRY
1 to 3 credits. Prerequisite: CHEM 344. Topics that may be covered, according to student demand, include absorption, catalysis, colloids, electro-chemistry, heterogeneous equilibria (phase rule), etc.

CHEM 641 GEOCHEMISTRY
(3-0) 3 credits. Prerequisites: CHEM 342, MET 320, or permission of instructor. Geochemical principles, applications, and design considerations, including thermodynamics, kinetics, and transport phenomena. Applications in low-temperature aqueous systems, carbonate equilibria, geothermal and hydrothermal systems, petroleum generation, metamorphism, and igneous processes. Computer solutions to geochemical problems will be used. An engineering design project is required. This course is cross-listed with GEOE 641.

CHEM 650 ADVANCED TOPICS IN INORGANIC CHEMISTRY
1 to 3 credits. Prerequisite: CHEM 452 or equivalent. Topics selected to broaden the background of the individual student.

CHEM 682 ADVANCED CHEMISTRY OUTREACH
(3-0) 3 credits. Prerequisite: Permission of instructor. This course will cover modules each of which centers about a on-line chemical demonstration video and which includes on-line explanations of chemical terminology and phenomena high-lighted by the demonstrations. Students will collaboratively interact with other students and teachers on-line to explore and understand the material.

CP 297/397/497 COOPERATIVE EDUCATION
1 to 3 credits. Prerequisite: Permission of instructor. Applied, monitored and supervised, field-based learning experience for which the student may or may not be paid. Students gain practical experience; they follow a negotiated and or directed plan of study established between the student, instructor and field experience supervisor. Due to the presence of a field experience supervisor, a lower level of supervision is provided by the instructor in these courses than is the case with an internship or practicum course. Students must satisfy departmental co-op requirements, which include a written report of the co-op work experience and an employer's evaluation, to earn credit for the course. Minimum GPA and other co-op eligibility requirements vary among employers. Because the work performed by a student while on co-op is equivalent to the workload of a full-time student, a student on co-op assignment who is registered for CP credit shall be considered to have full-time status.

CP 697 COOPERATIVE EDUCATION
1 to 3 credits. A single semester work experience at the employer's location. Students will be asked to utilize specialized skills learned in the classroom and will be permitted to develop human relations skills and maturity in a degree-relevant work environment. Each student must satisfy departmental requirements

in order to earn credit for the course. Requirements will include but not be limited to a written report of the work experience and an employer's evaluation of work performance. Students must have the approval of their graduate committee in order to enroll.

CSC 105 INTRODUCTION TO COMPUTERS
(3-0) 3 credits. Overview of computer applications with emphasis on word processing, spreadsheets, database, presentation tools and Internet-based applications. May not be used for credit toward an engineering or science degree (except Interdisciplinary Sciences and Associate of Arts).

CSC 115 HARDWARE/NETWORKING ISSUES ON THE WEB
(3-0) 3 credits. Prerequisites: CSC 105 and corequisite CSC 210 , or permission of instructor. This course will teach students the basics of the hardware and system software necessary to create and maintain a web-based enterprise. Topics include: operating systems, networking hardware (servers, routers, switches), connectivity (ways to connect to a site, types of networks, throughput, mirror sites), and overview of the most popular networking software and security (access rights, backup procedures, content filtering). Students will also learn the basic system administration tasks necessary to manage web sites on a NT server or a UNIX server. Understanding file sizes, file transfer rates, compression, and encryption will also be important.

CSC 121/121L NT WORKSTATION ADMINSTRATION
(2-1) 3 credits. Prerequisites: CSC 105 or permission of instructor. Students will learn the fundamentals of NT workstation administration. This course has a significant laboratory component to give the student hands-on experience with NT workstation administration.

CSC 131/131L NT SERVER ADMINISTRATION
(2-1) 3 credits. Prerequisites: CSC 121 or permission of instructor. This course will prepare students to perform system administration tasks in an NT server environment. This course will have a structured lab to provide hands-on experience with an NT server.

CSC 141/141L NETWORKING ESSENTIALS
(2-1) 3 credits. Prerequisites: CSC 105 or permission of instructor. This course will teach the fundamentals of current networking technology. Topics covered will include: network components, how a network functions, network architectures, and network operations.

CSC 150/150L COMPUTER SCIENCE I
(2-1) 3 credits. Prerequisite and corequisite: MATH 123. An introduction to computer programming. Focus on problem solving, algorithm development, design, and programming concepts. Topics include sequence, selection, repetition, functions, and arrays.

CSC 210 WEB AUTHORING
(3-0) 3 credits. Prerequisite: CSC 105 or permission of instructor. This course focuses on techniques and methods for writing specifically for the Internet. Topics will include designing and creating documents for the World Wide Web, design considerations, and publishing and maintaining Web sites. Students will use HTML, Web authoring software, and other software for Web development.

CSC 211 WEB PROGRAMMING I
(3-0) 3 credits. Prerequisites: CSC 210 and CSC 115, or permission of instructor. This course introduces students to the issues and techniques for creating interactive web sites. Students explore the framework for web programming applications with particular attention to the Microsoft Active Server Pages (ASP) model. VBScript programming will be taught and used as the tool for creating interactive web sites. An introduction to Active X controls will also be provided. This is a programming course and students should expect to spend a significant amount of time outside of the classroom on course projects.

CSC 212 WEB PROGRAMMING II
(3-0) 3 credits. Prerequisites: CSC 211 or permission of instructor. This course explores web programming languages. Emphasis will be on connecting interactive web sites to databases. Students will use the ASP learned in CSC 211 as well as learn Java and JavaScript for this course. Students will also be introduced to PHP on UNIX and to XML. A comparison of the strengths and weaknesses of the different models will be an important part of this course. This is a programming course and students should expect to spend a significant amount of time outside of the classroom on course projects.

CSC 242 NT IN THE ENTERPRISE
(3-0) 3 credits. Prerequisites: CSC 131 or permission of instructor. This course will prepare students to design, implement, and support directory services on a Microsoft Windows NT server network. Students will also have hands on experience in analyzing and optimizing Windows NT Servers and Troubleshooting Windows NT Server in the Enterprise Environment.

CSC 244/244L INTERNET INFORMATION SERVER AND NETWORK PROTOCOLS
(2-1) 3 credits. Prerequisites: CSC 141 or permission of instructor. This course will prepare

students to install and configure Internet Information Server. Students will learn the different components to administer the Internet Information Server. Students will learn about Transmission Control Protocol/Internet Protocol (TCP/IP) and how it works with the Internet Information Server. This course has a significant laboratory component to give the student hands-on experience.

CSC 250 COMPUTER SCIENCE II
(4-0) 4 credits. Prerequisite: CSC 150. Problem solving, algorithm design, standards of program style, debugging and testing. Extension of the control structures and data structures of the high-level language introduced in CSC 150. Elementary data structures and basic algorithms that include sorting and searching. Topics include more advanced treatment of functions, data types such as arrays and structures, and files.

CSC 251 FINITE STRUCTURES
(4-0) 4 credits. Prerequisite: CSC 150 or permission of instructor. Selected topics from Boolean algebra, set theory, congruencies, equivalence relations, complexity, graph theory, combinatorics, induction, difference equations, and logic.

CSC 284 DATABASE PROCESSING
(3-0) 3 credits. Prerequisite: CSC 211; corequisite: CSC 212 or permission of instructor. Student will learn the fundamentals of database management with specific attention to the most popular database systems currently in use on both NT and UNIX systems (Access, Sequel, and Oracle). Students will learn how data is stored and retrieved, the basics of the entity-relationship design methodology and table design, and an introduction to performance issues. This course emphasizes using existing systems rather than writing these systems. Students interested in the programming details should take CSC 484.

CSC 291 INDEPENDENT STUDY
1 to 5 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. May be repeated to a total of five (5) credit hours.

CSC 292 TOPICS
1 to 5 credits. Includes current topics, advanced topics, and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. May be repeated to a total of five (5) credit hours.

CSC 300 DATA STRUCTURES
(4-0) 4 credits. Prerequisite: CSC 250 and CSC 251. A systematic study of data structures and the accompanying algorithms used in computing problems; structure and use of storage; methods of representing data; techniques for implementing data structures; linear lists; stacks; queues; trees and tree traversal; linked lists; and other structures.

CSC 314/314L ASSEMBLY LANGUAGE
(2-2) 4 credits. Prerequisite: CSC 250. A thorough introduction to assembly language programming and processor architecture. A study of low-level programming techniques, and the layout of a typical computer. The student will gain insight into the memory layout, registers, run-time stack, and global data segment of a running program. This course is cross listed with CENG 314/314L. Graduation credit will not be allowed for both this course and CENG 314/314L.

CSC 317/317L COMPUTER ORGANIZATION AND ARCHITECTURE
(3-1) 4 credits. Prerequisite: CSC 314 and CENG 244. A course in computer organization with emphasis on the hierarchical structure of computer systems. Covers such topics as: components of computer systems and their configuration, design of basic digital circuits, the microprogram level, the conventional machine level, the operating system level, assembly language, addressing modes, interpreters/translators, computer arithmetic.

CSC 372 ANALYSIS OF ALGORITHMS
(3-0) 3 credits. Prerequisites: CSC 300 and MATH 125. Design and analysis of algorithms for numeric and nonnumeric problems, general problem-solving approaches, theory of computation. Topics will be selected from searching, sorting, graph algorithms, numerical algorithms, geometric algorithms, cryptography, and parallel algorithms.

CSC 391 INDEPENDENT STUDY
1 to 5 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. May be repeated to a total of five (5) credit hours.

CSC 392 TOPICS
1 to 5 credits. Includes current topics, advanced topics and special topics. A course devoted to a

particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrol particular, software validation and verification as well as scheduling and schedule assessment techniques will be discussed. This course together with CSC 465 form a two-course sequence.

CSC 410/510 PARALLEL COMPUTING
(3-0) 3 credits. Prerequisite: CSC 456. The fundamental ideas and issues involved in programming and using parallel computers. A survey of modern architectures and operating systems. Parallel programming applications in business, economic modeling, and science. SDSM&T emphasis scientific applications. Students enrolled in CSC 510 will be held to a higher standard than those enrolled in CSC 410.

CSC 421/521 GRAPHICAL USER INTERFACES
(3-0) 3 credits. Prerequisite: CSC 300. This introductory course in graphical user interface concepts will cover graphical user interface elements and style, events, component and object oriented user interface models, and graphical application programming issues. Topics will be covered in the context of common graphical user interface environments and programming languages. Possible topics include current GUI development languages such as Java, Web interfaces, GUI design principles and standards, and the role of the GUI in the overall application. Students enrolled in CSC 521 will be held to a higher standard than those enrolled in CSC 421.

CSC 433/533 COMPUTER GRAPHICS
(3-0) 3 credits. Prerequisites CSC 300 and MATH 225. Graphical programming concepts. Display media and device characteristics. Point, line, and circle plotting. Coordinate systems and transformations. Polygon clipping and filling. Spline methods, hidden surface elimination, and shading. Students enrolled in CSC 533 will be held to a higher standard than those enrolled in CSC 433.

CSC 440/440L ADVANCED DIGITAL SYSTEMS
(3-1) 4 credits. Prerequisites: CSC 317 or permission of instructor. Memory and disk systems, bus and I/0 systems, parallel processing. Applications of digital systems in real-time processing. Graduation credit will not be allowed for both this course and CENG 446.

CSC 445/545 INTRO TO THEORY OF COMPUTATION
(3-0) 3 credits. Prerequisite: CSC 251. Introduction to a series of models for computation and their relationship to formal languages that are useful in the definition of programming languages along with a look at the theoretical limits of computers. Topics include finite and pushdown automata, Turing machines, grammars, decidability and computational complexity. Students enrolled in CSC 545 will be held to a higher standard than those enrolled in CSC 445.

CSC 447/547 ARTIFICIAL INTELLIGENCE
(3-0) 3 credits. Prerequisite: CSC 300. Concepts in Artificial Intelligence: programming in languages such as Prolog or LISP; knowledge representation; search algorithms. Students enrolled in CSC 547 will be held to a higher standard than those enrolled in CSC 447.

CSC 448/548 MACHINE LEARNING
(3-0) 3 credits. Prerequisite: CSC 300. A systematic study of the theory and algorithms that constitute machine learning. It covers learning based on examples including genetic algorithms, case-based reasoning, decision trees, and Bayesian methods. Students enrolled in CSC 548 will be held to a higher standard than those enrolled in CSC 448.

CSC 456/456L OPERATING SYSTEMS
(3-1) 4 credits. Prerequisites: CSC 314 and CSC 300. A study of the functions and structures associated with operating systems with respect to process management, memory management, auxiliary storage management, and processor management. Topics include concurrent and distributed computing, deadlock, real and virtual memory, job and processor scheduling, security and protection. Graduation credit will not be allowed for both this course and CENG 456.

CSC 461 PROGRAMMING LANGUAGES
(3-0) 3 credits. Prerequisite: CSC 300. This course consists of two parts. The first part introduces how programming languages are designed, including an introduction to the concepts of parsing and compiling. Issues related to implementation such as type checking, binding, and memory management are discussed. Secondly, the course will survey the spectrum of programming languages paradigms, including traditional imperative, object oriented, functional, and logic languages.

CSC 463/563 DATA COMMUNICATIONS
(4-0) 4 credits. Prerequisite: CSC 250. A study of the principles of data communications, computer networks, and open systems, following the outline provided by the ISO/OSI model. Students enrolled in CSC 563 will be held to a higher standard than those enrolled in CSC 463.

CSC 464/564 INTRODUCTION TO DIGITAL IMAGE PROCESSING AND COMPUTER VISION
(3-0) 3 credits. Prerequisites: CSC 300 and MATH 125. Introduction to digital image processing and

computer vision, including image digitization and display, image enhancement and restoration, frequency domain techniques using the Fourier transform, image encoding, segmentation, and feature detection. Students enrolled in CSC 564 will be held to a higher standard then those enrolled in CSC 464.

CSC 465 SENIOR DESIGN PROJECT
(3-0) 3 credits. Prerequisites: CSC 470 or permission of instructor. Normally open only to Computer Science majors in their senior year. This is a team project design course. The course covers topics of current interest in computer science.

CSC 470 SOFTWARE ENGINEERING
(3-0) 3 credits. Prerequisites: CSC 300. An introduction to the software engineering process, including lifecycle phases, problem analysis, specification, project estimation and resource estimation, design, implementation, testing/maintenance, and project management. In particular, software validation and verification as well as scheduling and schedule assessment techniques will be discussed. This course together with CSC 465 form a two-course sequence.

CSC 476 THEORY OF COMPILERS
(3-0) 3 credits. Prerequisites: CSC 314 and CSC 461 or permission of instructor. Course covers formal languages, parsing, design of compilers, assemblers, and translators.

CSC 484 DATABASE MANAGEMENT SYSTEMS
(3-0) 3 credits. Prerequisite: CSC 300. The study of formalized database design. This course will focus on relational model design and the use of SQL. Students will use a modern relational database to implement designs and learn the basics of data management.

CSC 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems, and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. May be repeated to a total of five (5) credit hours.

CSC 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics, and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. May be repeated to a total of three (3) credit hours.

CSC 498 UNDERGRADUATE RESEARCH/SCHOLARSHIP
Credit to be arranged; not to exceed six credits toward fulfillment of B.S. degree requirements. Prerequisite: Permission of instructor. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical. May be repeated to a total of six credit hours.

CSC 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Student should have obtained permission of an instructor in the Department of Mathematics and Computer Science prior to registering for this course. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor. May be repeated to a total of five (5) credit hours.

CSC 692 TOPICS
1 to 3 credits. Student should have obtained permission of an instructor in the Department of Mathematics and Computer Science prior to registering for this course. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. May be repeated to a total of six credit hours.

CSC 713 ADVANCED SOFTWARE ENGINEERING
(3-0) 3 credits. Prerequisite: CSC 300 or permission of instructor. This course covers concepts and techniques within the different phases of the software life cycle: requirements, specifications, design, implementation, testing, operation, and management. The emphasis will be on the study of activities related to software configuration management and maintenance.

CSC 731 ADVANCED COMPUTER GRAPHICS
(3-0) 3 credits. Prerequisites: CSC 433 or permission of instructor. Topics considered in this course include the viewing/rendering pipeline, interaction strategies, curve and surface models, visible-surface determination, illumination and shading models, antialiasing. Also included will be project development using PHIGS and GKS (C programming required).

CSC 752 COMPUTER VISION
(3-0) 3 credits. Prerequisites: Permission of

Courses

instructor. Low-level processing for extraction of intrinsic image features (edges, range, surface orientation, motion and optical flow, texture), relaxation methods, image segmentation, pattern recognition, geometric and relational structures, knowledge representation, and neural network approaches.

CSC 761 ADVANCED ARTIFICIAL INTELLIGENCE
(3-0) 3 credits. Prerequisites: Permission of instructor. The objective of this course is to provide students with a background in advanced artificial intelligence problem solving methods. Topics covered include: Expert systems, fuzzy logic and fuzzy expert systems, genetic algorithms, case-based reasoning, and current research work on new areas of problem solving.

CSC 762 NEURAL NETWORKS
(3-0) 3 credits. Prerequisites: CSC 300 or permission of instructor. This course presents a survey of the architecture and algorithms of neural networks. Topics covered include perceptrons, competitive learning, multi-layer networks, back propagation, and selected topics from pattern recognition.

CSC 772 ADVANCED OPERATING SYSTEMS
(3-0) 3 credits. Prerequisites: CSC 456 or permission of instructor. Advanced topics in operating systems design for multiprocessing and distributed systems. Topics will include areas such as methods of interprocess communication, reliability, maintainability, security, and large-scale design considerations.

CSC 784 DATABASE DESIGN
(3-0) 3 credits. Prerequisites: CSC 300 or permission of instructor. This course will include an overview of the relational and entity relationship (E-R) models. It will cover database design, advanced data models, emerging trends in the database field, including data warehouse, data mining, and distributed and parallel databases. Oracle database design tools and programming will be taught.

CSC 788 MASTER'S RESEARCH PROBLEMS/PROJECTS
Credit to be arranged; not to exceed three (3) credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the M.S. non-thesis option. Directed investigation of a selected problem culminating in an acceptable written report. Oral defense of the report and findings are required.

CSC 790 SEMINAR
(1-0) 1 credit. May not be repeated for degree credit. Preparation of an oral and/or written presentation and group discussion of a research problem.

CSC 791 INDEPENDENT STUDY
1 to 5 credits. Prerequisite: Permission of instructor. Student should have obtained permission of an instructor in the Department of Mathematics and Computer Science prior to registering for this course. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor. May be repeated to a total of five (5) credit hours.

CSC 792 TOPICS
1 to 5 credits. Student should have obtained permission of an instructor in the Department of Mathematics and Computer Science prior to registering for this course. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. May be repeated to a total of six credit hours.

CSC 798 MASTER'S THESIS
Credit to be arranged; not to exceed six credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the M.S. thesis option. Supervised original or expository research culminating in an acceptable thesis. Oral defense of thesis and research findings are required.

ECON 201 PRINCIPLES OF MICROECONOMICS
(3-0) 3 credits. Principles of microeconomics studies basic economic concepts as they relate to consumer, worker, and business decisions. Emphasis is given to satisfaction maximizing behavior by individuals and profit maximization by firms. Market structures are thoroughly analyzed regarding their effect on price, output, and competitiveness.

ECON 202 PRINCIPLES OF MACROECONOMICS
(3-0) 3 credits. Principles of macroeconomics considers the economy as a whole, how its sectors interact, and how monetary and fiscal policy can influence output, inflation, interest rates, unemployment, poverty, debt, and other factors.

EE 220/220L CIRCUITS I
(3-1) 4 credits. Prerequisites: MATH 125 completed with a grade of "C". Corequisite: MATH 321. This course is designed to provide the electrical engineering student with an understanding of the basic concepts of the profession. Topics covered include resistive circuits, transient circuits, and sinusoidal analysis. Students also investigate essential principles by conducting laboratory experiments related to the topics studied in the classroom. P-spice is used to analyze electrical circuits using personal computers.

EE 221/221L CIRCUITS II
(3-1) 4 credits. Prerequisites: EE 220 completed with a grade of "C" and MATH 321. This course is designed to provide the electrical engineering student with an understanding of the basic concepts of the profession. Topics covered include resistive circuits, transient circuits, and sinusoidal analysis. Students also investigate essential principles by conducting laboratory experiments related to the topics studied in the classroom. P-spice is used to analyze electrical circuits using personal computers.

EE 291 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

EE 292 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

EE 301/301L INTRODUCTORY CIRCUITS, MACHINES, AND SYSTEMS
(3-1) 4 credits. Prerequisites: GE 115 or equivalent, MATH 125 completed with a grade of "C" or better, and MATH 321 completed or concurrent. Not for majors in electrical engineering or computer engineering. Introduces the essential concepts of electrical engineering concerning circuits, machines, electronics, and systems.

EE 311/311L SYSTEMS
(3-0.5) 3.5 credits. Prerequisites: EE 221 completed with a grade of "C" or better, EM 216 completed or concurrent. Mathematical, topological, and circuit models of electro-systems, such as electromagnetic, electromechanical, electrothermal, etc.

EE 312/312L SIGNALS
(3-0.5) 3.5 credits. Prerequisites: EE 221 completed with a grade of "C" or better. Characterization of signals; the complex plane as a representative of the transient and frequency responses, continuous and discrete signal processing.

EE 320/320L ELECTRONICS I
(3-1) 4 credits. Prerequisite or corequisite: EE 221. Presents concepts of electronic devices and circuits including modeling of semiconductor devices, analysis and design of transistor biasing circuits, and analysis an design process is emphasized. Students are introduced to methods for designing circuits that still meet specifications even when they are statistical variations in the component values.

EE 322/322L ELECTRONICS II
(3-1) 4 credits. Prerequisite: EE 221 and EE 320. A continuation of EE 320 with emphasis on design applications of linear and nonlinear integrated circuits.

EE 330/330L ENERGY SYSTEMS
(3-1) 4 credits. Prerequisite: EE 221. Production, transmission, and utilization of energy in systems with major electrical subsystems, with particular emphasis on electromagnetic and electromechanical systems and devices.

EE 351/351L MECHATRONICS AND MEASUREMENT SYSTEMS
(3-1) 4 credits. Prerequisite: CSC 150 and EE 220 or EE 301. This course will encompass general measurement techniques found in Mechanical and Electrical Engineering. These include measurement of force, strain, frequency, pressure flow rates, and temperatures. Elements of signal conditioning and data acquisition will be introduced. In addition to this material, the course will have a Mechatronics approach reflected in the combined applications of electronic mechanical and control systems. This course is cross-listed with ME 351/351L.

EE 362 ELECTRIC AND MAGNETIC PROPERTIES OF MATERIALS
(3-0) 3 credits. Prerequisites: MATH 225, MATH 321, and PHYS 213. This course studies the behavior of materials of interest to electrical engineers and covers fundamental issues such as energy band theory, density of states, Fermi-Dirac statistics, equilibrium statistics in semiconductors, and Fermi energy. This foundation is then used to study a variety of topics such as conduction, semiconductor devices, ferromagnetism, lasers, gaseous electronics, and thermoelectric phenomena.

EE 381 ELECTRIC AND MAGNETIC FIELDS
(3-0) 3 credits. Prerequisites: MATH 225, MATH 321, and PHYS 213. Fundamentals of field theory (i.e., Maxwell's equations) as applied to static electric and magnetic phenomena. Also, theory and applications of lossless transmission lines are covered..

EE 382/382L APPLIED ELECTROMAGNETICS
(2.5-0.5) 3 credits. Prerequisite: EE 381. Field theory (e.g., Maxwell's equations) for time-varying electromagnetic phenomena. Applications include transmission lines, plane waves, and antennas.

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Students are introduced to typical laboratory equipment associated with applied electromagnetics (e.g., vector network analyzer).

EE 391 INDEPENDENT STUDY
1 to 4 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems, and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

EE 392 TOPICS
1 to 4 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

EE 421/421L COMMUNICATION SYSTEMS
(3-1) 4 credits. Prerequisites: EE 312 and EE 322. Fundamentals of analog- and digital-signal transmission. Performance characteristics such as channel loss, distortion, bandwidth requirements, signal-to-noise ratios, and error probability. (Design content - two (2) credits)

EE 431/431L POWER SYSTEMS
(3-1) 4 credits. Prerequisite: EE 311 and EE 330. The principles of energy conversion and transmission in modern power systems. Specialized problems of design, control, and protection are included. (Design content - two (2) credits)

EE 432/432L POWER ELECTRONICS
(3-1) 4 credits. Prerequisites: EE 330. The conversion, regulation, and control of electric power by means of electronic switching devices; inverter and chopper circuits; pulse width modulation; motor drives. (Design content - two (2) credits)

EE 451/451L CONTROL SYSTEMS
(3-1) 4 credits. Prerequisite: ME 352 or EE 311. Analysis and design of automatic control and process systems by techniques encountered in modern engineering practice, including both linear and nonlinear systems with either continuous or discrete signals. This course is cross-listed with ME 453/453L (Design content - two (2) credits)

EE 461/461L VLSI TECHNOLOGY
(3-1) 4 credits. Prerequisite: EE 362. Development of the theory of solid-state devices, and an introduction to the design, fabrication, and packaging of integrated and hybrid circuits. (Design content - two (2) credits)

EE 464 SENIOR DESIGN I
(2-0) 2 credits. Prerequisites: Senior standing and prerequisite or corequisite EE 311, EE 312, EE 322 and ENGL 289. This course will focus on the design process and culminate with the EE faculty approval of design projects (including schematics and parts list) for EE 465. Typical topics included are the development of a product mission statement, identification of the customer and customer needs, development of target specifications, consideration of alternate designs using a decision matrix, project management techniques, legal and ethical issues, FCC verification and certification, use of probability and statistics for reliable design, interpretation of data sheets, and component selection.

EE 465 SENIOR DESIGN II
(2-0) 2 credits. Prerequisites: EE 464. Sequel to EE 464. Seniors build project in simulated environment incorporating engineering standards and realistic constraints. Requirements include laboratory notebook, progress reports, final oral presentation, and written report. (Design content - two (2) credits)

EE 481/481L MICROWAVE ENGINEERING
(3-1) 4 credits. Presentation of basic principles, characteristics, and applications of microwave devices and systems. Development of techniques for analysis and design of microwave circuits. (Design content - two (2) credits)

EE 482/482L LASER AND OPTO-ELECTRONIC SYSTEMS
(3-1) 4 credits. Prerequisite: EE 362. Presentation of basic principles, characteristics, and applications of opto-electronic devices. Development of techniques for analysis and design of opto-electronic systems. (Design content - two (2) credits)

EE 483/483L ANTENNAS FOR WIRELESS COMMUNICATIONS
(3-1) 4 credits. Prerequisite: EE 382. Introduction to antenna design, measurement, and theory for wireless communications including fundamental antenna concepts and parameters (directivity, gain, patterns, etc.), matching techniques, and signal propagation. Theory and design of linear, loop, and patch antennas, antenna arrays, and other commonly used antennas. Students will design, model, build, and test antenna(s). (Design content - two (2) credits)

EE 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems, and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher

involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

EE 492 TOPICS
1 to 4 credits. Includes current topics, advanced topics, and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

EE 498 UNDERGRADUATE RESEARCH/SCHOLARSHIP
Credit to be arranged: not to exceed four credits toward fulfillment of B.S. degree requirements. Prerequisite: Permission of instructor. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical.

EE 612/612L HIGH-SPEED DIGITAL DESIGN
(2.5-0.5) 3 credits. Prerequisites: EE 220 and EE 320 or equivalent courses in introductory circuits and introductory electronics. This course is an introduction to signal integrity and the design of high-speed circuits and interconnects. Topics include signal Integrity issues such as ringing, ground bounce, clock skew, jitter, crosstalk, and unwanted radiation, time-domain analysis and spice simulation of lumped and distributed high speed circuits, micro-strip and strip-line design, ground and power plane design, proper capacitor decoupling, line termination, and multi-layer routing strategies. The student is also introduced to high-speed measurement techniques and equipment.

EE 618/618L INSTRUMENTATION SYSTEMS
(2-1) 3 credits. Presentation of principles, characteristics, and applications of instrumentation systems including sensors, filters, instrumentation amplifiers, analog-to-digital and digital-to-analog conversions, and noise. This course will be useful to graduate students beginning their laboratory thesis research. It is available to students from other departments with permission of instructor.

EE 621 INFORMATION AND CODING THEORY
(3-0) 3 credits. Principles and techniques of information theory and coding theory and their application to the design of information handling systems. Topics include: Entropy, Shannon theory, channel capacity, coding for data translation, compaction, transmission and compression, block codes, and Markov processes.

EE 622 STATISTICAL COMMUNICATION SYSTEMS
(3-0) 3 credits. Concepts of probability and random processes; linear systems and random processes; performance of amplitude angle and pulse modulation systems in noisy environments; digital data transmission; and basic concepts of information theory.

EE 623 RANDOM SIGNALS AND NOISE
(3-0) 3 credits. Prerequisite: Permission of instructor. Selected topics in the theory of probability and statistics; spectral analysis; shot noise and Gaussian processes; noise figures; signal-to-noise ratios; random signals in linear systems; optimum linear systems. Taught as required.

EE 624/624L ADVANCED DIGITAL SIGNAL PROCESSING
(2.5-0.5) 3 credits. Prerequisites: CENG 420 or equivalent. This course develops the theory essential to understanding the algorithms that are increasingly found in modern signal processing applications, such as speech, image processing, digital radio and audio, statistical and adaptive systems. Topics include: analysis of non-stationary signals, transform techniques, Wiener filters, Kalman filters, multirate rate systems and filter banks, hardware implementation and simulation of filters, and applications of multriate signal processing. Matlab will be used extensively.

EE 633 POWER SYSTEM ANALYSIS I
(3-0) 3 credits. Prerequisite: EE 431 or equivalent. Synchronous machine theory and modeling; short-circuit, load flow, and stability studies in large scale systems. Taught as required.

EE 634 POWER SYSTEM ANALYSIS II
(3-0) 3 credits. Prerequisite: EE 633. Advanced topics in power system analysis; excitation and speed-control systems; protective relaying and relay applications. Taught as required.

EE 641 DIGITAL SYSTEMS DESIGN
(3-0) 3 credits. Prerequisite: Permission of instructor. Design of digital systems (including computer systems) and implementation by fixed logic and programmed logic (microprocessors and microprogramming). Taught as required.

EE 642 DIGITAL SYSTEMS THEORY
(3-0) 3 credits. Prerequisite: CENG 342 or equivalent. Theory of digital systems including switching algebra, minimization, function decomposition, fault diagnosis, sequential circuits, state identification, linear sequential machines, and automata theory. Taught as required.

EE 643 ADVANCED DIGITAL SYSTEMS
(3-0) 3 credits. Study of current advanced topics in digital systems; multiprocessors; computer networks; digital communication; pattern recognition systems. Taught as required.

EE 644 FAULT TOLERANT COMPUTING
(3-0) 3 credits. Prerequisite: CENG 342 or equivalent or permission of instructor. The objective of this course is to provide students with a background in the various techniques used in fault tolerant approaches. After an introduction to fault tolerance, deterministic testing and probabilistic testing will be presented. Important topics in the area of fault tolerant computing will be covered, such as random testing, error detection and correction, reliability analysis, fault-tolerant design techniques, and design faults including software reliability methods.

EE 645 ADVANCED DIGITAL SYSTEMS AND VLSI TESTING
(3-0) 3 credits. Prerequisite: CENG 342 or equivalent or permission of instructor. The objective of this course is to provide students with background of the various techniques in testing of digital and VLSI systems, with emphasis on CMOS logic circuits. Fault Modeling will first be introduced. Various test generation algorithms for static and dynamic circuits will then be presented. Important topics in CMOS, BiCMOS testing will be covered, such as: test invalidation, testing for bridging faults, design for robust restability. Other current issues in testing will be discussed as well, such as, memory testing, delay testing, etc.

EE 647/647L HDL DESIGN
(2.5-0.5) 3 credits. Prerequisite: CENG 342 or permission of instructor. This course explores modern design techniques utilizing hardware description languages (HDLs) such as VHDL, VHDL-A, and Verilog. Fundamental language syntax will be covered in addition to advanced language constructs. Various hierarchical design styles such as dataflow, structural, and behavioral descriptions will be presented. Emphasis will be placed on both design simulation and synthesis. Synthesis platforms (e.g., FPGAs and ASICs) will also be examined. Other current issues will also be discussed such as reconfigurability, system-on-a-chip solutions, testbenches, soft processors, etc.

EE 648/648L ADVANCED VLSI DESIGN
(2.5-0.5) 3 credits. Prerequisite: CENG 440. This course presents more advanced material related to the technology and design of modern VLSI integrated circuits including topics such as mixed logic design, BiCMOS logic design, memory design, low power design, silicon-on-insulator chips, deep sub-micron design issues, crosstalk, parasitic parameter extraction and optimization, gallium arsenide logic devices, design-for-test, fault-tolerant VLSI architectures, etc.

EE 651 DIGITAL CONTROL SYSTEMS
(3-0) 3 credits. Prerequisite: EE 451 or equivalent. Study of topics in digital control systems, digital compensation techniques; real-time digital control of dynamic systems; optimization of digital systems; digital control of robotic systems, digital to continuous system interfacing. Taught as required.

EE 652 NONLINEAR AND OPTIMAL CONTROL SYSTEMS
(3-0) 3 credits. The study of nonlinear and optimal systems using the phase plane method, describing functions, Lyapunov's theory, nonlinear control systems design, linear, dynamic and integer programmer, parameter optimization, and system optimization using calculus of variation.

EE 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor.

EE 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

EE 791 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor.

EE 792 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

EE 798 MASTER'S THESIS
Credit to be arranged; not to exceed six (6) credits toward fulfillment of the M.S. degree requirements. Supervised original or expository research culminating in an acceptable thesis. Oral defense of the thesis and research findings are required.

EM 214 STATICS
(3-0) 3 credits. Prerequisite: MATH 125. The study of the effects of external forces acting on stationary rigid bodies in equilibrium. Vector algebra is used to study two and three dimensional systems of forces. Trusses, frames and machines, shear and moment in beams, friction, centroids, moments of inertia, and mass moments of inertia are discussed.

EM 215 DYNAMICS
(3-0) 3 credits. Prerequisite: EM 214. Newton's laws of motion are applied to particles and rigid bodies. Absolute and relative motion; force, mass and acceleration; work and energy; and impulse and momentum.

EM 216 STATICS & DYNAMICS
(4-0) 4 credits. Prerequisite: MATH 125. Statics: the study of effects of external forces acting on stationary rigid bodies in equilibrium. Frames and machines, friction, centroids and moments of inertia of areas and mass are discussed. Dynamics: Newton's laws of motion are applied T particles and rigid bodies. Topics considered are absolute and relative motion; force, mass, and acceleration (or particles and rigid bodies); work and energy; and impulse and momentum (of particles).

EM 217 STATICS AND MECHANICS OF MATERIALS
(4-0) 4 credits. Prerequisite: MATH 125. Integrated course involving the study of force systems in equilibrium and the mechanics of deformable bodies. Emphasis is placed on the basic concepts of the static behavior of rigid bodies and the behavior of deformable bodies under loadings common to engineering problems.

EM 218 EXPERIMENTAL ANALYSIS OF STRESS AND STRAIN
(0-1) 1 credit. Prerequisite: Preceded by or concurrent with EM 321 or EM 217. Laboratory procedures common to the mechanical design area are studied and developed. Methods and applications of tension and bending tests will be explored. Procedures studied will include topics such as strain rosette analysis, tension, torsion, and bending tests, fatigue, photoelasticity, and brittle coatings.

EM 321 MECHANICS OF MATERIALS
(3-0) 3 credits. Prerequisite: EM 214. Basic concepts of stress and strain that result from axial, transverse, and torsional loads on bodies loaded within the elastic range. Shear and movement equations and diagrams; combined stresses; Mohr's circle; beam deflections; and column action and equations.

EM 327 APPLIED FLUID MECHANICS
(4-0) 4 credits. Prerequisites: EM 321, EM 217, or permission of instructor. An introduction to the static and dynamic properties of real and ideal fluids; application of continuity, energy, and momentum principles to laminar, turbulent, compressible, and incompressible flows; laminar and turbulent flow of fluids in closed conduits and open channels; flow through orifices, weirs, and venturi meters; and flow in pipe networks and pumping systems.

EM 328 APPLIED FLUID MECHANICS
(3-0) 3 credits. Prerequisites: EM 214 or concurrent enrollment in EM 217, or EM 216. Topics will include an introduction to the static and dynamic properties of real and ideal fluids; application of continuity, energy, and momentum principles to laminar, turbulent, compressible, and incompressible flows; laminar and turbulent flow of fluids in closed conduits and open channels; flow through orifices, weirs, and venturi meters. Flow in pipe networks and pumping systems will be investigated using a projectized team approach.

EM 331 FLUID MECHANICS
(3-0) 3 credits. Prerequisites or corequisite: EM 321. An introduction to the static and dynamic properties of real and ideal fluids; application of continuity, energy, and momentum principles to laminar, turbulent, compressible, and incompressible flows; and laminar and turbulent flow of fluids in closed conduits and around immersed bodies.

EM 680 ADVANCED STRENGTH OF MATERIALS
(3-0) 3 credits. Prerequisites: EM 321, MATH 225, MATH 321. Study of advanced concepts in strength of materials. Topics will be selected from the following: theories of stress and strain, failure criteria, energy methods, torsion, nonsymmetrical beams on elastic foundation, plates, shells, stress concentrations, contact stresses, finite element methods, and plastic behavior of solids.

ENGL 031 BASIC WRITING
(1-0) 1 credit. Prerequisite: Appropriate student placement based on entry level assessment. Intensive work in grammar and usage, punctuation, and paragraph development. Does not count toward graduation.

ENGL 032 BASIC WRITING
(2-0) 2 credits. Prerequisite: Prerequisite: Appropriate student placement based on entry level assessment. Intensive work in grammar and usage, punctuation, and paragraph development. Does not count toward graduation.

ENGL 033 BASIC WRITING
(3-0) 3 credits. Prerequisite: Prerequisite: Appropriate student placement based on entry level assessment. Intensive work in grammar and usage, punctuation, and paragraph development. Does not count toward graduation.

ENGL 101 COMPOSITION I
(3-0) 3 credits. Appropriate student placement based on entry level assessment or completion of ENGL 031, 032, or 033. Practice in the skills, research, and documentation needed for effective academic writing. Analysis of a variety of academic and non-

academic texts, rhetorical structures, critical thinking, and audience will be included.

ENGL 201 COMPOSITION II
(3-0) 3 credits. Prerequisite: ENGL 101 or permission of instructor. Study of and practice in writing persuasive prose, with the aim to improve writing skills in all disciplines. Includes literary analysis and requires a research report.

ENGL 221 BRITISH LITERATURE I
(3-0) 3 credits. A chronological survey of British literature from Old English through the 18th Century. ENGL 221 and ENGL 222 need not be taken in sequence.

ENGL 222 BRITISH LITERATURE II
(3-0) 3 credits. A chronological survey of British literature from the 19th century to the present. ENGL 221 and ENGL 222 need not be taken in sequence.

ENGL 241 AMERICAN LIT I
(3-0) 3 credits. Background to and survey of major works from the beginnings to the Civil War. ENGL 241 and ENGL 242 need not be taken in sequence.

ENGL 242 AMERICAN LIT II
(3-0) 3 credits. Background to and survey of major works from the Civil War to the present. ENGL 241 and ENGL 242 need not be taken in sequence.

ENGL 250 SCIENCE FICTION
(3-0) 3 credits. A survey of short stories and novels from the 19th century to the present.

ENGL 279 TECHNICAL COMMUNICATIONS I
(3-0) 3 credits. Prerequisites: ENGL 101 or equivalent and sophomore standing. Introductory written and oral technical communications with emphasis on research and explanations of scientific and engineering topics.

ENGL 289/289L TECHNICAL COMMUNICATIONS II
(2-1) 3 credits. Prerequisites: ENGL 279 or equivalent and sophomore standing. Advanced written and oral technical communications with emphasis on the research, preparation, and delivery of complex technical documents.

ENGL 300 THE LITERARY EXPERIENCE OF NATURE
(3-0) 3 credits. Prerequisite: Junior or senior standing. An interdisciplinary survey of writing about nature, examining the relationship between literary, cultural, and scientific perspectives.

ENGL 330 SHAKESPEARE
(3-0) 3 credits. Prerequisite: ENGL 101 or permission of instructor. Representative comedies, tragedies, and histories of Shakespeare.

ENGL 343 SELECTED AUTHORS
(1-0) 1 credit. Prerequisite: ENGL 101 or permission of instructor. A study of the work of one or several major literary figures. Authors may change each time the course is offered. May be taken up to three (3) times with different authors.

ENGL 350 HUMOR IN AMERICAN CULTURE
(3-0) 3 credits. Prerequisite: Junior or senior standing. The interdisciplinary study of American literary humor and its relationship to significant historical and regional issues.

ENGL 360 STUDIES IN EUROPEAN LITERATURE
(3-0) 3 credits. Prerequisite: Junior or senior standing. The interdisciplinary study of a facet of European literature through focus on literature of a particular century, a specific country or individual authors such as 19th century nationalism, literature of France, or James Joyce. May be repeated to maximum of credit of six hours on different topics.

ENGL 374 STUDIES IN AMERICAN LITERATURE
1 to 3 credits. Prerequisite: Junior or senior standing. The interdisciplinary study of American literature through focus on a particular facet of the American experience, such as a national issue or concern, a unique historical period or literary genre, or a distinct segment of U.S. society. May be repeated to maximum credit of six (6) hours on different topics.

ENGL 383 CREATIVE WRITING
(3-0) 3 credits. Prerequisite: Junior standing. Study and practice in the techniques of writing fiction, poetry, and/or drama.

ENGL 391 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

ENGL 392 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with

significant one-on-one student/teacher involvement. A maximum of six (6) credits of special topics will be allowed for degree credit.

ENGL 468 CONTEMPORARY FICTION
(3-0) 3 credits. A study of the significant trends in contemporary fiction.

ENTR 336 ENTREPRENEURSHIP I
(3-0) 3 credits. This course is an introduction to the concepts, terminology, and process of new venture creation, operation and growth, as well as the introduction of entrepreneurial management practices into existing businesses. New ventures include public and non-profit institutions as well as for profit businesses. This course will assist in the identification of entrepreneurial opportunities and strategies and the role of personal factors (including creativity). Legal, ethical, and social responsibilities are emphasized. This course is cross-listed with BADM 336.

ENTR 406/506 ACCOUNTING FOR ENTREPRENEURS
(3-0) 3 credits. Accounting concepts and practices for entrepreneurs/small business owners. Emphasis given to the use of accounting tools to solve small business problems. Students enrolled in BADM 506 will be held to a higher standard than those enrolled in BADM 406. This course is cross-listed with ACCT 406/506 and BADN 406/506. This course cannot count as a social science/humanities credit.

ENTR 438/538 ENTREPRENEURSHIP II
(3-0) 3 credits. This course focuses on the process of screening an opportunity, drafting a personal entrepreneurial strategy, and understanding the business plan writing process. Building the entrepreneurial team and the acquisition and management of financil resources are emphasized along with venture growth, harvest strategies, and valuation. Students enrolled in ENTR 538 will be held to a higher standard than those enrolled in ENTR 438. This course is cross-listed with BADM 438/538.

ENTR 489 BUSINESS PLAN WRITING AND COMPETITION
(1-0) 1 credit. Students will write a business plan and present it to a panel of faculty and business community members. The top three business plan presenters will more on to a statewide competition. This course is cross-listed with BADM 489.

ENVE 120 INTRODUCTION TO MINING AND SUSTAINABLE DEVELOPMENT
(2-0) 2 credits. Principles and definitions related to the mining engineering discipline. Introduction overview of current mining practices and mining technology in general. Presentation of mining faculty and their areas of expertise. Discussion of various career paths in mining engineering. Principles, terminology and definitions of sustainable development in mining. Elements and indicators of sustainable development: environment, economics, society and governance. Discussion of how the mining industry can develop more successful operations in the changing global community, and how these and other issues impact the design, operation and closure of large mining projects. This course is cross-listed with MEM 120.

ENVE 204 SURFACE MINING METHODS AND EQUIPMENT FOR COAL, METAL AND QUARRYING OPERATIONS
(3-0) 3 credits. Prerequisites: ENVE/MEM 120 and MEM 203. Basic engineering principles relating to surface mining methods for coal, metal and quarrying operations. Equipment selection and design parameters. Mining method selection process as it relates to surface mining. This course is cross-listed with MEM 204.

ENVE 217 CHEMICAL ENGINEERING I
(3-0) 3 credits. Prerequisite or corequisite: CHEM 114, GES 115 and PHYS 211. The course on the theory and practice of Chemical Engineering with emphasis on material and energy balances. This course is cross-listed with CHE 217.

ENVE 220/220L MINERAL PROCESSING AND RESOURCE RECOVERY
(3-1) 4 credits. Prerequisite: Sophomore standing. An introductory course in mineral processing highlighting unit operations involved including comminution, sizing, froth flotation, gravity separation, electrostatic separation, magnetic separation and flocculation. Other topics discussed include remediation of contaminant effluents and the unit operations associated with recycling of post-consumer materials using mineral processing techniques. This course is cross-listed with MET 220/220L.

ENVE 290 SEMINAR
(.25-0) .25 credits. Prerequisite: Sophomore Standing. A highly focused, and topical course. The format includes student presentations and discussions of reports based on literature, practices, problems, and research. Seminars may be conducted over electronic media such as internet and are at the upper division or graduate levels. Enrollment is generally limited to fewer than 20 students. Course may be repeated twice for a total of 0.5 credits.

ENVE 302 MINERAL ECONOMICS AND FINANCE
(3-0) 3 credits. Prerequisite: Junior standing. Economic evaluation methods regarding acquisition/investment requirements, mine

equipment, and mineral commodities. The importance of the mineral industries to the national economy. This course is cross-listed with MEM 302.

ENVE 310 AQUEOUS EXTRACTION, CONCENTRATION, AND RECYCLING
(3-0) 3 credits. Prerequisites: MET 220 and MET 320. Scientific and engineering principles involved in the winning of metals from ores and scrap. Areas covered include the unit operations of comminution, sizing, solid/liquid separations, leaching, ion exchange, solvent extraction, and surface phenomena as related to flocculation, froth floatation, and electrostatic separation. This course is cross-listed with MET 310.

ENVE 310L AQUEOUS EXTRACTION, CONCENTRATION, AND RECYCLING LAB
(0-1) 1 credit. Prerequisites: Concurrent registration in ENVE 310 or permission of instructor. Laboratory experiments in design of processing equipment and cost estimation, zeta potential, surface tension, leaching kinetics, electrowinning, and solvent extraction. This course is cross-listed with MET 310L.

ENVE 315 FUNDAMENTALS OF HEAT TRANSFER
(2-0) 2 credits. Prerequisites: CHE/ENVE 217, completion of or concurrent registration in MATH 321. Course topics address theory and application of principles of heat transfer by conduction, convection and radiation.

ENVE 317 CHEMICAL ENGINEERING III
(3-0) 3 credits. Prerequisites: CHE 217, concurrent registration in MATH 321. The third course on the theory and practice of Chemical Engineering with emphasis on heat transfer. Heat transfer by conduction, convection, and radiation is studied. This course is cross-listed with CHE 317.

ENVE 318 CHEMICAL ENGINEERING IV
(3-0) 3 credits. Prerequisite: CHE 317. The fourth course on the theory and practice of Chemical Engineering with emphasis on molecular diffusion, membranes, convective mass transfer, drying, humidification, and continuous gas-liquid separation processes. This course is cross-listed with CHE 318.

ENVE 320 METALLURGICAL THERMODYNAMICS
(4-0) 4 credits. Prerequisites: PHYS 211, CHEM 114, MATH 125. The principles of chemical thermodynamics and their application to metallurgical engineering processes. Topics covered include the zeroth, first, and second laws of thermodynamics, the fundamental equations of state for open and closed systems, criterion of equilibrium, heat capacities, reaction equilibrium constants and their dependence upon temperature and pressure, chemical potential, standard and reference states, stability diagrams, and solution thermodynamics. This course is cross-listed with MET 320.

ENVE 321/321L HIGH TEMPERATURE EXTRACTION, CONCENTRATION, AND RECYCLING
(3-1) 4 credits. Prerequisite: MET 320. Thermodynamic principles involved in the winning of metals. Areas covered include calcination, oxidation, reduction processes, smelting, high - temperature refining, electrorefining, slags, and slag-metal interactions. This course is cross-listed with MET 321/321L.

ENVE 322/322L STRUCTURAL GEOLOGY
(2-1) 3 credits. Prerequisites GEOL 201 and GEOL 201L, or GEOE 221; and GEOL 341. A study of the character and genesis of large-scale and small-scale deformational structures and their patterns in the earth's crust. Laboratory work includes various trigonometric, geometric, and stereographic methods applicable to structural analysis and presents open-ended problems in geologic, structure contour, and isopach map interpretation, as well as engineering design problems including drilling exploration projects. This course is cross-listed with GEOE 322/322L.

ENVE 324/324L ENGINEERING GEOPHYSICS I
(2-1) 3 credits. Prerequisites MATH 125 and PHYS 213. Application of the more commonly used methods of geophysical prospecting in mineral exploration, petroleum exploration, and engineering construction. Includes field design and interpretation of surveys using the engineering seismograph, gravity meter, electrical resistivity equipment, scintillometers, and magnetometers. Extensive use of computers is made in the laboratory work. This course is cross-listed with GEOE 324/324L.

ENVE 326 ENVIRONMENTAL ENGINEERING PROCESS FUNDAMENTALS
(3-0) 3 credits. Prerequisites: CHEM 114, EM 331, and CEE 284. The first course in the theory and practice of Environmental Engineering. Emphasis is on the mass-balance approach to problem solving with consideration of water chemistry, environmental process kinetics, ideal reactors, and biological process fundamentals. This course is cross-listed with CEE 326 and MINE 326.

ENVE 327/327L INTRODUCTORY ENVIRONMENTAL ENGINEERING DESIGN
(2-1) 3 credits. Prerequisites: CEE/ENVE 326 or permission of instructor. A second course in the theory and practice of Environmental Engineering. Emphases are on the applications of environmental engineering principles in the design and analysis of

water and wastewater treatment, and solid and hazardous waste disposal. Laboratory exercises will be completed and reports with computer-generated text tables and figures are required. This course is cross-listed with CEE 327/327L.

ENVE 331/331L STRATIGRAPHY AND SEDIMENTATION
(2-1) 3 credits. Prerequisites: GEOL 201 and GEOL 201L, or GEOE 221, or permission of instructor. The principles of correlation and sediment analysis are discussed. A background in sedimentary source materials, depositional environments, nomenclature and classification of stratigraphic units, and the interpretation of stratigraphic units will be presented. Emphasis is placed on modern depositional systems and their ancient counterparts. Laboratory exercises stress field trips to local sections, facies descriptions, rock analysis, and interpretation of an exploration prospect. This course is cross-listed with GEOL 331/331L.

ENVE 337 ENGINEERING HYDROLOGY
(3-0) 3 credits. Prerequisites: CEE 336 or EM 327 or permission of instructor. A quantification study of the components of the hydrologic cycle with emphasis on engineering applications involving the design of water supplies, reservoirs, spillways, floodways, and urban drainage with computer applications. This course is cross-listed with CEE 337.

ENVE 421/521 ENVIRONMENTAL SYSTEMS ANALYSIS
(3-0) 3 credits. Prerequisites: CHEM 114 or permission of instructor. Applications of fundamental physical and chemical principles in the examination of solution phase behavior of organic and inorganic substances in Environmental Engineering systems. Analytical and computer solutions are performed. Students enrolled in ENVE 521 will be held to a higher standard than those enrolled in ENVE 421. This course is cross-listed with CEE 421/521.

ENVE 426/526 ENVIRONMENTAL ENGINEERING PHYSICAL/CHEMICAL PROCESS DESIGN
(3-0) 3 credits. Prerequisites: CEE/ENVE 326 and CEE/ENVE 327, graduate standing, or permission of instructor. A third course in the theory and practice of Environmental Engineering. Emphases are on the design and analysis of physical/chemical environmental engineering unit operations and processes. Students enrolled in ENVE 526 will be held to a higher standard than those enrolled in ENVE 426. This course is cross-listed with CEE 426/526.

ENVE 426L/526L ENVIRONMENTAL PHYSICAL/CHEMICAL PROCESS LABORATORY
(0-1) 1 credit. Prerequisite or corequisite: CEE/ENVE 426/526 or permission on instructor. A laboratory course to accompany CEE/ENVE 426/526. Examination of processes employed in design of environmental physical and chemical systems for renovation of contaminated waters and soils. Various bench-scale experiments will be performed with laboratory analysis using standard environmental web chemical and instrumental analytical techniques. Laboratory reports employing word processing, numerical and statistical analysis, and interpretation of process performance data will be written. Students enrolled in ENVE 526L will be held to a higher standard than those enrolled in ENVE 426L. This course is cross-listed with CEE 426L/526L.

ENVE 427/527 ENVIRONMENTAL ENGINEERING BIOLOGICAL PROCESS DESIGN
(3-0) 3 credits. Prerequisites: CEE/ENVE/MINE 326 and CEE/ENVE 327, graduate standing, or permission of instructor. A fourth course in the theory and practice of Environmental Engineering. Emphases are on the design and analysis of biological environmental engineering unit operations and processes. Students enrolled in ENVE 527 will be held to a higher standard than those enrolled in ENVE 427. This course is cross-listed with CEE 427/527.

ENVE 427L/527L ENVIRONMENTAL BIOLOGICAL PROCESS LABORATORY
(0-1) 1 credit. Prerequisite or corequisite: CEE/ENVE 427/527 or permission of instructor. A laboratory course to accompany CEE/ENVE 427/527. Examination of processes employed in design of environmental biological systems for renovation of contaminated waters and soils. Various bench-scale experiments will be performed with laboratory analysis using standard environmental web chemical, microbiological, and instrumental analytical techniques. Laboratory reports employing word processing, numerical and statistical analysis, and interpretation of process performance data will be written. Students enrolled in ENVE 527L will be held to a higher standard than those enrolled in ENVE 427L. This course is cross-listed with CEE 427L/527L.

ENVE 428/528 ADVANCED TREATMENT PLANT DESIGN
(3-0) 3 credits. Prerequisites: CEE 327, CEE 336, and CEE 426, or permission of instructor. Advanced topics relating to the design of systems for the renovation of contaminated waters. Several major design problems will be completed. Students

enrolled in ENVE 528 will be held to a higher standard than those enrolled in ENVE 428. This course is cross-listed with CEE 428/528.

ENVE 429L/529L ENVIRONMENTAL ENGINEERING LAND SYSTEMS LABORATORY
(0-1) 1 credit. Prerequisites: Senior or graduate standing or permission of instructor. Students will complete selected laboratory exercises from the Chemical, Civil and Materials/Metallurgical Engineering emphases areas of the BS Environmental Engineering Program, embodying the examination of fundamental principles applicable to design or analysis of land systems and associated environmental health aspects. Students will design and conduct experiments, collect and analyze data both deterministically and statistically, and write detailed laboratory reports. Students enrolled in ENVE 529L will be held to a higher standard than those enrolled in ENVE 429L.

ENVE 433/433L/533/533L COMPUTER APPLICATIONS IN GEOSCIENCE MODELING
(3-1) 4 credits. Prerequisite: Junior standing. The use of computer techniques in modern geoscience modeling of mining, geology and environmental problems such as exploration, geological characterization and mining exploitation. Practical application of state-of-the-art Vulcan modeling software will be essential part of the course. Students enrolled in ENVE 533 will be held to a higher standard than those enrolled in ENVE 433. This course is cross-listed with MEM 433/433L/533/533L.

ENVE 440/540 ENVIRONMENTAL AND RECLAMATION PRACTICES IN THE MINING INDUSTRY
(3-0) 3 credits. A study of various environmental problems that is associated with mining and the reclamation practices that have been developed or are being evaluated to alleviate these problems. Federal, state, and local reclamation regulations are examined for their effects on present and future mining practices and costs. Field trips to several mining operations are taken for on-site observation of actual reclamation problems and the mining practices used to resolve these problems. Students enrolled in ENVE 540 will be held to a higher standard than those enrolled in ENVE 440. This course is cross-listed with MINE 440/540.

ENVE 441 ECONOMICS OF MINING
(3-0) 3 credits. Prerequisite: Junior standing. The significance of the mineral industries in the economy, mineral and engineering economics with special emphasis on the valuation of mineral properties, and mine administration economic decision methodologies. This course is cross-listed with MINE 441.

ENVE 445/545 OXIDATION AND CORROSION OF METALS
(3-0) 3 credits. Prerequisites: MET 232, MET 320 or CHE 222 or ME 311 or permission of instructor. Initially, the thermodynamics of electrochemical processes are covered; use of the Nernst equation and Pourbaix diagram is presented in this material. Fundamentals of electrode kinetics are then discussed with special emphasis on the derivation of the Butler-Volmer equation and application of the Evan's diagram. Following presentation of these fundamental concepts, phenomena observed in corrosion and oxidation such as uniform attack, pitting, stress corrosion cracking, and corrosion fatigue are discussed. Finally, selection of materials for site specific applications is covered. Students enrolled in ENVE 545 will be held to a higher standard than those enrolled in ENVE 445. This course is cross-listed with MET 445/545, CHE 445/545, ME 445/545.

ENVE 450/550 ROCK SLOPE ENGINEERING
(3-0) 3 credits. Prerequisite: MEM 304 or CEE 346 or equivalent. Modes of slope failure. Economic consequences of instability in mining and construction. Geological factors controlling stability of rock slopes. Shear strength of highly jointed rock mass and discontinuities. Projection methods. Vectoral analysis of 3-D problems by means of the stereographic projection method. Analytical, graphical and computer analysis of planar, wedge and toppling failures. Probabilistic methods. Students enrolled in ENVE 550 will be held to a higher standard than those enrolled in ENVE 450. This course is cross-listed with MEM 450/550.

ENVE 455/555 POLLUTION PHENOMENA AND PROCESS DESIGN
(3-0) 3 credits. Prerequisites: CHE 218, CHE 317, and CHE 417, or equivalent, or permission of instructor. The study of the industrial sources of and treatment of air, water, and land pollutants. The chemical and physical phenomena operating in pollution control equipment and the design of pollution control equipment will be examined. Waste minimization and pollution prevention strategies will be considered. Students enrolled in ENVE 555 will be held to a higher standard than those enrolled in ENVE 455. This course is cross-listed with CHE 455/555.

ENVE 464 ENVIRONMENTAL ENGINEERING DESIGN I
(0-2) 2 credits. Prerequisites: Senior standing. Students in this course will undertake a design effort integrating principles from prior course work into completion of an overall project that will require

both individual and team efforts. This first design course will concentrate on definition of the design problem, preliminary design with investigation of various options, and screening of the various design options prior to undertaking detailed design. Economic and legal constraints, general social considerations and personnel factors will be considered along with the technical aspects of the design. Both oral and written engineering reports delineating project activities and results will be completed.

ENVE 465 ENVIRONMENTAL ENGINEERING DESIGN II
(0-2) 2 credits. Prerequisites: ENVE 464. Students in this course will undertake a design effort integrating principles from prior course work into completion of the overall project that will require both individual and team efforts. This second design course will involve completion of the detailed design, construction of bench or pilot-scale units in accord with detailed design and demonstration of design effectiveness. Economic and legal constraints, general social considerations and personnel factors will be considered along with the technical aspects of the design. Both oral and written engineering reports delineating project activities and results will be completed.

ENVE 466/466L/566/566L ENGINEERING AND ENVIRONMENTAL GEOLOGY
(2-1) 3 credits. Prerequisite: Junior or senior standing. The application of geology to engineering, including topics such as landslides, earthquakes, fluvial processes, land subsidence, and their global context. Field trips and laboratory exercises illustrate the influence of geology on the environment. Computer applications are required for problem assignments and a final comprehensive report (oral and written) involving the design of engineering works in complex geological terrain. Students enrolled in ENVE 566 will be held to a higher standard than those enrolled in ENVE 466. This course is cross-listed with GEOE 466/466L/566/566L.

ENVE 475/475L GROUND WATER
(2-1) 3 credits. Prerequisites: GEOL 201 or GEOE 221 and MATH 225, or permission of instructor. Note: Engineering majors must complete the equivalent of Calculus III before registration. Geohydrologic principles, applications, and design considerations concerning ground-water occurrence, flow, and quality. Ground-water and surface-water relations; theory of aquifer tests; flow nets; head distribution by graphical, analytical, and digital models; ground-water contamination. Laboratories include water budgets, chemistry of ground water, design of exploration programs and aquifer tests, computer solutions, and field trips to areas of geohydrologic interest. A design project with written and oral presentations is required. This course is cross-listed with GEOE 475/475L.

ENVE 490 SENINAR
(0.5-0) .05 credits. Prerequisite: Senior Standing. A highly focused, and topical course. The format includes student presentations and discussions of reports based on literature, practices, problems, and research. Seminars may be conducted over electronic media such as internet and are at the upper division or graduate levels. Enrollment is generally limited to fewer than 20 students.

ENVE 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

ENVE 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

ENVE 498 UNDERGRADUATE RESEARCH/SCHOLARSHIP
1 to 6 credits. Prerequisite: Permission of instructor. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical.

FREN 101 INTRODUCTORY FRENCH I
FREN 102 INTRODUCTORY FRENCH II
(4-0) 4 credits each. Prerequisite: for FREN 102 is FREN 101. Fundamentals of language structure and introduction to French culture enabling students to converse, read, and write simple French. Classwork may be supplemented with required aural/oral practice outside of class.

GE 100 ENTERPRISE TEAMS
0 credits. This zero credit course will be used to track student participation in enterprise teams, i.e. teams of two or more students working under the direction of faculty member on a project that involves the participation of an external company,

government agency, etc.

GE 112/112L PERSONAL COMPUTER PROGRAMMING
(1-1) 2 credits. Prerequisite: Completion of college algebra with a grade of "C" or better or an acceptable score on the Calculus Qualifying Examination in algebra. Included in the course is an introduction to engineering profession, ethics, and problem solving methods. This course will cover the basic principles of programming with Visual Basic, including arithmetic, control structures, arrays, files, input/output, functions, subroutines, and basic numerical and statistical applications in engineering and science.

GE 665 PROJECT PLANNING AND CONTROL
(3-0) 3 credits. Prerequisite: PSYC 101 preferred. Project planning, execution and control of less repetitive types of work. This includes quantitative aspects such as costs, time. and performance specifications; and qualitative aspects such as organization structures, psychological, and sociological relationships. This course is cross-listed with TM 665.

GEOE 211 EARTH SYSTEMS ENGINEERING ANALYSIS
(0-1) 1 credits. Application of computational analysis using spreadsheets to geological engineering problems in the earth system. Typical problems will include those found in energy systems, ground water and environmental systems, and economic evaluations having a significant geologic aspect. Examples and problems from the Black Hills region will be emphasized.

GEOE 221/221L GEOLOGY FOR ENGINEERS
(2-1) 3 credits. Basic concepts in the study of the earth, with emphasis on geological processes acting on the earth's surface. Topics include rock forming processes and identification, mass wasting, ground water, streams, glaciers, coastal erosion, and earthquakes. Emphasis is given to engineering significance of processes and their resulting deposits.

GEOE 322/322L STRUCTURAL GEOLOGY
(2-1) 3 credits. Prerequisites GEOL 201 and GEOL 201L, or GEOE 221; and GEOL 341. A study of the character and genesis of large-scale and small-scale deformational structures and their patterns in the earth's crust. Laboratory work includes various trigonometric, geometric, and stereographic methods applicable to structural analysis and presents open-ended problems in geologic, structure contour, and isopach map interpretation, as well as engineering design problems including drilling exploration projects. This course is cross-listed with ENVE 322/322L.

GEOE 324/324L ENGINEERING GEOPHYSICS I
(2-1) 3 credits. Prerequisites MATH 125 and PHYS 213. Application of the more commonly used methods of geophysical prospecting in mineral exploration, petroleum exploration, and engineering construction. Includes field design and interpretation of surveys using the engineering seismograph, gravity meter, electrical resistivity equipment, scintillometers, and magnetometers. Extensive use of computers is made in the laboratory work. This course is cross-listed with ENVE 324/324L.

GEOE 410 ENGINEERING FIELD GEOLOGY
5 to 6 credits. Prerequisite: Completion of junior-year studies. Instruction, practice, and independent work involving field techniques for geological engineering. Includes use of aerial photography and field mapping for completing large-scale and intermediate-scale geologic maps, structural sections, and structural contour maps of designated areas in the Black Hills region. Written reports will accompany the maps and sections. Three weeks of the five-week course are devoted to engineering problems including surface-water and ground-water hydrology, geotechnics, and minerals. Conducted for five (5) weeks during the summer in the northern Black Hills. Arrangements for transportation, room, and board are made through the Black Hills Natural Sciences Field Station.

GEOE 425/425L/525/525L ENGINEERING GEOPHYSICS II
(2-1) 3 credits. Prerequisites: MATH 125, GEOE 324, and GEOE 211. The course concentrates on geophysical techniques applicable to petroleum exploration and production, including the acquisition of seismic data, its preparation, interpretation, and use in engineering design. Use of computer packages and individual program design is emphasized. Students enrolled in GEOE 525 will be held to a higher standard than those enrolled in GEOE 425.

GEOE 431/531 PRINCIPLES OF WELL LOGGING
(3-0) 3 credits. Fundamentals of borehole measurements. Petrophysical considerations. Wellbore environment. Qualitative log evaluation methods. Interpretation and analysis of formation properties. Students enrolled in GEOE 531 will be held to a higher standard than those enrolled in GEOE 431.

GEOE 451/451L ECONOMIC GEOLOGY
(2-1) 3 credits. Prerequisites: GEOL 341, GEOE 322, senior standing. Study of the economics and distribution of mineral resources, geologic characteristics and origins of metallic ore deposits, and the application of genetic models, geochemical

techniques, and geophysical methods to the design of mineral exploration programs. Laboratory work includes ore mineralogy and textures, sample suites from ore deposits, calculation of ore reserves (manual and computer), and design and implementation of exploration programs (computer exercises). A term paper is required on the design of exploration programs. Field trips are arranged to nearby ore deposits.

GEOE 452/452L/552/552L GEOCHEMICAL EXPLORATION
(2-1) 3 credits. Prerequisites: GEOE 451 or permission of instructor. An integrated application of geochemical principles, trace-element analytical techniques, basic statistical methods, and computer techniques to the design and implementation of geochemical exploration programs for the detection of mineral deposits. An area of the Black Hills will be selected for the design and implementation of a geochemical exploration program. A term paper will result from this study. Students enrolled in GEOE 552 will be held to a higher standard than those enrolled in GEOE 452.

GEOE 461 PETROLEUM PRODUCTION
(3-0) 3 credits. Characteristics of hydrocarbon reservoirs and geological considerations in well completion design. Well in-flow performance. Tubing string and packer completion design. Design and analysis of artificial lift systems. Acidizing and stimulation operations Computer-aided design. Single-phase and multi-phase flow measurements, physical modeling of oil production, and permeability tests. Global oil production and use, and societal implications.

GEOE 462 DRILLING ENGINEERING
(3-0) 3 credits. Prerequisites: EM 321 or permission of instructor. Introduction to oil and gas field terminology. Design and analysis of an oil or gas well drilling operation including equipment, tubulars, completion, casing and cementing. Computer-aided design of well control and rig hydraulics. Rheological properties of drilling fluids will be studied in the laboratory. A comprehensive design project is required. Field trips to a local drilling operation as available.

GEOE 464 GEOLOGICAL ENGINEERING DESIGN PROJECT I
(3-0) 3 credits. Prerequisite: Completion of junior-year studies. Independent engineering design work by students on a comprehensive geological engineering project that integrates 1) ground-water resources and contaminant remediation, or 2) exploration for and development of fuels or minerals. Economic and legal constraints, environmental concerns, safety, and aesthetic considerations will be included. Engineering reports (oral and written) with analysis, specifications, and results are required.

GEOE 465 GEOLOGICAL ENGINEERING DESIGN PROJECT II
(3-0) 3 credits. Prerequisite: Completion of junior-year studies. Independent engineering design work by students on a comprehensive geological engineering project that integrates 1) environmental site planning and natural hazards, or 2) geomechanics and geotechnics. Economic and legal constraints, environmental concerns, safety, and aesthetic considerations will be included. Engineering reports (oral and written) with analysis, specifications, and results are required.

GEOE 466/466L/566/566L ENGINEERING AND ENVIRONMENTAL GEOLOGY
(2-1) 3 credits. Prerequisite: Junior or senior standing. The application of geology to engineering, including topics such as landslides, earthquakes, fluvial processes, land subsidence, and their global context. Field trips and laboratory exercises illustrate the influence of geology on the environment. Computer applications are required for problem assignments and a final comprehensive report (oral and written) involving the design of engineering works in complex geological terrain. Students enrolled in GEOE 566 will be held to a higher standard than those enrolled in GEOE 466. This course is cross-listed with ENVE 466/466L/566/566L.

GEOE 475/475L GROUND WATER
(2-1) 3 credits. Prerequisites: GEOL 201 or GEOE 221, and MATH 225, or permission of instructor. Note: Engineering majors must complete the equivalent of Calculus III before registration. Geohydrologic principles, applications, and design considerations concerning ground-water occurrence, flow, and quality. Ground-water and surface-water relations; theory of aquifer tests; flow nets; head distribution by graphical, analytical, and digital models; ground-water contamination. Laboratories include water budgets, chemistry of ground water, design of exploration programs and aquifer tests, computer solutions, and field trips to areas of geohydrologic interest. A design project with written and oral presentations is required. This course is cross-listed with ENVE 475/475L.

GEOE 482/482L APPLIED GEOMORPHOLOGY
(2-1) 3 credits. Prerequisites: GEOL 201 and GEOL 201L, or GEOE 221; GEOE 322. A systematic analysis of landform evolution with emphasis on process and terrain analysis. Topics include process-response in geomorphic systems and quantitative techniques used in engineering design applications. Laboratory consists of aerial photos, topographic map interpretation and the application of

geomorphology as an engineering tool. Field trips taken to regional areas of interest. Computer solutions in engineering analysis and a design project are required.

GEOE 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems, and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. May be repeated to a total of three (3) credit hours. Research findings are required.

GEOE 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A description of the work to be performed must be filed in the Geology/Geological Engineering Office.

GEOE 615 ADVANCED FIELD METHODS IN GROUND WATER
(0-3) 3 credits. Prerequisites: GEOE 475 or equivalent. Advanced instruction and independent work involving field techniques such as aquifer mapping, water quality sampling and interpretation, piezometer tests, and the design, conduct, and analysis of aquifer tests.

GEOE 626/626L ENVIRONMENTAL GEOPHYSICS
(2-1) 3 credits. The most frequently used geophysical techniques for the investigation of environmental problems are covered. These include electrical resistivity, electromagnetic surveys, shallow seismic refraction and reflection surveys, and ground-probing radar. The design and performance of field surveys is emphasized.

GEOE 641 GEOCHEMISTRY
(3-0) 3 credits. Geochemical principles, applications, and design considerations, including thermodynamics, kinetics, and transport phenomena. Applications in low-temperature aqueous systems, carbonate equilibria, geothermal and hydrothermal systems, petroleum generation, metamorphism, and igneous processes. Computer solutions to geochemical problems will be used. An engineering design project is required. This course is cross-listed with CHEM 641.

GEOE 661 PETROLEUM GEOLOGY
(3-0) 3 credits. Prerequisites: GEOE 322 and GEOL 331. Part 1. Worldwide occurrence, current and future demand, OPEC cartel and prices, and ethics of exploitation. Part 2. Petroleum source rocks and generation, migration, and entrapment. Geology of major oil-producing regions of world. Petroleum exploration methods.

GEOE 662 ANALYTICAL METHODS IN GROUND WATER
(3-0) 3 credits. Prerequisite: GEOE 475 or equivalent. Quantitative methods used to evaluate ground-water resources, including pumping tests as well as physical and computer methods.

GEOE 663/663L GROUND-WATER GEOCHEMISTRY
(2-1) 3 credits. Prerequisite: GEOE 475 or equivalent. A study of the natural chemistry of ground water and the effects of man's activities on ground-water quality. Laboratories include dispersion experiments and several field trips to areas of interest relating to ground-water geochemistry.

GEOE 664/664L ADVANCED GROUND WATER
(2-1) 3 credits. Prerequisites: GEOL 201 or GEOE 221 or equivalent. Basic hydrologic principles with emphasis on hydrologic and geologic interrelationships. Design problems of location, development, and conservation of ground water. Use of quantitative techniques for aquifer evaluation. Studies of ground-water contamination. Laboratories, field trips, and problem assignments require use of analytical methods.

GEOE 665 BIOREMEDIATION OF HAZARDOUS MATERIALS
(3-0) 3 credits. Main thrust of the course is to introduce various techniques (both in-situ and ex-situ) of bioremediation to the cleanup of hazardous wastes, such as petroleum, heavy metals, cyanide, nitrates, nuclear materials, etc. Fundamentals of bacterial metabolic behavior will be covered. The physiology of bacteria will be emphasized in terms of their physicochemical requirements, pH, etc. Mathematical models for bacterial growth versus material degradation and seeping will be presented. Focus will be on practical application of bioremediation in the field by means of biological and engineering approaches.

GEOE 667 FLUID FLOW IN POROUS MEDIA
(3-0) 3 credits. Prerequisites: MATH 321, EM 321, EM 327, CEE 346, or equivalents. Introduction to flow of fluids through porous media. Formulation of basic flow equations for incompressible, slightly compressible, and compressible fluid flow. One-

dimensional steady state flow. Two-dimensional steady state flow with single well or multi wells. Unsteady state flow problems.

GEOE 668 ENGINEERING GEOLOGY OF SURFICIAL DEPOSITS
(3-0) 3 credits. Review of weathering, soils, and Quaternary deposits. Emphasis on engineering design problems such as those found in highway construction, landfills, water supply, waste disposal, landslides, and land subsidence. Engineering geology of surficial deposits including alluvium, loess, clay, and glacial and periglacial deposits. Two field trips are required.

GEOE 682/682L FLUVIAL PROCESSES
(2-1) 3 credits. A systematic study of the evolution of drainage basins and stream systems. Emphasis is placed on basin morphometry, stream channel 'equilibrium', fluvial mechanics and resulting fluvial landforms. Laboratory consists of basin analysis, stream flow, sediment transport and at least two field trips to surrounding areas of interest.

GEOE 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory of field work, and preparation of papers, as agreed to in advance, by student and instructor. A description of the work to be performed must be filed in the Geology/Geological Engineering Office.

GEOE 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. A description of the work to be performed must be filed in the Geology/Geological Engineering Office.

GEOE 766/766L DIGITAL MODELING OF GROUND-WATER FLOW SYSTEMS
(2-1) 3 credits. Prerequisite: GEOE 475 or CEE 634, or equivalent. Practical applications of digital models as tools in the study of ground-water flow systems. Methods of simulating aquifer systems and solute transport will be used. Specific emphasis will be placed on the development, application, and limitations of finite-difference and finite-element computer models.

GEOE 790 SEMINAR
(1-0) 1 credit. May not be repeated for degree credit. Preparation, oral and/or written presentation, and group discussion of a research problem. The student is expected to present orally the results of his/her own research. This presentation normally will directly precede the final oral defense of the thesis.

GEOE 798 MASTER'S THESIS
Credit to be arranged; not to exceed 6 credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the M.S. thesis option. Supervised original or expository research culminating in an acceptable thesis. Oral defense of thesis and research findings are required.

GEOE 898 DISSERTATION
Credit to be arranged; not to exceed 30 credits toward fulfillment of Ph.D. degree requirements. Open only to doctoral candidates. Supervised original research investigation of a selected problem, with emphasis on independent work, culminating in an acceptable dissertation. Oral defense of dissertation and research findings are required.

GEOG 101 INTRODUCTION TO GEOGRAPHY
(3-0) 3 credits. The course presents a broad, introductory overview of geographic concepts, themes, and elements designed to help students better understand and analyze the world from a geographic perspective. It provides a background to earth's physical and human elements and systems. It also emphasizes the unique quality of world regions, and the spatial interaction of people, elements, and regions, as well as major global and regional problems and prospects.

GEOG 212 GEOGRAPHY OF NORTH AMERICA
(3-0) 3 credits. A regional and topical analysis of the geographic patterns of the United States and Canada. Focus is upon the interaction of groups of people with the natural environment to produce regional differentiation. Geographic aspects of the physical geography, population, culture groups, economy, settlement system, land division, and use of natural resources.

GEOG 240 WORLD REGIONAL GEOGRAPHY I - THE LESS DEVELOPED REGIONS
(3-0) 3 credits. This course surveys the developing regions of the world in the context of post-cold war economic and political change. Emphasis will be placed on the demography, natural resource use, and pace of modernization in East Asia, in particular the country of China, and on the rapidly industrializing countries of Southeast Asia. Other significant regions include South Asia, sub-Saharan Africa, and the Islamic realm of North Africa and Western Asia.

GEOG 250 WORLD REGIONAL GEOGRAPHY II - THE DEVELOPED REGIONS
(3-0) 3 credits. This course examines the developed regions of the world. The focus is on the changing economic and political relationship between these

regions-Europe and North America, in particular-and the developing regions of the world.

GEOG 400 CULTURAL GEOGRAPHY
(3-0) 3 credits. A detailed analysis of the concept of culture in a geographical context, including such applications as culture and nature, cultural growth and change, cultural universals, culture and economy, cultural relativity, cultural landscape, cultural region, and cultural conflict.

GEOL 103 INTRODUCTION TO BLACK HILLS GEOLOGY
(2-0) 2 credits. An introductory view of geological features unique to Black Hills, e.g., Devil's Tower, Harney Peak granite and pegmatites, gold deposits, caves, and fossils such as those of the Badlands. Also includes an introduction to the general principles used to study the evolution of the Earth.

GEOL 162 WATER RESOURCES OF THE BLACK HILLS
(2-0) 2 credits. A study of the basic concepts of hydrology with emphasis on precipitation, lakes, streams, and ground water in the Black Hills. The course will concentrate on data collection techniques such as stream gauging and pumping tests and on the use of hydrologic data for watershed, pollution, and management studies. Field trips will emphasize engineering projects such as dams, reservoirs, municipal water supplies, and monitoring well systems.

GEOL 201 PHYSICAL GEOLOGY
(3-0) 3 credits. Basic concepts in the study of the earth and its history. Brief introduction to the earth's place in the universe and solar system and the evolution, composition and structure of the earth. Introduction to minerals, and igneous, sedimentary and metamorphic rocks. Survey of geological processes acting at the surface of the earth such as wind, rivers, glaciers, ground water and the sea; introduction to internal processes regarding plate tectonics theory and growth of mountains. Societal implications of geological processes are emphasized throughout the course.   GEOL 201L should be taken concurrently.

GEOL 201L PHYSICAL GEOLOGY LABORATORY
(0-1) 1 credit. Prerequisite or corequisite: GEOL 201. Classification and identification of the important rocks and minerals. Interpretation of topographic and geologic maps. Field trips to view representative rock types of the Black Hills area.

GEOL 207 EARTH SYSTEM SCIENCE
(3-0) 3 credits. A non-technical interdisciplinary course for majors or non-majors. The goal is to introduce the major processes affecting global change in the interdisciplinary context. The course will include a brief introduction to Earth history, the evolution of life on earth, and the geologic record of past climate and environmental changes. The main emphasis of the course will be the interdependence of processes in the solid Earth, atmosphere, hydrosphere, and biosphere. Humans' role in influencing the course of global change will also be critically examined, along with various societal, political, and economic aspects of environmental change.

GEOL 212/212L MINERALOGY AND CRYSTALLOGRAPHY
(2-1) 3 credits. A study of morphological and geometrical crystallography followed by determinative mineralogy. The 32 crystal classes and about 120 minerals are studied in detail. Course includes a brief introduction to optical microscopy. Emphasis in the laboratory is directed toward descriptive and determinative mineralogy.

GEOL 235 GEOLOGY OF NATIONAL PARKS
(3-0) 3 credits. A survey of the U.S. National Park system to understand the geologic diversity and significance of the preserved natural and historic areas of the United States. Field trip to an area park is required.

GEOL 276 DINOSAURS
(3-0) 3 credits. An introduction to the study of dinosaurs with emphasis on their origin, diversification, ecology, and extinction.

GEOL 321 SEARCH FOR OUR PAST
(3-0) 3 credits. Prerequisite: GEOL 201 or GEOE 221. Study of the geologic history of North America. The formation and early history of the earth, the tectonic evolution of the continents, and the history of evolution of life are studied. Current scientific issues regarding tectonics and the biosphere are also discussed, such as evolutionary theory, the Gaia hypothesis, and biocomplexity.

GEOL 331/331L STRATIGRAPHY AND SEDIMENTATION
(2-1) 3 credits. Prerequisites: GEOL 201 and GEOL 201L or GEOE 221, or permission of instructor. The principles of correlation and sediment analysis are discussed. A background in sedimentary source materials, depositional environments, nomenclature and classification of stratigraphic units, and the interpretation of stratigraphic units will be presented. Emphasis is placed on modern depositional systems and their ancient counterparts. Laboratory exercises stress field trips to local sections, facies descriptions, rock analysis, and interpretation of an exploration prospect. This course is cross-listed with ENVE 331/331L.

GEOL 341/341L ELEMENTARY PETROLOGY
(2-1) 3 credits. Prerequisites: GEOL 201L or GEOE 221, and GEOL 212. Identification and classification of igneous, metamorphic, and sedimentary rocks in hand sample and thin section. Emphasis is on environments of formation as deduced from textures and structures. Lecture, laboratory, and field trips.

GEOL 351 EARTH RESOURCES AND THE ENVIRONMENT
(3-0) 3 credits. Prerequisites: GEOL 201, or permission of instructor. This course will examine the distribution, origin, use, and future of earth's energy, metallic, and non-metallic resources. Economic, political, sociological, and environmental implications of the resource industries will be emphasized. Resource issues of topical interest will be discussed.

GEOL 361 OCEANOGRAPHY I
(3-0) 3 credits. An introductory course in oceanography that focuses on ocean basins of the world, their composition and processes by which they formed. Other subjects to be examined include the "hot springs" of the deep oceans, patterns of sediment distribution, life in the oceans, the role of the oceans as an integral part of global climatic cycles including the "greenhouse effect."

GEOL 371 FIELD PALEONTOLOGY
(0-2) 2 credits. An introduction to the methods of prospecting, collecting, and documenting fossils for exhibition and research. Field trips will be made to the productive fossil sites in western South Dakota and elsewhere. This course can only be taken twice to fulfill graduation requirements.

GEOL 403/503 REGIONAL FIELD GEOLOGY
(0-1) 1 credit. Prerequisites: GEOL 201 or GEOE 211. A one-week guided field trip to an area of outstanding geological interest in a global context. Students enrolled in GEOL 503 will be held to a higher standard than those enrolled in GEOL 403.

GEOL 407/507 GEOLOGY OF THE BLACK HILLS
(0-2) 2 credits. Prerequisites: Junior or senior standing or permission of instructor. A field course which entails inspection of major rock types and structures in the Black Hills area. Daily field trips in the Black Hills and Badlands. Major geologic and scenic features such as Mt. Rushmore, the Needles, Devil's Tower, the Homestake Gold Mine's open cut, pegmatite mines, Spearfish Canyon, the Hot Springs Mammoth Site, and many others will be visited and studied. The cause, composition, unique features, economic potential, the possible alteration of land forms will be emphasized to gain an understanding of how exposed rock forms originated and changed. Taught in the Black Hills Natural Sciences Field Station. Students enrolled in GEOL 507 will be held to a higher standard than those enrolled in GEOL 407.

GEOL 410 FIELD GEOLOGY
(0-6) 6 credits. Prerequisites: Completion of junior year studies. This five-week course focuses on the instruction and practice in the use of surveying instruments and aerial photographs for the purpose of completing large and intermediate-scale geologic maps, structure sections, and structure contour maps of Precambrian metasediments, Phanerozoic sedimentary rocks, and Tertiary intrusions within designated areas of the Black Hills region. A written geologic report will accompany the maps and sections conducted for five (5) weeks during the summer in the northern Black Hills. Field equipment will be furnished by the department. Arrangements for transportation, room, and board are made through the Black Hills Natural Sciences Field Station.

GEOL 413/413L/513/513L ORE MICROSCOPY
(1-2) 3 credits. Prerequisite: GEOE 451. Polished surfaces of ores and rocks are examined in reflected light to identify opaque minerals, study textures and their interpretation, and determine paragenesis. Additional techniques of ore mineral identification such as micro-hardness determination, reflectivity measurements, SEM, and electron microprobe will be covered. There will be a project involving preparation and description of polished sections, and their interpretation. Students enrolled in GEOL 513 will be held to a higher standard than those enrolled in GEOL 413.

GEOL 416/416L/516/516L GIS I: INTRODUCTION TO GIS
(2-1) 3 credits. Introduction to principles and application of geographic information systems, with emphasis on GIS analysis techniques. Laboratory work will involve introduction to PC-based GIS software, and data sets. A semester project and presentation is required. Students are expected to have basic computer system, word processing, and spreadsheet skills prior to taking this class. Students enrolled in GEOL 516 will be held to a higher standard than those enrolled in GEOL 416.

GEOL 417/517 GIS II: SPATIAL DATABASE DEVELOPMENT
(3-0) 3 credits. Prerequisite: GEOL 416 or GEOL 516 or permission of instructor. Building on basic principles of Geographic Information Systems developed in GEOL 416, this course launches students into developing GIS databases for research projects in geology, engineering, or environmental science. Students learn to compile and analyze spatial data with ArcGIS, the most utilized GIS software in science, government, and industry. Assignments include hands-on practice downloading,

processing, editing, scanning and digitizing data. The class also includes an extensive introduction to the software documentation to build independent learning and problem-solving ability. Students are expected to complete a semester GIS project that relates to their own research interests. Students are expected to complete a semester GIS project that relates to their own research interests. Students enrolled in GEOL 517 will be held to a higher standard than those enrolled in GEOL 417.

GEOL 419/519 GIS III: ADVANCED GIS ANALYSIS
(3-0) 3 credits. Prerequisites: GEOL 416 or GEOL 516 or permission of instructor. This course will introduce those already familiar with Arcview and Arc/Info GIS systems to advanced spatial analysis techniques. Specific topics may change from year to year depending on student interests, and may include advanced vector and raster analysis, 3-D surface modeling, GIS programming with AML and Avenue, and network modeling. Students will complete one or more real-life GIS projects and may be required to work individually or on small research teams. Students enrolled in GEOL 519 will be held to a higher standard than those enrolled in GEOL 419. May be repeated once for additional credit.

GEOL 442/442L/542/542L OPTICAL PETROLOGY
(0-2) 3 credits. Prerequisites: GEOL 341. The study of igneous, sedimentary, and metamorphic rocks and ore samples in thin and polished section, with emphasis on their identification, classification, and genesis. Students enrolled in GEOL 542 will be held to a higher standard than those enrolled in GEOL 442.

GEOL 461/461L INVERTEBRATE PALEONTOLOGY
(2-1) 3 credits. A systematic study of the structure and classification of selected invertebrate taxa. The course will provide a useful tool for field and laboratory work involving fossil-bearing rocks and will form a background for advanced work in paleontology or paleontological stratigraphy.

GEOL 464 SENIOR RESEARCH I
(1-0) 1 credit. Prerequisite: GEOL 410. A study of scientific research methodology with emphasis on identifying research problems and formulating a methodology to address a specific research question. Students will identify a topic of study chosen with the advise and approval of an instructor, and develop a proposal for their senior research project.

GEOL 465 SENIOR RESEARCH II
(3-0) 3 credits. Prerequisite: GEOL 464. The student undertakes a field and/or laboratory study of a topic chosen with the advice and approval of an instructor. This work is the basis for a thesis written in a standard format.

GEOL 472/472L/572/572L MUSEUM CONSERVATION AND CURATION
(2-1) 3 credits. Ethics, theories, and methodology behind conservation and curation in natural history museums. Laboratory covers conservation techniques and curation training in systematically organizing a collection, in addition to training in computer database collection management systems. Students enrolled in GEOL 572 will be held t principles of hydrothermal ore deposits, and techniques used to study hydrothermal ore deposits. Modern theories on metallic ore deposition will be applied to the critical study of major classes of metallic ore deposits.

GEOL 473/473L/573/573L MUSEUM PREPARATION TECHNIQUES AND EXHIBIT DESIGN
(1-2) 3 credits. Techniques in vertebrate fossil preparation and museum exhibit design will be the focus in this course. Students will be required to prepare fossils and design an exhibit for actual display in the Museum or other designated locations. Proposal writing is another important facet of this course and will provide the background needed to those that pursue a museum career. Students enrolled in GEOL 573 will be held to a higher standard than those enrolled in GEOL 473.

GEOL 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. May be repeated to a total of three (3) credit hours.

GEOL 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

GEOL 585 GLACIAL AND PLEISTOCENE GEOLOGY
(3-0) 3 credits. A systematic study of glacial geology and related geologic and climatologic effects during the Pleistocene Epoch. Focus is on glacial mechanics and sedimentary deposits of both continental and alpine settings. An extended field

trip to a nearby glaciated region will acquaint the student with glacial settings and resulting landforms. Laboratory work consists of analysis of aerial photos and topographic maps that illustrate glacial principles.

GEOL 604 ADVANCED FIELD GEOLOGY
(0-3) 3 credits. Prerequisite: GEOL 410. Field techniques and related laboratory methods of investigation in moderately complicated geologic environments. Includes data collection, presentation, and interpretation. Laboratory work involving aerial photographs, drilling projects, and miscellaneous work may be introduced during inclement weather in December.

GEOL 621/621L ADVANCED STRUCTURAL GEOLOGY
(2-1) 3 credits. Prerequisite: GEOE 322 or permission of instructor. Examination of selected geologic terrains such as fold-thrust belts, Laramide foreland uplifts and basins, wrench and rift systems, etc., concentrating on geometric styles, sequential and mechanical development and regional models. Includes selected readings and laboratory examinations of maps regarding the various types of terrains.

GEOL 622 GEOTECTONICS
(3-0) 3 credits. The course examines development of regional and world-wide structures of the earth in regard to plate tectonic processes and current thought regarding concepts of sea-floor spreading, continental drift, paleomagnetism, origin of continents, ocean basins, and mountain building.

GEOL 623/623L REGIONAL TECTONICS
(2-1) 3 credits. Prerequisite: GEOE 322. Detailed study by the student of a region, preferably in the U.S., in order to synthesize existing maps and reports into a tectonic map. Analysis of structures and litho-tectonic rock packages leads to a final report outlining structural development of the region. Lectures detail techniques of synthesis, analysis and report preparation.

GEOL 631 ROCKY MOUNTAIN STRATIGRAPHY I
GEOL 632 ROCKY MOUNTAIN STRATIGRAPHY II
(3-0) 3 credits each. Prerequisite: Senior or graduate standing in geology or geological engineering. Stratigraphic sequences in the Rocky Mountain area are studied with emphasis on the paleoenvironmental and tectonic conditions under which the strata were deposited. First semester considers Paleozoic strata; the second semester considers Mesozoic and Cenozoic rocks.

GEOL 633/633L SEDIMENTATION
(2-1) 3 credits. Sedimentary process-response models are studied. The procedures for classification and description of sedimentary rocks are reviewed. Numerous field trips to localities illustrating a variety of sedimentary facies are conducted. Laboratory determinations are made of such parameters of sedimentary particles as size, shape, and degree of roundness, mineralogy, and chemical composition. An analysis is made of field and laboratory data by graphical and statistical methods and a geological interpretation is made of the results. Natural resources associated with various facies are emphasized.

GEOL 643/643L INTRO TO MICROBEAM INSTRUMENTS
(2-1) 3 credits. An introduction to electron optics, electron-beam - specimen interactions, and qualitative and quantitative x-ray microanalysis in the scanning electron microscope and electron microprobe. One three (3)-hour laboratory demonstration per week.

GEOL 644/644L PETROLOGY OF THE IGNEOUS ROCKS
(2-1) 3 credits. Prerequisite: GEOL 341. Discussion of partial melting in mantle and crustal source regions, transport, fractionation and final emplacement. Heavy emphasis will be placed on phase diagrams, equilibria, and geochemistry of igneous rocks from the standpoint of constraining evolutionary models. Basaltic and granitic systems will be emphasized. Problems involving the use of the petrographic microscope will be assigned and several field trips are planned.

GEOL 650 SEMINAR IN ORE DEPOSITS
1 to 3 credits. Prerequisite: GEOE 451 or permission of instructor. Studies by a group of advanced students, under the guidance of one or more selected instructors, of topics of special and current interest to the group. Involves a combination of lectures, papers, readings, oral and/or written presentations, and discussions. Course focuses on different themes in ore deposits, and varies each time offered. Themes that will be offered include such topics as the geology of gold deposits, uranium deposits, porphyry copper deposits, volcanogenic massive sulfides, and sediment-hosted metal deposits. Emphasis is placed on gaining an in-depth knowledge on the controls of localization of a specific class of mineral deposits.

GEOL 652 PROBLEMS IN ORE DEPOSITS
(3-0) 3 credits. Prerequisite: GEOE 451 or permission of instructor. Emphasis is placed on the principles of hydrothermal ore deposits, and techniques used to study hydrothermal ore deposits. Modern theories on metallic ore deposition will be

applied to the critical study of major classes of metallic ore deposits.

GEOL 672/672L MICROPALEONTOLOGY
(2-1) 3 credits. A study of the morphology, ecology, and stratigraphic significance of selected groups of protozoans and invertebrate and plant microfossils with special emphasis on Foraminifera and conodonts. This course is cross-listed with PALE 672/672L.

GEOL 673/673L COMPARATIVE OSTEOLOGY
(2-1) 3 credits. A comparison of recent and fossil vertebrate skeletons and dentitions with emphasis on the skeletons and teeth of sharks, bony fish, salamanders, frogs, turtles, alligators, lizards, birds, and mammals to establish a thorough understanding of diversity of the form and function of the vertebrate skeleton. A major objective is the identification of vertebrates based on osteology and odontology. This course is cross-listed with PALE 673/673L.

GEOL 674/674L STRATIGRAPHIC PALEONTOLOGY OF THE CONTINENTAL MESOZOIC AND PALEOGENE
(2-1) 3 credits. Prerequisite: GEOL/PALE 676. The stratigraphic section of the Mesozoic and Paleogene vertebrate-bearing formations of North America is reviewed. Evolution of mammalian faunas and the succession of land-mammal ages is coordinated with this section. Extensive use is made of the published literature and the Museum of Geology collections. This course is cross-listed with PALE 674/674L.

GEOL 675/675L STRATIGRAPHIC PALEONTOLOGY OF THE CONTINENTAL NEOGENE
(2-1) 3 credits.. The stratigraphic section of the Neogene vertebrate bearing formations of North America is reviewed. Evolution of mammalian faunas and the succession of land-mammal ages is coordinated with this section. Extensive use is made of the published literature and the Museum of Geology collections. This course is cross-listed with PALE 675/675L.

GEOL 676/676L VERTEBRATE PALEONTOLOGY
(3-1) 4 credits. An in-depth assessment of the fossil record of vertebrates with special emphasis on current problems in the evolution of vertebrates and the tangible record preserved in the collections of the Museum of Geology. This course is cross-listed with PALE 676/676L.

GEOL 678/678L VERTEBRATE BIOSTRATIGRAPHY
(3-1) 4 credits. Prerequisite: GEOL/PALE 676. The principles and practices for establishing the distribution of vertebrate fossils in the rock record. This course will include a brief history of biostratigraphy, methodology, and the content and assessment of vertebrate ages, particularly of Mesozoic and Cenozoic mammals. This course is cross-listed with PALE 678/678L.

GEOL 684/684L PALEOENVIRONMENTS
(2-1) 3 credits. This course will integrate topics from paleobotany, vertebrate paleontology, and paleoclimatology in a study of paleontological communities through time. Laboratories will include studies of fossil materials. Note: This course is to be offered both through Black Hills State University and South Dakota School of Mines and Technology. This course is cross-listed with PALE 684/684L.

GEOL 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor. A description of the work to be performed must be filed in the department office. This course is cross-listed with PALE 691.

GEOL 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. A description of the work to be performed must be filed in the Geology/Geological Engineering Office. This course is cross-listed with PALE 692.

GEOL 770 SEMINAR IN VERTEBRATE PALEONTOLOGY
(2-0) 2 credits. Studies by a group of advanced students, under the guidance of one or more selected instructors, on topics of special and current interest to the group. Involves a combination of lectures and discussions. Review of current literature in vertebrate paleontology of special topics and/or analysis of new procedures and techniques. Emphasis will be on mammalian paleontology. This course is cross-listed with PALE 770.

GEOL 790 SEMINAR
(1-0) 1 credit. May not be repeated for degree credit. Preparation, oral and/or written presentation, and group discussion of a research problem. The student is expected to present orally the results of his/her own research. This presentation normally will directly precede the final oral defense of the thesis. This course is cross-listed with PALE 790.

GEOL 798 MASTER'S THESIS
Credit to be arranged; not to exceed six (6) credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the M.S. thesis

option. Supervised original or expository research culminating in an acceptable thesis. Oral defense of thesis and research findings are required. This course is cross-listed with PALE 798.

GEOL 808 FUNDAMENTAL PROBLEMS IN ENGINEERING AND SCIENCE
(3-0) 3 credits. The course, available only for doctoral candidates, involves description, analysis, and proposed methods of attack of long-standing, fundamental problems in science and engineering. Independent work is emphasized with goals of understanding these basic questions and proposing practical designs and experiments for the solution. This course is cross-listed with AES 808.

GEOL 898 DISSERTATION
Credit to be arranged; not to exceed 30 credits towards fulfillment of Ph.D. degree requirements. Open only to doctoral candidates. Supervised original research investigation of a selected problem, with emphasis on independent work, culminating in an acceptable dissertation. Oral defense of dissertation and research findings are required.

GER 101 INTRODUCTORY GERMAN I
GER 102 INTRODUCTORY GERMAN II
(4-0) 4 credits each. Becoming sensitized to authentic listening, speaking, reading, writing and culture skills at the elementary level. Introduction to basic functional grammar and sentence structure. GER 102-Prerequisite: GER 101 or permission of instructor. Continued emphasis on authentic listening, speaking, reading, writing, and culture skills at the elementary level.

GES 115/115L PROFESSIONALISM IN ENGINEERING AND SCIENCE
(1-1) 2 credit. Prerequisite: MATH 102. This course is designed to give students the opportunity to learn how to solve engineering and science design problems as they are practiced in industry. Students will be exposed to professional development in the form of team building, technology tools, and project management. In addition, students will have the opportunity to learn from professional engineers and scientists through interaction with industry.

HIST 121 WESTERN CIVILIZATION I
(3-0) 3 credits. Surveys the evolution of western civilization from its beginnings into the Reformation and religious wars.

HIST 122 WESTERN CIVILIZATION II
(3-0) 3 credits. Surveys the development of western civilization from the Reformation era to the present.

HIST 151 UNITED STATES HISTORY I
(3-0) 3 credits. Surveys the background and development of the United States from its colonial origins to the Civil War and Reconstruction.

HIST 152 UNITED STATES HISTORY II
(3-0) 3 credits. Surveys development of the United States since the Civil War and Reconstruction.

HIST 492 TOPICS
1 to 4 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. May be repeated once for credit when the topic is different and with permission of department chair.

HUM 100 INTRODUCTION TO HUMANITIES
(3-0) 3 credits. This interdisciplinary course introduces students to humanistic knowledge, inquiry, and values by focusing on connections among humanities disciplines (such as art, languages, literature, music, philosophy, and religion).

HUM 200 CONNECTIONS: HUMANITIES AND TECHNOLOGY
(3-0) 3 credits. A thematic approach to human values stressing the relationship between technology and the humanities; traces the development and social impact of our major technologies.

HUM 291 INDEPENDENT STUDY
1 to 4 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

HUM 292 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six (6) credits of special topics will be allowed for degree credit.

HUM 300 MATERIALS AND CIVILIZATION
(3-0) 3 credits. Prerequisite: Junior or senior standing. Details the development of civilization with the advancement of new materials, including the role of metals and advanced materials in the larger cultural context.

Courses

HUM 350 AMERICAN SOCIAL HISTORY
(3-0) 3 credits. Prerequisite: Junior or senior standing. A study of the lives, customs, and beliefs of ordinary Americans, using fiction and nonfiction from various periods.

HUM 375 COMPUTERS IN SOCIETY
(3-0) 3 credits. Prerequisite: Junior or senior standing. Examines the social impact of computers with emphasis on the development of the computer establishment, the cultural blueprint being shaped for the future, and the question of values and social responsibility in personal, business, and governmental sectors.

HUM 410 CONTEMPORARY IDEAS
(3-0) 3 credits. Prerequisite: Junior or senior standing. Interdisciplinary study of contemporary human values related to culture and society.

HUM 491 INDEPENDENT STUDY
1 to 4 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

HUM 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six (6) credits of special topics will be allowed for degree credit.

IENG 301 BASIC ENGINEERING ECONOMICS
(2-0) 2 credits. Junior or higher standing preferred. Introduces the concepts of economic evaluation regarding capital investments, including the time value of money and income tax effects. Graduation credit cannot be given for both IENG 301 and IENG 302.

IENG 302 ENGINEERING ECONOMICS
(3-0) 3 credits. Junior or higher standing preferred. Studies economic decision making regarding capital investment alternatives. Covers compound interest and depreciation models, replacement and procurement models. Analysis is made variously assuming certainty, risk and uncertainty. Graduation credit cannot be given for both IENG 301 and IENG 302.

IENG 311/311L WORK METHODS AND MEASUREMENT
(2-1) 3 credits. Corequisite: IENG/MATH 381. This course presents the underlying theory and basic methodology for work methods and measurement techniques. Emphasis is placed on knowledge of the basis for selection of a technique appropriate for the individual as related to the task to be performed.

IENG 321/321L ERGONOMICS/HUMAN FACTORS ENGINEERING
(2-1) 3 credits. Prerequisite: PSYC 101. Corequisite: MATH 281 or higher statistics. Topics covered include: Engineering anthropometry methods, workplace design, electrophysiologic models and measurement, biomechanical modeling, work kinesiology, and hand-tool evaluation.

IENG 331 SAFETY ENGINEERING
(3-0) 3 credits. Prerequisite: Junior or senior standing. Overview to the field of Safety Engineering emphasizing quantitative problem solving. Will draw on fundamental knowledge from the fields of chemistry, physics, mechanics, mathematics, and statistics. Contents: fundamental concepts and terminology, injury and accident statistics, ethics, certification, regulations, standards, hazards and their control, and management aspects.

IENG 341 INDUSTRIAL HYGIENE
(3-0) 3 credits. Prerequisites: CHEM 112/112L, MATH 281 or higher statistics course. Overview of the field of industrial hygiene. Examines the identification, evaluation, and control of occupational health hazards in the workplace that can cause illness among workers or citizens of the surrounding community with routes of entry through the lungs, skin, ears, and eyes. Specific hazard classifications of chemical, physical, and biological origin will be addressed.

IENG 345 ENTREPRENEURSHIP
(4-0) 4 credits. Prerequisites: ACCT 211 and IENG 301 or IENG 302 or permission of instructor. Covers topics on the legal aspects, management skills, business plans, and sources of capital as well as case studies of successful and unsuccessful entrepreneurial initiatives. This course is cross-listed with BADM 345.

IENG 362 STOCHASTIC MODELS
(3-0) 3 credits. Prerequisite: IENG/MATH 381 or permission of instructor. This course covers stochastic models in operations research and is a complementary course to MATH 353. Topics include queueing theory, Markov chains, Pert/CPM, decision theory, dynamic programming and inventory control models.

IENG 366 MANAGEMENT PROCESSES
(3-0) 3 credits. Junior or senior standing preferred. A survey course designed to acquaint the student with formation and operation of business and industrial enterprises. Management and decision making are explored through analysis of the functions of principal staff and line departments.

IENG 375 ETHICS AND PROFESSIONALISM FOR ENGINEERS AND SCIENTISTS
(3-0) 3 credits. Prerequisite: Junior standing or higher preferred. This course will introduce students to many of the professional and ethical issues they will encounter over the course of their career. Professionalism topics include: networking, business etiquette, and professional dress. Ethics topics include: harassment, necessary disclosure, and the Whistle Blower Act.

IENG 381 INTRO TO PROB AND STAT
(3-0) 3 credits. Prerequisite: MATH 125 and prerequisite or corequisite: MATH 225. Introduction to probability, discrete and continuous distributions, sampling distributions, central limit theorem, and general principles for statistical inference. This course is cross-listed with MATH 381.

IENG 382 PROBABILITY THEORY AND STATISTICS II
(3-0) 3 credits. Prerequisite: IENG 381. Review of general principles for statistical inference, linear regression and correlation, multiple linear regression, ANOVA, and statistical design of experiments. This course is cross-listed with MATH 382.

IENG 425 PRODUCTION AND OPERATION
(3-0) 3 credits. Prerequisites: MATH 123; IENG/MATH 381 or BADM 221. Management of the production environment. Topics such as bills of materials, inventory control, production control, production scheduling and MRP will be discussed. The impact of production management on the design process and how products can be designed for better manufacture.

IENG 441 SIMULATION
(3-0) 3 credits. Prerequisite: IENG 381 or MATH 441. Development of computer simulation models of real or conceptual systems. Interpretation of results of computer simulation experiments.

IENG 451/451L OPERATIONAL STRATEGIES
(2-1) 3 credits. Corequisite: IENG 311. Review of philosophies, systems, and practices utilized by world-class organizations to meet current operational challenges. Focuses include “lean production” in the manufacturing industries, including material flow, plant-floor quality assurance, job design, work and management practices as well as the most effective practices in the service industries. Students complete lab projects and tour organizations to analyze the extent and potential of the philosophies.

IENG 452 INTRODUCTION TO SIX SIGMA
(1-0) 1 credit. This course introduces students to the philosophy of Six Sigma. Topics include the history of Six Sigma and the Six Sigma problem solving methodology.

IENG 460 INDUSTRIAL INFORMATION SYSTEMS AND DATA PROCESSING
(3-0) 3 credits. Prerequisite: IENG 381 concurrent, some programming experience, and junior or senior standing. Role of information systems in supporting industrial operations such as manufacturing, personnel, resource allocation, scheduling, and forecasting. Data acquisition, organization, manipulation, and use of various data storage media. Human factors in the design of information systems.

IENG 461 SIX SIGMA GREENBELT EXAM
(1-0) 1 credit. This self-paced, pass/fail course culminates in a written exam. Passing this exam is necessary component of the Six Sigma Greenbelt Certification.

IENG 463 SIX SIGMA GREENBELT PROJECT
(1-0) 1 credit. Taken in conjunction with another course requiring a project, students in this course will use the Six Sigma problem solving philosophy in the completion of the project. Students will then document how they use the Six Sigma process and the results of the project in a written report.

IENG 464 SENIOR DESIGN PROJECT I
(0-3) 3 credits. Prerequisite: Senior standing or graduation within three (3) semesters. Small groups of students work on original design projects. Topics are solicited from local companies, hospitals, banks, mines, government agencies, thus providing students the opportunity to apply their knowledge and techniques to real problems in business and industry.

IENG 465 SENIOR DESIGN PROJECT II
(0-3) 3 credits. Continuation of IENG 464. Small groups of students work on original design projects. Topics are solicited from local companies, hospitals, banks, mines, government agencies, thus providing students the opportunity to apply their knowledge and techniques to real problems in business and industry. As applicable, these are continuation projects started in IENG 464.

IENG 471 FACILITIES PLANNING
(3-0) 3 credits. Prerequisite: Senior standing or graduation within three (3) semesters. Topics covered include: material handling, computerized layout planning, storage facilities, flexible manufacturing systems, and “Factory of the Future.”

IENG 475/475L COMPUTER-CONTROLLED MANUFACTURING SYSTEMS AND ROBOTICS
(2-1) 3 credits. Prerequisite: Senior standing or permission of instructor. Fundamental concepts of using computers in the design of a computer integrated, discrete-item, manufacturing facility are covered. Basic ideas of Computer Aided Design (CAD), Group Technology (GT), process planning, integrated production control and computer numerical control are covered. The manufacturability issues and concepts of selecting and using robots in the workplace are explored.

IENG 486 STATISTICAL QUALITY AND PROCESS CONTROL
(3-0) 3 credits. Prerequisites: IENG 381 or MATH 441 or permission of instructor. This course covers the development of statistical methods for application to problems in quality and process control. Statistical topics include: basics of processes and variability, statistically controlled processes, variable and attribute control charts, moving averages, individual trend and others, process capability, sampling plans for attributes and variables. This course is cross-listed with MATH 486.

IENG 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

IENG 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

IS 191 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. This course can not be counted for social science/humanities credit.

IS 192 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six credits will be allowed for degree credit. This course can not be counted for social science/humanities credit.

IS 201 INTRODUCTION TO SCIENCE, TECHNOLOGY, AND SOCIETY
(3-0) 3 credits. Prerequisites: ENGL 101 and sophomore standing. Prerequisite or corequisite: GES 115. Includes study of current issues within the IS specializations. Introduces students to how science and technology affect individual, societal, and global change (e.g., how science and technology influence ethical choices, the political and economic systems, and the relationship between humans and the natural world.) Required for all students seeking a B.S. in Interdisciplinary Sciences.

IS 270 FIELD EXPERIENCES IN INTERDISCIPLINARY STUDIES
(1-0) 1 credit. This course affords students an opportunity to pursue demonstrations, projects, experiments, or presentations for community outreach in schools and organizations. Outreach can include volunteer efforts through outreach programs provided the project documentation and reporting requirements are met. This course can not be counted for social science/humanities credit.

IS 291 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems, and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. This course can not be counted for social science/humanities credit.

IS 292 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six credits will be allowed for degree credit. This course can not count for social science/humanities credit.

IS 301 WRITING AND RESEARCH IN THE INTERDISCIPLINARY SCIENCES
(3-0) 3 credits. Prerequisites: IS 201, ENGL 289, and junior standing. Advanced writing in the interdisciplinary sciences with emphasis on research and explanation of science topics in the IS specializations. This course provides students with a basic understanding of the various styles of science writing, including writing for popular and professional audiences, and the use of library and/or laboratory research in formal research papers. This course is required for all students pursing the B.S. degree in Interdisciplinary Sciences.

IS 370 APPLICATIONS OF RESEARCH METHODS USING COMPUTER SYSTEMS
(1-0) 1 credit. Prerequisite: CSC 210 or permission of instructor. Course on advanced research methods, which involves analyzing electronic database systems and preparing research based on those systems. Resources to be utilized include the Internet, CD-ROM products, and/or private bulletin board systems. Methods of study include guest lectures, field trips to Internet providers, topical discussion of issues, and a major research project involving accessing, retrieving, and evaluating information. This course can not be counted for social science/humanities credit.

IS 380 INTERNSHIP IN INTERDISCIPLINARY STUDIES
1 to 4 credits. Prerequisite: Permission of Instructor. The opportunity for a student to complete a plan for an internship and thereby acquire practical job-related experience. A maximum of six credits will be allowed for degree credit. This course can not be counted for social science/humanities credit.

IS 391 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. This course can not be counted for social science/humanities credit.

IS 392 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six credits will be allowed for degree credit. This course can not be counted for social science/humanities credit.

IS 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. This course can not be counted for social science/humanities credit.

IS 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six credits will be allowed for degree credit. This course can not be counted for social science/humanities credit.

IS 498 UNDERGRADUATE RESEARCH/SCHOLARSHIP
(3-0) 3 credits. Prerequisite: Senior standing, permission of instructor, an approved Letter of Intent on file in the IS Office and successful completion of IS 301. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical. This course is required for all students pursuing the B.S. degree in Interdisciplinary Sciences.

IS 691 INDEPENDENT STUDY
.5 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor. This course can not be counted for social science/humanities credit.

IS 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. This course can not be counted for social science/humanities credit.

LAKL 101 LAKOTA LANGUAGE I
(4-0) 4 credits. An introduction to the Lakota language with emphasis on basic conversation, language structure, and vocabulary.

Courses

LAKL 102 LAKOTA LANGUAGE II
(4-0) 4 credits. Prerequisite: LAKL 101 or permission of instructor.   A continued introduction to the Lakota language with emphasis on basic conversation, language structure, and vocabulary.

LAW 457 THE LEGAL SYSTEM: BUSINESS AND PROFESSIONAL APPLICATIONS
(3-0) 3 credits. Prerequisite: Junior or senior standing, or permission of instructor. A survey of branches of law directly bearing upon the engineering profession, including definition and objectives of law; torts; contracts; employer-employee relations, agency, and collective bargaining; partnerships and corporations; and the engineer's professional responsibility and liability.

MATH 021 BASIC ALGEBRA
(3-0) 3 credits. Prerequisite: Appropriate mathematics placement.   This course prepares students for college level mathematics. Topics generally include: basic properties of real numbers, exponents and radicals, rectangular coordinate geometry, solutions to linear and quadratic equations, inequalities, polynomials and factoring. Students may also be introduced to functions and systems of equations. Note: This is remedial level course and no credit for MATH 021 will be granted for graduation.

MATH 101 INTERMEDIATE ALGEBRA
(3-0) 3 credits. Prerequisite: MATH 021 or appropriate mathematics placement. Basic properties of real numbers, linear equations and inequalities, quadratic equations, systems of equations, polynomials and factoring, rational expressions and equations, and radical expressions and equations, and an introduction to functions such as polynomial, exponential and logarithmic functions. May not be used for credit toward a baccalaureate degree, but may be used toward the associate degree.

MATH 102/102L COLLEGE ALGEBRA
(3-1) 4 credits. Prerequisite: MATH 101 or appropriate mathematics placement. Corequisite: MATH 102L. Equations and inequalities; polynomial functions and graphs; exponents, radicals, binomial theorem, zeros of polynomials; systems of equations; exponential, logarithmic, and inverse functions, applications and graphs. Other topics selected from sequences, series, and complex numbers. This course may not be used for credit toward an engineering or science degree (except for Interdisciplinary Science, Chemistry, and Associate of Arts).

MATH 115 PRECALCULUS
(5-0) 5 credits. Prerequisite: MATH 101 or appropriate mathematics placement.   A preparatory course for the calculus sequence. Topics include: polynomial, rational, exponential, logarithmic and trigonometric functions and their graphs; systems of equations, inequalities and complex numbers. May not be used for credit toward an engineering or science degree (except for Interdisciplinary Science, Chemistry, and Associate of Arts).

MATH 120 TRIGONOMETRY
(3-0) 3 credits. Prerequisite: MATH 102 "C" or better, or an acceptable score on the COMPASS Placement Examination. Topics include: trigonometric functions, equations, and identities; inverse trigonometric functions; exponential and logarithmic functions, and applications of these functions. This course may not be used for credit toward an engineering or science degree (except for Interdisciplinary Science, Chemistry, and Associate of Arts).

MATH 123 CALCULUS I
(4-0) 4 credits.   Prerequisite: MATH 115 with a minimum grade of "C" or appropriate mathematics placement or permission of instructor. Students who are initially placed into MATH 102 or below must complete MATH 102 and MATH 120 with grades of "C" or better before enrolling in MATH 123. Students who are placed in MATH 120 should consult their advisor to determine whether their placement score was sufficiently high to allow concurrent registration in MATH 123. The study of limits, continuity, derivatives, applications of the derivative, antiderivatives, the definite and indefinite integral, and the fundamental theorem of calculus.

MATH 125 CALCULUS II
(4-0) 4 credits. Prerequisite: MATH 120 completed with a minimum grade of "C" or appropriate score on departmental Trigonometry Placement Examination and MATH 123 completed with a minimum grade of "C." A continuation of the study of calculus, including the study of sequences, series, polar coordinates, parametric equations, techniques of integration, applications of integration, indeterminate forms, and improper integrals.

MATH 140 THE NATURE OF MATHEMATICS
(3-0) 3 credits. Prerequisites: MATH 102 (College Algebra) or MATH 115 completed with a "C" or better or an acceptable score on the Algebra Placement Examination, and ENGL 101. The intent of this course is to give the student an appreciation for the mathematical approach to problem solving and an overall perspective of the role of mathematics in the history of technology and society. Major themes in mathematics are explored from several points of view: the mathematics involved, the historical development of ideas, and the utilization of these ideas in other fields of endeavor.

MATH 225 CALCULUS III
(4-0) 4 credits. Prerequisite: MATH 125 completed with a minimum grade of "C." A continuation of the study of calculus, including an introduction to vectors, vector calculus, partial derivatives, and multiple integrals.

MATH 241 MATHEMATICS OF FINANCE
(3-0) 3 credits. Prerequisites: MATH 102 or permission of instructor. Topics include simple and compound interest including annuities, amortization, sinking funds, valuation of bonds, depreciation and capitalized cost.

MATH 281 INTRODUCTION TO STATISTICS
(3-0) 3 credits. Prerequisite: MATH 102 or MATH 115. A study of descriptive statistics including graphs, measures of central tendency and variability and an introduction to probability theory, sampling and techniques of statistical inference with an emphasis on statistical applications.

MATH 291 INDEPENDENT STUDY
1 to 5 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. May be repeated to a total of five (5) credit hours.

MATH 292 TOPICS
1 to 5 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. May be repeated to a total of five (5) credit hours.

MATH 315 LINEAR ALGEBRA
(4-0) 4 credits. Prerequisite: MATH 225 and MATH 321 or permission of instructor. Course topics include: the theory and applications of systems of linear equations, matrices, determinants, vector spaces, linear transformations and applications.

MATH 321 DIFFERENTIAL EQUATIONS
(4-0) 4 credits. Prerequisite: MATH 125 with a minimum grade of "C." Selected topics from ordinary differential equations including development and applications of first order, higher order linear and systems of linear equations, general solutions and solutions to initial-value problems using matrices. Additional topics may include Laplace transforms and power series solutions. MATH 225 and 321 may be taken concurrently or in either order. In addition to analytical methods this course will also provide an introduction to numerical solution techniques.

MATH 353 LINEAR OPTIMIZATION
(3-0) 3 credits. Prerequisites: MATH 321 or MATH 315 or permission of instructor. Convex sets and functions, linear inequalities and combinatorial problems; topics in linear programming from fundamental theorems of simplex method through sensitivity analysis, duality, transportation, and assignment problems.

MATH 354 NON-LINEAR OPTIMIZATION
(3-0) 3 credits. Prerequisite: MATH 225. Numerical methods for constrained and unconstrained problems. Emphasis on algorithms such as simplex method, direct search methods, conjugate gradient methods, shortest-path problems, and integer programming.

MATH 373 INTRODUCTION TO NUMERICAL ANALYSIS
(3-0) 3 credits. Prerequisite: MATH 321 and CSC 150 or permission of instructor. This course is an introduction to numerical methods. Topics include elementary discussion of errors, polynomial interpolation, quadrature, non-linear equations, and systems of linear equations. The algorithmic approach and efficient use of the computer will be emphasized. Additional topics may include: calculation of eigenvalues and eigenvectors, numerical differentiation and integration, numerical solution of differential equations.

MATH 381 INTRO TO PROB AND STAT
(3-0) 3 credits. Prerequisite: MATH 125 and prerequisite or corequisite: MATH 225. Introduction to probability theory, discrete and continuous distributions, sampling distributions and the Central Limit Theorem with general principles for statistical inference and applications of random sampling to hypothesis testing, confidence limits, correlation, and regression. This course is cross-listed with IENG 381.

MATH 382 PROBABILITY THEORY AND STATISTICS II
(3-0) 3 credits. Prerequisite: MATH 381. Review of general principles of statistical inference, linear regression and correlation, multiple linear regression, ANOVA, and statistical design of experiments. This course is cross-listed with IENG 382.

MATH 391 INDEPENDENT STUDY
1 to 5 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher

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involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. May be repeated to a total of five (5) credit hours.

MATH 392 TOPICS
1 to 5 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. May be repeated to a total of five (5) credit hours.

MATH 402 COMMUNICATING MATHEMATICS
(1-0) 1 credit. Prerequisite: MATH 498. The student will produce a word-processed technical report of research conducted in MATH 498 and give a department colloquium talk summarizing her or his work. Department faculty member(s) will provide guidance in the production of the technical report and in the preparation for the colloquium talk.

MATH 413 ABSTRACT ALGEBRA I
(3-0) 3 credits. Prerequisites: CSC 251 or permission of instructor. Introduction to the theory and applications of algebraic structures including groups, rings, and fields.

MATH 421 COMPLEX ANALYSIS
(3-0) 3 credits. Prerequisite: MATH 225. The algebra of complex numbers; complex functions; contour integration and Cauchy integral theorems; Taylor and Laurent series and the residue theorem; the evaluation of real definite integrals; elementary mapping problems.

MATH 423 ADVANCED CALCULUS I
MATH 424 ADVANCED CALCULUS II
(4-0) 4 credits each. Prerequisite: MATH 225 or permission of instructor. Prerequisite for MATH 424 is MATH 423. A theoretical treatment of Calculus that covers: limits; continuity and differentiability of functions of a single variable and of several variables; convergence of sequences and series; integration; and applications.

MATH 431 DYNAMICAL SYSTEMS
(3-0) 3 credits. Prerequisites: MATH 315 or permission of instructor. This course is a study of both discrete and continuous dynamical systems. Topics include analysis of planar autonomous systems, stability analysis, bifurcation, chaos, and strange attractors. In addition, this course may include the study of Van der Pol's equation, Lorenz equations, Duffing's equation, Hamiltonian systems, and Poincare maps.

MATH 432 PARTIAL DIFFERENTIAL EQUATIONS
(3-0) 3 credits. Prerequisites: MATH 225 and MATH 321. Fourier series, partial differential equations, Frobenius series, Bessel functions, and transform methods.

MATH 441 ENGINEERING STATISTICS I
(2-0) 2 credits. Prerequisite: MATH 225. An introduction to the core ideas in probability and statistics. Computation of probabilities using, for instance, counting techniques and Bayes' rule. Introduction to discrete and continuous random variables, joint and conditional distributions, expectation, variance and correlation, random sampling from populations, hypothesis tests and confidence intervals, and least squares. This course is the first in a sequence of two (2) two-credit mini-courses in probability and statistics offered in a single term, the second being MATH 442.

MATH 442 ENGINEERING STATISTICS II
(2-0) 2 credits. Prerequisite: MATH 441. In part, covers topics from MATH 441 in more depth including additional standard distributions used to model real-world phenomena, additional standard hypothesis tests and confidence intervals. Other topics include building multiple regression models, parameter estimation, and reliability. Selected non-parametric and computer-intensive methods may also be covered. This course is the second in a sequence of two (2) two-credit mini-courses in probability and statistics offered in a single term, the first being MATH 441.

MATH 451 MATH MODELING
(3-0) 3 credits. Prerequisites: MATH 321 or permission of instructor. The primary goal of this course is to present the mathematical formulation and analysis utilized in scientific modeling. Applications from both Science and Engineering will be covered. The types of models will include deterministic and stochastic models. Topics may include: epidemiology, biomass, elasticity, heat flow, electrical circuits, mechanical vibrations and optimization.

MATH 471 NUMERICAL ANALYSIS I
(3-0) 3 credits. Prerequisite: MATH 373 or CSC 372. Analysis of rounding errors, numerical solutions of nonlinear equations, numerical differentiation, numerical integration, interpolation and approximation, numerical methods for solving linear systems.

MATH 486 STATISTICAL QUALITY AND PROCESS CONTROL
(3-0) 3 credits. Prerequisites: IENG 381 or MATH 441 or permission of instructor. This course covers the development of statistical methods for

application to problems in quality and process control. Statistical topics include: basics of processes and variability, statistically controlled processes, variable and attribute control charts, moving averages, individual trend and others, process capability, sampling plans for attributes and variables. This course is cross-listed with IENG 486.

MATH 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic. May be repeated to a total of three (3) credit hours.

MATH 492 TOPICS
1 to 6 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. May be repeated to a total of six credit hours.

MATH 498 UNDERGRADUATE RESEARCH/SCHOLARSHIP
(1-0) 1 credit. Prerequisite: Permission of instructor. Includes senior project, and capstone experience. Independent research problems/projects or scholarship activities. The plan of study is negotiated by the faculty member and the student. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical.

MATH 685 STATISTICAL APPROACHES TO RELIABILITY
(4-0) 4 credits. Prerequisite: MATH 441 or permission of instructor. This course covers the development of statistical methods for application to problems in reliability engineering. Statistical topics include: basics of reliability and life-testing, probabilistic reliability, patterns of failures, probability concepts and distributions in reliability, analysis of reliability data, prediction and modeling, reliability measurements and problems. This course is cross-listed with ME 685.

MATH 687 STATISTICAL DESIGN AND ANALYSIS OF EXPERIMENTS
(3-0) 3 credits. Prerequisite: MATH 381 or MATH 441 and MATH 442 or permission of instructor. Sampling distribution and inference for normal distribution parameters, single and multifactor experiments, ANOVA, randomized blocks, Latin square and related designs, simple and multiple regression, analysis of covariance. Use of computer subroutines.

MATH 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Student should have obtained permission of an instructor in the Department of Mathematics and Computer Science prior to registering for this course. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor. May be repeated to a total of six credit hours.

MATH 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. May be repeated to a total of six credit hours.

ME 110/110L INTRODUCTION TO MECHANICAL ENGINEERING
(1-1) 2 credits. An introductory course for incoming mechanical engineering freshmen which will introduce the student to the profession they have chosen. Topics to be covered include: Solid modeling, CAD lab, professional development, engineering design, technical communication, personal development, and academic success skills.

ME 211 INTRODUCTION TO THERMODYNAMICS
(3-0) 3 credits. Prerequisites: MATH 125 and PHYS 211. An introduction to the basic concepts of energy conversion, including the first and second laws of thermodynamics, energy and entropy, work and heat, thermodynamic systems analysis, and the concepts of properties and state. Application of these fundamentals to energy conversion systems will be presented.

ME 221 DYNAMICS OF MECHANISMS
(3-0) 3 credits. Prerequisites: PHYS 211, EM 214, MATH 125. Brief review of dynamics of a particle. Kinetics and kinematics of two and three-dimensional mechanisms. Emphasis will include free body diagrams, vector methods, and various coordinate systems. Newton's law and energy methods will both be used.

ME 262/262L PRODUCT DEVELOPMENT
(3-1) 4 credits. Prerequisites GES 115, ME 110, MATH 123 and sophomore standing. The course presents in a detailed fashion useful tools and structured methodologies that support the product development practice. Also, it attempts to develop in the students the necessary skills and attitudes required for successful product development in

today's competitive marketplace. The cornerstone is a semester-long project in which small teams of students plan, conceive, design, and prototype a simple physical product. Each student brings his/her own background to the team effort, and must learn to synthesize his/her perspective with those of the other students in the group to develop a marketable product. An introduction to manufacturing aspects that must be taken into consideration during product development is provided in the context of a mini-project.

ME 312 THERMODYNAMICS II
(3-0) 3 credits. Prerequisites: ME 211and ME 221. Thermodynamic power cycles using vapors and gases. One-dimensional compressible flow. Energy analysis. Refrigeration cycles. Mistures and psychrometry. Maxwell's relations. Combustion and thermochemistry.

ME 313 HEAT TRANSFER
(3-0) 3 credits. Prerequisites: ME 211 and MATH 373 (concurrent). A study of the transfer of heat by conduction, convection and radiation. Application to thermal systems.

ME 316 SOLID MECHANICS
(3-0) 3 credits. Prerequisites: EM 321 and ME 221. Covers stress analysis and failure theories of both brittle and ductile materials and energy methods. Also includes such topics as elastic impact, stability, axisymmetrically loaded members in flexure and torsion, and an introduction to plastic behavior of solids.

ME 322 MACHINE DESIGN I
(3-0) 3 credits. Prerequisites: ME 316 and ME 262. Applications of the fundamentals of strength of materials, basic elastic theory, material science and how they apply to the design and selection of machine elements. Elements include shafts, gears, fasteners, and drive components such as gears and chains.

ME 331 THERMO FLUID DYNAMICS
(3-0) 3 credits. Prerequisites: ME 211 and ME 221. A study of the nature of fluids, constitutive relations, fluid statics/buoyancy, and the equations governing the motion of ideal (inviscid) and viscous, incompressible fluids, as well as inviscid, compressible fluids (1-dimensional gas dynamics). Internal and external flows, including viscous pipe flow, the Moody diagram, lift, drag and separation. Laminar and turbulent boundary layer theory, and dimensional analysis, modeling, and similitude.

ME 351/351L MECHATRONICS AND MEASUREMENT SYSTEMS
(3-1) 4 credits. Prerequisite: CSC 150 and EE 220 or EE 301. This course will encompass general measurement techniques found in Mechanical and Electrical Engineering. These include measurement of force, strain, frequency, pressure flow rates and temperatures. Elements of signal conditioning and data acquisition will be introduced. In addition to this material, the course will have a Mechatronics approach reflected in the combined applications of electronic mechanical and control systems. This course is cross-listed with EE 351/351L.

ME 352 INTRODUCTION TO DYNAMIC SYSTEMS
(3-0) 3 credits. Prerequisites: MATH 321, ME 221. This is an introductory course in the control of dynamic systems. The course presents the methodology for modeling and linearizing of electrical, mechanical, thermal, hydraulic and pneumatic systems. The course also covers control system analysis and synthesis in the time and the frequency domains.

ME 380 INTRODUCTION TO BIOMECHANICS
(3-0) 3 credits. Prerequisites: EM 321 or EM 217, MET 231, and MET 232. This course will provide an introduction to the important field of biomechanics. It will cover topics such as: engineering based on biological design; human anatomy; neural systems; locomotion; and biological materials.

ME 385 MECHANICS AND MATERIALS IN DESIGN I
(3-0) 3 credits. Prerequisites: EM 321, ME 221, ME 262, MET 231, MET 232. Corequisite: MATH 321. Part I of a functional design course integrating basic engineering concepts of solid mechanics, materials science, and failure mechanics. These integrated concepts are then applied to the "total" design of engineering structures, for example, aerospace and terrestrial vehicles, electronic packages, and machinery.

ME 386 MECHANICS AND MATERIALS IN DESIGN II
(3-0) 3 credits. Prerequisite: ME 385. Part II of a functional design course integrating basic engineering concepts of solid mechanics, materials science, and failure mechanics. These integrated concepts are then applied to the "total" design of engineering structures, for example, aerospace and terrestrial vehicles, electronic packages, and machinery.

ME 391 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher

involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

ME 392 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

ME 402/502 GAS DYNAMICS
(3-0) 3 credits. This course will review fundamental concepts from thermodynamics including isentropic flow and normal shock functions. The equations of motion will be derived in differential form and wave theory will be introduced. Multidimensional flows and oblique shock theory will be discussed. Integral methods for inviscid, compressible flow will be developed and numerical methods (including the method of characteristics for hyperbolic equations) will be employed in the second half of the course. Students enrolled in ME 502 will be held to a higher standard than those enrolled in ME 402.

ME 404 HEATING, VENTILATING, AND AIR CONDITIONING
(3-0) 3 credits. Prerequisites: ME 312 (concurrent), ME 313 (concurrent), ME 331. A study of space heating and cooling systems and equipment, building heating and cooling load calculations, solar radiation concepts, and moist air properties/conditioning processes. Indoor air quality/comfort and health issues will be discussed. Basic heat and mass transfer processes will be introduced; pump and fan performance issues along with duct and piping system design. Heat exchangers and mass transfer devices will also be studied.

ME 411/411L INTERNAL COMBUSTION ENGINES I
(3-1) 4 credits. Prerequisites: ME 312 (concurrent), ME 313 (concurrent), ME 331, ME 351. Otto and diesel cycle analysis; combustion in engines; exhaust gas analysis; engine mechanical design features. Laboratory includes experiments designed to coordinate with the lectures and special investigations to topics of current interest such as noise and pollution.

ME 416 THERMOSCIENCE LAB
(0-1) 1 credit. Prerequisites: ME 351, ME 312, ME 313 and ME 331. A hands-on experience with experimental methods in mechanical engineering thermoscience; measurement techniques for temperature, pressure, flow and velocity; data acquisition systems and uncertainty analysis will be covered. Group projects to illustrate design of experiments will be assigned, in addition to conducting various heat transfer, fluid mechanics, and thermodynamics experiments.

ME 419/419L THERMO-FLUID SYSTEMS DESIGN
(3-1) 4 credits. Prerequisites: ME 312, ME 313, and ME 331. Investigation and design of thermal and fluid systems and components, emphasizing the major thermal/fluid design issues that arise in internal combustion engine power conversion; analysis and synthesis involving modeling and optimization of thermo-fluid systems, components and processes. Development and application of fundamental numerical tools and algorithms for thermal and fluid problems. A central design problem for a thermal/fluid system or component will be selected to meet an existing or future project need and will be decomposed into the relevant thermal and fluid aspects which will studied throughout the course. Review of the basics of the design process and physical processes important to thermal-fluid problems (basic thermodynamics, heat transfer and fluid mechanics), the fundamentals of building and solving mathematical models, and design issues and concepts unique to internal combustion engines will be discussed. Students will be required to implement one or more previously developed Fluent learning modules to study the use of CFD in thermal/fluid system design. The final project will incorporate skills developed in the learning modules into the required design of the system or component. The laboratory will include experiments to compliment the lecture material and provide a means for hands on validation of concepts.

ME 422 MACHINE DESIGN II
(3-0) 3 credits. Prerequisite: ME 322. This course will explore advanced structural design concepts within an integrated framework of theory, simulation, experiment, and materials. Of particular importance will be the study of modern topics, such as plastic materials and their response to service loads. Structural mechanics and materials response will be brought together in support of machine component design.

ME 423 MECHANICAL VIBRATIONS
(3-0) 3 credits. Prerequisite: ME 352. Study of the oscillatory nature and vibration design of mechanical systems. One, two, multi, and infinite degree of freedom systems are analyzed for their response in both free and forced vibration regimes. Particular emphasis is given to designing for vibration control. Brief introductions are made to vibration testing and measurement, and human response to vibrations.

ME 424 FATIGUE DESIGN OF MECHANICAL COMPONENTS
(3-0) 3 credits. Prerequisite: ME 322. The analysis and prevention of fatigue related failures in mechanical components. Topics covered include historical background, failure theories, macroscopic aspects of fracture and fatigue, fatigue characteristics of materials, stress concentration factors, environmental effects, and surface treatments. (Design Elective)

ME 425 PROBABILISTIC MECHANICAL DESIGN
(3-0) 3 credits. Prerequisite: ME 322. Basic concepts of probability and statistics are introduced including Gaussian, Exponential, and Weibul distributions. Primary emphasis is placed on treating stresses, strains, deformations, and strength limitations as random variables and computing probability of failure under required loads. Considerable time is devoted to converting data into meaningful engineering parameters for making engineering decisions. Statistical methods applied to topics in mechanical design. (Design Elective)

ME 426 MECHANICAL SYSTEMS ANALYSIS LABORATORY
(0-1) 1 credit. Prerequisites: ME 423 (concurrent). Use of experimental methods and modern instrumentation techniques to understand the free and forced oscillations of machines and machine components, as well as the control of these vibrations. Laboratory exercises are designed to reinforce material learned in the companion lecture class ME 423, extend knowledge into new areas, and help to make the connection between theory and practice.

ME 427/427L COMPUTER-AIDED DESIGN AND MANUFACTURE
(2-1) 3 credits. Prerequisite: Senior standing or permission of instructor. Discussion of methods and topics in computer-aided design and manufacture. How to bridge the gap between the design/analysis phase and the actual manufacture phase. Database requirements of CNC machine tools and how they can be constructed.

ME 428/428L APPLIED FINITE ELEMENT ANALYSIS
(2-1) 3 credits. Prerequisites: ME 316 or permission of instructor. Basic mathematical concepts of finite element analysis will be covered. The students will learn finite element modeling using state of the art software, including solid modeling. Modeling techniques for beams, frames, two and three-dimensional solids, and thin walled structures will be covered in the course.

ME 430 WELDING ENGINEERING AND DESIGN OF WELDED STRUCTURES
(3-0) 3 credits. Introduces the state-of-art in welding processes and technology. Discusses fundamentals of the fabrication welded structures by introducing basics of solidification in welds, metallurgy of welds, fatigue and fracture in welds, joint design, and weld defects and inspection. The technology focus is friction stir and laser welding. This course is cross-listed with MET 430.

ME 442 FAILURE MODES OF ENGINEERING MATERIALS
(3-0) 3 credits. Prerequisites: ME 322. Discussion of various material failure modes with emphasis on understanding how to design components to avoid failures. Topics covered will include deformation, fatigue, fracture, creep and corrosion. The course will include examples of typical failures, discussion of case studies and laboratory demonstrations.

ME 443 COMPOSITE MATERIALS
(3-0) 3 credits. Prerequisites: ME 316 or concurrent enrollment in MET 440. This course will cover heterogeneous material systems; basic design concepts and preparation; types of composite materials; advances in filaments, fibers and matrices; physical and mechanical properties; failure modes; thermal and dynamic effects; and application to construction, transportation and communication. This course is cross-listed with MET 443.

ME 445/545 OXIDATION AND CORROSION OF METALS
(3-0) 3 credits. Prerequisites: MET 232, MET 320 or CHE 222 or ME 312 or permission of instructor. Initially, the thermodynamics of electrochemical processes are covered; use of the Nernst equation and Pourbaix diagram is presented in this material. Fundamentals of electrode kinetics are then discussed with special emphasis on the derivation of the Butler-Volmer equation and application of the Evan's diagram. Following presentation of these fundamental concepts, phenomena observed in corrosion and oxidation such as uniform attack, pitting, stress corrosion cracking, and corrosion fatigue are discussed. Finally, selection of materials for site specific applications is covered. Students enrolled in ME 545 will be held to a higher standard than those enrolled in ME 445. This course is cross-listed with CHE 445/545, ENVE 445/545, MET 445/545.

ME 453/453L CONTROL SYSTEMS
(3-1) 4 credits. Prerequisite: ME 352 or EE 311. Analysis and design of automatic control and process systems by techniques encountered in modern engineering practice, including both linear and nonlinear systems with either continuous or discrete signals. This course is cross-listed with EE 451/451L

ME 454 INDUSTRIAL HYDRAULICS
(3-0) 3 credits. Prerequisites: ME 331, ME 352. Design and use of high pressure hydraulic pumps, valves, systems and computer control systems.

ME 456 CONTROLS LABORATORY
(0-1) 1 credit. Prerequisite: ME 453 (concurrent). The purpose of this laboratory is to expose the students to real-time control applications. During the course of this lab the students get acquainted with the TMS320C30 board, its data acquisition capabilities as well as its control capabilities. Two major set-ups exist in this laboratory. The first one consists of a servo motor - C30 board combination, while the ECP's inverted pendulum is the other experimental configuration. The students are asked to design, investigate, implement, and evaluate various control strategies on these two control systems.

ME 477 MECHANICAL ENGINEERING DESIGN I
(0-2) 2 credits. Prerequisite: Senior standing or graduation within three (3) semesters, ME 322, ME 351 (concurrent). The first semester of a two (2) course sequence in senior design practice. Integrates concepts from all areas in mechanical engineering into a practical design project. Fundamentals of the design process, specifications, decision making, and preliminary design will be the focus, with the major part of the course being the project.

ME 479 MECHANICAL SYSTEMS DESIGN II
(0-2) 2 credits. Prerequisite: ME 477 and senior standing. Corequisite: ME 351. The second semester continuation of Mechanical Systems Design. Integrates concepts from all areas in Mechanical Engineering into a practical design project. Detailed design and analysis, manufacturing, and assembly will be the focus.

ME 481L ADVANCED PRODUCT DEVELOPMENT LAB I
(0-1) 1 credit. Corequisite: ME 477. Advanced laboratory experience in product development. Students will perform activities in support of preliminary product design and trade studies, including virtual prototyping, computational investigations and proof-of-concept experiments. During the time of this course and in order to broaden their views on globalization, students will be required to attend a seminar series.

ME 482L ADVANCED PRODUCT DEVELOPMENT LAB II
(0-2) 2 credits. Corequisite: ME 479. Advanced laboratory experience in product development. Students will perform activities in support of detailed product design, including virtual prototyping, computational investigations, and testing of components and systems. During the time of this course and in order to broaden their views on globalization, students will be required to attend a seminar series.

ME 499/599 RESEARCH PROBLEMS/PROJECTS
1 to 3 credits. Prerequisite: Permission of instructor. Independent research problems/projects that lead to a research or design paper but not to a thesis. The plan of study is negotiated by the faculty member and the candidate. Contact between the two may be extensive and intensive. Does not include research courses which are theoretical. Students enrolled in ME 599 will be held to a higher standard than those enrolled in ME 499.

ME 555/555L ADVANCED APPLICATIONS IN COMPUTATIONAL MECHANICS
(1-2) 3 credits. Prerequisite: Senior or higher standing. Introduction to solid modeling techniques using advanced solid modeling software. Use of Computational Fluid Mechanics codes for the solution of complex fluid mechanics and heat transfer problems. Use of finite element codes for the solution of non-linear and transient problems in solid mechanics.

ME 612 TRANSPORT PHENOMENA: MOMENTUM
(3-0) 3 credits. Introduction to momentum transport. Equations of continuity and motion. Velocity distributions. Boundary layer theory. Turbulent transport compressible flow. This course is cross-listed with CHE 612.

ME 613 TRANSPORT PHENOMENA: HEAT
(3-0) 3 credits. Prerequisites: ME 313, MATH 373 (concurrent). An in-depth study of the fundamental laws of heat transfer. Major areas considered are: heat conduction, free and forced convection, and radiative heat transfer. Emphasis is placed on the formulation and solution of engineering problems by analytical and numerical methods. This course is cross-listed with CHE 613.

ME 616 COMPUTATIONS IN TRANSPORT PHENOMENA
(3-0) 3 credits. Prerequisite: MATH 373 or permission of instructor. Various computerized techniques, including finite difference and finite element, will be used to solve transient and steady state heat transfer problems involving conduction and convection. This course is cross-listed with CHE 616.

ME 623 ADVANCED MECHANICAL VIBRATIONS
(3-0) 3 credits. Prerequisite: ME 423 or equivalent. Study of the vibration of systems of particles both

Courses

forced and free. Included is the study of transient vibrations and system natural frequencies. Classical studies of the vibration of continuous systems, free and forced, damped and undamped using computer solutions are emphasized. Introduction to Theoretical and Experiment Modal Analysis. (Design Elective)

ME 661 ENGINEERING ECONOMICS FOR MANAGERS
Credit: Variable 1 to 4. Students are expected to have prerequisite skills in the time value of money and basic probability. Students not having these skills require the permission of instructor. The course is divided into four (4) one-credit modules, which include: economic valuation for decision making, problems with uncertainty and risk, budgeting and cost management, and financial statements and enterprise management. (Manufacturing elective). This course is cross-listed with TM 661.

ME 673 APPLIED ENGINEERING ANALYSIS I
(3-0) 3 credits. Advanced topics in engineering analysis. Special mathematical concepts will be applied to mechanical engineering problems. Topics will be selected from the following: Fourier series and boundary value problems applied to heat conduction and convection, Laplace transforms and complex variable analysis applied to vibrations and dynamic system analysis, series solutions of differential equations, partial differential equations, general matrix applications to a variety of large systems of equations in engineering, calculus of variation, and Ritz method for various engineering problems.

ME 683 ADVANCED MECHANICAL SYSTEM CONTROL
(3-0) 3 credits. Prerequisites: ME 673, ME 453, MATH 315 or permission of instructor. Derivation of state equations for continuous and discrete control systems. A study of optimal and adaptive control of mechanical systems. (Manufacturing Elective)

ME 685 STATISTICAL APPROACHES T0 RELIABILITY
(4-0) 4 credits. Prerequisite: MATH 441 or permission of instructor. This course covers the development of statistical methods for application to problems in reliability engineering. Statistical topics include: basics of reliability and life-testing, probabilistic reliability, patterns of failures, probability concepts and distributions in reliability, analysis of reliability data, prediction and modeling, reliability measurements and problems. This course is cross-listed with MATH 685.

ME 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission on instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor.

ME 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

ME 715 ADVANCED COMPOSITE MATERIALS
(3-0) 3 credits. Prerequisite: Permission of instructor. Includes classification and mechanical behavior of composite materials, macro-mechanical behavior of lamina and laminates. Course emphasizes study of advanced composite laminates including failure theories, experimental methods, stresses, strains, and deformations.

ME 722 ADVANCED MECHANICAL DESIGN
(3-0) 3 credits. Prerequisite: ME 422. Study of some advanced concepts required for design of mechanical systems. Included are a review of basic concepts of mechanics and failure theories, in elastic responses, thermal stresses and introduction into design for composite structures. Special topics such as non-homogeneous beams, twisting of beams, torsion of non-circular sections, beams on an elastic foundation, plates, and shells are covered. (Design Elective)

ME 773 APPLIED ENGINEERING ANALYSIS II
(3-0) 3 credits. Applications of numerical methods to mechanical engineering problems. Topics will include data processing techniques, curve fitting and interpolation of experimental information, solutions to systems of ordinary differential equations, solutions to partial differential equations, and numerical integration both of known functions and functions described only by experimental data.

ME 781 ROBOTICS
(3-0) 3 credits. The course covers the following topics as related to modern industrial robots, sensors and actuators, motion trajectories, synthesis, control, computers and languages, available robots, and applications. (Manufacturing Elective)

ME 782 INTEGRATED MANUFACTURING SYSTEMS
(3-0) 3 credits. The course deals with the role of the computer in modern manufacturing plants. Its use in all divisions of manufacturing is discussed, including shop floor control, scheduling, routing, inventory, etc. Several case studies are presented. (Manufacturing Elective)

ME 788 GRADUATE RESEARCH (Non-Thesis)
Credit to be arranged. A course designed to provide an opportunity for the graduate student to do applied research work in his/her major field. This course will be the basis for the project required when the student has opted for the non-thesis option, for the Master of Science degree in the Mechanical Engineering Department.

ME 790 SEMINAR
(1-0) 1 credit. May not be repeated for credit. Oral presentations followed by group discussions on a weekly basis. Speakers will be drawn primarily from the graduate student body but may also include faculty and invited lecturers.

ME 791 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advanced, by student and instructor.

ME 792 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

ME 798 MASTER'S THESIS
Credit to be arranged. A course designed to provide an opportunity for the graduate student to do research work in his major field. This course will be the basis for the thesis required when the student has opted for the thesis option, for the master of science degree in the Mechanical Engineering Department.

MEM 120 INTRODUCTION TO MINING AND SUSTAINABLE DEVELOPMENT
(2-0) 2 credits. Principles and definitions related to the mining engineering discipline. Introduction overview of current mining practices and mining technology in general. Presentation of mining faculty and their areas of expertise. Discussion of various career paths in mining engineering. Principles, terminology, and definitions of sustainable development in mining. Elements and indicators of sustainable development: environment, economics, society, and governance. Discussion of how the mining industry can develop more successful operations in the changing global community, and how these and other issues impact the design, operation and closure of large mining projects. This course is cross-listed with ENVE 120.

MEM 201/201L SURVEYING FOR MINERAL ENGINEERS
(1-1) 2 credits. Prerequisites: Sophomore standing. Principles of surface and underground surveying, including measurements, data collection, calculations, error analysis, topographic mapping, and applications of the Global Positioning System.

MEM 202 MATERIALS HANDLING AND TRANSPORTATION
(2-0) 2 credits. Prerequisites: EM 216 and MEM 120. The theory of operation of mining equipment, and its selection and application to materials handling in surface and underground mines. Emphasis is on economics, productivity, reliability, maintenance, and safety.

MEM 203 INTRODUCTION TO MINE HEALTH AND SAFETY
(1-0) 1 credit. Prerequisite: Sophomore standing. Instruction in the safety aspects of mining in accordance with MSHA rules. A study of mine regulations and the recognition of mine hazards along with their prevention and control.

MEM 204 SURFACE MINING METHODS AND EQUIPMENT FOR COAL, METAL AND QUARRYING OPERATIONS
(3-0) 3 credits. Prerequisites: ENVE/MEM 120 and MEM 203. Basic engineering principles relating to surface mining methods for coal, metal, and quarrying operations. Equipment selection and design parameters. Mining method selection process as it relates to surface mining. This course is cross-listed with ENVE 204.

MEM 301/301L COMPUTER APPLICATIONS IN MINING
(1-1) 2 credits. Prerequisite: GE 115 or permission of instructor. Computer hardware and software. Applications in exploration and resource modeling, equipment selection and simulations, mine planning and design, rock stability analysis, and economics and cost estimates. Emphasis on three-dimensional modeling and visualization. Vulcan software and other software applications.

MEM 302 MINERAL ECONOMICS AND FINANCE
(3-0) 3 credits. Prerequisite: Junior standing. Economic evaluation methods regarding acquisition/investment requirements, mine equipment, and mineral commodities. The importance of the mineral industries to the national economy. This course is cross-listed with ENVE 302.

MEM 303 UNDERGROUND MINING METHODS AND EQUIPMENT FOR COAL, METAL AND STONE OPERATIONS
(3-0) 3 credits. Prerequisite: MEM 204. Basic engineering principles relating to underground mining methods for coal, metal, and stone operations. Equipment selection and design parameters. Mining method selection process as it relates to underground and surface environment.

MEM 304/304L THEORETICAL AND APPLIED ROCK MECHANICS
(3-1) 4 credits. Prerequisite: EM 216 and Junior standing. Principles of rock mechanics and mechanics of materials. Concept of stress, strain and the theory of elasticity. Applications in mining, geological engineering and tunneling. Emphasis on the design of safe structures in rocks. Laboratory experience for determining the basic physical and mechanical properties of rocks.

MEM 305 INTRODUCTION TO EXPLOSIVES ENGINEERING
(3-0) 3 credits. Prerequisite: MEM 202. An introduction to explosives products; the theory of rock breakage by explosives; and the design of blast patterns for different applications including surface blasting techniques, underground blasting techniques, controlled blasting and specialized techniques. The techniques and equipment used to control and/or monitor airblast, ground vibration and flyrock are studied.

MEM 306 MINE POWER AND PUMPING SYSTEMS
(3-0) 3 credits. Prerequisites: MEM 301 and MEM 303. Fundamentals of electric circuits, basic mine power systems, and power distribution system design. Applications of pumping in surface and underground mines.

MEM 307 MINERAL EXPLORATION AND GEOSTATISTICS
(3-0) 3 credits. Prerequisite: GEOE 221. The application of the theory of geostatistics to qualify the geological concepts of (1) area of influence of a sample, (2) the continuity of the regionalized variable within a deposit, and (3) the lateral changes in the regionalized variable according to the direction. Basic concepts and theory of probability and statistics will be introduced, including probability distributions, sampling distributions, treatment of data, the mean, variance, and correlation. Computer techniques will be extensively used for geostatistical estimation of grade, volume, and variance.

MEM 401/401L THEORETICAL AND APPLIED MINE VENTILATION
(3-1) 4 credits. Prerequisite: Senior standing. Analysis of mine atmosphere and the control of airflow in an underground mine. Basic principles of thermodynamics and air conditions. Emphasis is on solutions of airflow networks and the design principles of mine ventilation systems. Laboratory experience for determining the basic pressure and airflow parameters, ventilation network analysis, and fan characteristics.

MEM 405 MINE PERMITTING AND RECLAMATION
(3-0) 3 credits. Prerequisite: Junior standing. Mine permitting process and mine reclamation practices used in various mining environments (coal, metal and quarrying operations). Surface and underground environmental and mining laws. Management of reclamation programs.

MEM 433/433L/533/533L COMPUTER APPLICATIONS IN GEOSCIENCE MODELING
(3-1) 4 credits. Prerequisite: Junior standing. The use of computer techniques in modern geoscience modeling of mining, geology and environmental problems such as exploration, geological characterization and mining exploitation. Practical application of state-of-the-art Vulcan modeling software will be essential part of the course. Students enrolled in MEM 533 will be held to a higher standard than those enrolled in MEM 433. This course is cross-listed with ENVE 433/433L/533/533L.

MEM 450/550 ROCK SLOPE ENGINEERING
(3-0) 3 credits. Prerequisite: MEM 304 or CEE 346 or equivalent. Modes of slope failure. Economic consequences of instability in mining and construction. Geological factors controlling stability of rock slopes. Shear strength of highly jointed rock mass and discontinuities. Projection methods. Vectoral analysis of 3-D problems by means of the stereographic projection method. Analytical, graphical and computer analysis of planar, wedge and toppling failures. Probabilistic methods. Students enrolled in MEM 550 will be held to a higher standard than those enrolled in MEM 450. This course is cross-listed with ENVE 450/550.

MEM 464 MINE DESIGN AND FEASIBILITY STUDY
(4-0) 4 credits. Prerequisites: MEM 204, MEM 302, MEM 303, MEM 304, MEM 305, MEM 306, MEM 307 and MEM 401. A complete mine feasibility study conducted as a senior design project. Students will have a choice of designing one of the following: a surface or underground coal mine, a quarry, a surface or underground hard rock metal mine, or a sub-surface underground space (tunneling, large excavations, industrial/environmental underground storage site, or underground science laboratory). A comprehensive study of principles and practices involved in developing an ore deposit (surface or underground) starting with drill hole data following through with a complete feasibility study (based on financial returns on investment and sensitivity analysis) covering ore reserve calculations, and selection of mining methods and equipment. Computerized approach will be an integral part of the course: SurvCADD software and Vulcan

software are available to use. In addition to a computerized model of the mine, a final written report and presentation in front of the class will be required.

MEM 466 MINE MANAGEMENT
(2-0) 2 credits. Prerequisite: Senior standing or permission of instructor. The study of critical management issues of fundamental importance to the mining industry: forms of management, organizational structures, project management and mine administration, risk management, and modern management tools. Development of leadership skills. Management of human resources.

MEM 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems, and special projects. Student complete individualized plans of study which include significant one-on-one student/teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending on the requirements of the topic.

MEM 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may service as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

MES 601 FUNDAMENTALS OF MATERIALS ENGINEERING
(4-0) 4 credits. Prerequisite: Admission to M.S./MES or Ph.D./MES program or permission of instructor. The course is taught when the required seven student minimum is reached. The objective of this course is to provide students with the working knowledge required to understand principles governing engineering aspects of materials synthesis and manufacturing. Students are able to analyze the effect of transport phenomena, surface chemistry, solution thermodynamics and kinetics on design, control and process optimization of various materials processes.

MES 603 CONDENSED MATTER PHYSICS
(4-0) 4 credits. Prerequisite: Admission to M.S./MES or MES Ph.D. program or permission of instructor. The objective of this course is to provide students with working knowledge required to understand the principles of condensed matter physics with application to materials science and engineering. The students will be able to analyze basic experiments related to electronic structure of atoms and chemical bonding in solids, diffraction of x-rays and electrons by crystal lattices, lattice dynamics, elastic and thermal properties of solids, electronic band structure, classification of solids, dynamics of electrons in crystals, optical properties of solids, doped semiconductors, p-n junctions and hetero-junctions, dielectric properties of insulators, piezoelectricity, electrostriction, ferroelectricity, and magnetic properties of solids (dia-, para-, and ferro-magnetism).

MES 604 CHEMISTRY OF MATERIALS
(4-0) 4 credits. Prerequisite: Admission to M.S./MES or MES Ph.D. program or permission of instructor. The object of this course is to provide students with the working knowledge required to understand the theoretical chemical basis for chemical and physical properties of crystalline, ceramic, polymeric and metallic materials. Students will be able to analyze macroscopic properties on the basis of underlying chemical concepts.

MES 614 TRANSPORT PHENOMENA: MASS
(3-0) 3 credits. Prerequisite: Permission of instructor. Includes classification and mechanical behavior of composite materials, macromechanical behavior of lamina and laminates. Course emphasizes study of advance composite laminates including failure theories, experimental methods, stresses, strains, and deformations. This course is cross-listed with CHE 614.

MES 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advanced, by student and instructor.

MES 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. This course is cross-listed with MES 792.

MES 708/708L ADVANCED INSTRUMENTAL ANALYSIS
(3-1) 4 credits. Prerequisites: Admission to MS/MES or Phd/MES program or permission of instructor. The objective of this course is to provide the students a working knowledge of the principles of modern analytical instrumentation. Specific topics of the course include how electromagnetic radiation interacts with matter, atomic and molecular spectroscopy and chromatography. The laboratory portion of this course will include experiments in atomic and molecular spectroscopy. In addition, chromatographic experiments are also covered.

MES 712 INTERFACIAL PHENOMENA
(3-0) 3 credits. A course in the surface properties of solids and liquids. Areas covered include the

thermodynamics of surfaces, material transfer across interfaces, nucleation, surface energies of solids, three-phase contact, wetting phenomena, and adsorption.

MES 713 ADVANCED SOLID MECHANICS I
(3-0) 3 credits. Presented and discussed. Emphasis is placed on the mathematical description of phenomenological behavior, deformation and flow. Practical solutions from the classical theories of solid mechanics are discussed.

MES 721 THEORY OF MATERIALS BEHAVIOR I
(3-0) 3 credits. An advanced course covering the properties of crystalline, amorphous, and multiphase solids. Study of the mechanical, thermal, electrical, chemical, magnetic, and optical behavior of metals, semiconductors, ceramics, polymers, concretes, and composites, including time-dependent and environmental effects.

MES 728 HETEROGENEOUS KINETICS
(3-0) 3 credits. Principles of Absolute Rate Theory are combined with thermodynamics to study the mechanisms of homogeneous and heterogeneous reactions in metallurgical systems.

MES 737 SOLID STATE PHYSICS I
(3-0) 3 credits. Prerequisite: PHYS 431 or equivalent. The structure of solids, lattice vibrations, free electron and energy band theory. Applications to the thermal, electrical, magnetic, and optical properties of solids.

MES 770 CONTINUUM MECHANICS
(3-0) 3 credits. Prerequisite: Permission of instructor. Introduction to tensor algebra and calculus. Derivation of kinematic, stress, strain, and thermodynamic field equations governing continuous media. Development of constitutive relations for real materials. Applications to problems in fluid and solid mechanics.

MES 788 MASTER'S RESEARCH PROB/PROJECTS
Credit to be arranged; not to exceed 5 credit hours toward fulfillment of the Masters of Science in Materials Engineering and Science (M.S./MES). Prerequisite: approval of advisor. Directed research investigation of a selected problem culminating in an acceptable written report. Oral defense of the report and research findings are required.

MES 790/890 SEMINAR
(1-0) 1 credit. May not be repeated for degree credit. Open only to candidates for the Ph.D. in Materials Engineering and Science. Preparation, oral presentation, and group discussion of a research problem. Students enrolled in MES 860 will be held to a higher standard than those enrolled in MES 790.

MES 792 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. This course is cross-listed with MES 692.

MES 798 MASTER'S THESIS
Credit to be arranged; not to exceed 6 credit hours toward fulfillment of the Masters of Science in Materials Engineering and Science (M.S./MES). Prerequisite: approval of advisor. An original investigation of a materials engineering or materials science subject normally presented as a thesis for the M.S./MES degree.

MES 898 DISSERTATION
Credit to be arranged; not to exceed 30 credits toward fulfillment of Ph.D. degree requirements. Open only to doctoral candidates. Supervised original research investigation of a selected problem, with emphasis on independent work, culminating in an acceptable dissertation. Oral defense of dissertation and research findings are required.

MET 220/220L MINERAL PROCESSING AND RESOURCE RECOVERY
(3-1) 4 credits. Prerequisite: Sophomore standing. An introductory course in mineral processing highlighting unit operations involved including comminution, sizing, froth flotation, gravity separation, electrostatic separation, magnetic separation and flocculation. Other topics discussed include remediation of contaminant effluents and the unit operations associated with recycling of post-consumer materials using mineral processing techniques. This course is cross-listed with ENVE 220/220L.

MET 231 STRUCTURES AND PROPERTIES OF MATERIALS LAB
(0-1) 1 credit. Prerequisites: Concurrent registration in MET 232, or permission of instructor. A laboratory involving quantitative metallography, heat treating practice, mechanical property measurements and metallurgical design of the thermal mechanical treatment of metals.

MET 232 PROPERTIES OF MATERIALS
(3-0) 3 credits. Prerequisite: MATH 123 and PHYS 111. A course in engineering materials and their applications. The different technological uses of metals, ceramics, plastics, and composite materials are discussed and explained in terms of their basic atomic structure, and mechanical, thermal, optical, electrical, and magnetic properties. Material selection in engineering design is emphasized.

MET 310 AQUEOUS EXTRACTION, CONCENTRATION, AND RECYCLING
(3-0) 3 credits. Prerequisites: MET 320 or CHE 321, or CHEM 342. Scientific and engineering principles involved in the winning of metals from ores and scrap. Areas covered include the unit operations of comminution, sizing, solid/liquid separations, leaching, ion exchange, solvent extraction, and surface phenomena as related to flocculation, froth floatation, and electrostatic separation. This course is cross-listed with ENVE 310.

MET 310L AQUEOUS EXTRACTION, CONCENTRATION, AND RECYCLING LAB
(0-1) 1 credit. Prerequisites: Concurrent registration in MET 310 or permission of instructor. Laboratory experiments in design of processing equipment and cost estimation, zeta potential, surface tension, leaching kinetics, electrowinning, and solvent extraction. This course is cross-listed with ENVE 310L.

MET 320 METALLURGICAL THERMODYNAMICS
(4-0) 4 credits. Prerequisites: PHYS 211, CHEM 112, MATH 125. The principles of chemical thermodynamics and their application to metallurgical engineering processes. Topics covered include the zeroth, first and second laws of thermodynamics, the fundamental equations of state for open and closed systems, criterion of equilibrium, heat capacities, reaction equilibrium constants and their dependence upon temperature and pressure, chemical potential, standard and reference states, stability diagrams, and solution thermodynamics. This course is cross-listed with ENVE 320.

MET 321/321L HIGH TEMPERATURE EXTRACTION, CONCENTRATION, AND RECYCLING
(3-1) 4 credits. Prerequisite: MET 320. Thermodynamic principles involved in the winning of metals. Areas covered include calcination, oxidation, reduction processes, smelting, high - temperature refining, electrorefining, slags, and slag-metal interactions. This course is cross-listed with ENVE 321/321L.

MET 330 PHYSICS OF METALS
(3-0) 3 credits. Prerequisite: MET 232. The fundamental principles of physical metallurgy with emphasis on the mathematical description of mechanisms that control the structure of materials. Topics covered are structure of metals, x-ray diffraction, elementary theory of metals, dislocations, slip phenomena, grain boundaries, vacancies, annealing, and solid solutions.

MET 330L PHYSICS OF METALS LAB
(0-1) 1 credit. Prerequisites: MET 232 and MET 231. Practical laboratory exercises that involve (1) x-ray diffraction methods, (2) transmission electron microscopy as it applies to dislocations in materials, (3) recovery, recrystallization and grain growth as it applies to annealing of materials, (4) optional and scanning electron microscopy as it applies to the microstructure of materials, and (5) thermomechanical processing of metals with limited regions of solid solubility.

MET 332 THERMOMECHANICAL TREATMENT
(3-0) 3 credits. Prerequisites: MET 232 and concurrent registration in MET 330, and MET 320 or ME 211. The relationship between the structure and properties of materials. Topics covered are the iron-carbon system, hardenability of iron base alloys, stainless steels, cast irons, aluminum, copper and magnesium, rubber and copper polymers. Concepts of heat treatment, age hardening, dispersion hardening, and hot and cold working correlated with modification of the structure and physical properties of materials.

MET 351 ENGINEERING DESIGN I
(2-0) 2 credits. Prerequisites: MET 220 and MET 232. Introduction to engineering design. Compare the scientific method with the engineering design method. Define the concept of need as it pertains to the design process. Develop skills associated with the use of modern and classic sources of information. In addition, material selection processes, interaction of materials, and materials processing topics are presented. Focus on the design process, and the design method. The development of interdisciplinary teams is a high priority.

MET 352 ENGINEERING DESIGN II
(1-0) 1 credit. Prerequisite: MET 351. A continuation of the design sequence.

MET 421/521 REFRACTORIES AND CERAMICS
(3-0) 3 credits. Prerequisites: MET 232 and MET 320 or graduate standing. This fundamental course on the properties of refractory and ceramic materials covers the production of ceramic and refractory materials including concentration, purification, and forming. Refractory selection, practice, and service in high-temperature thermochemical processes and environments; thermal anal electrical properties; the relationship among structure, bonding imperfections, and properties; and failure diagnosis and avoidance is included. Students enrolled in MET 521 will be held to a higher standard than those enrolled in MET 421.

MET 422 TRANSPORT PHENOMENA
(4-0) 4 credits. Prerequisite: MATH 321 and concurrent enrollment in MET 320. The principles

of momentum, heat and mass transfer and their application to metallurgical engineering. Topics covered include thermal conductivity, mass diffusion, mechanisms of transport, Fourier's and Fick's Laws, shell balance, boundary conditions, equations of change, unsteady-state transport, mass and heat distributions in turbulent flow, and interphase transport.

MET 426/526 STEELMAKING
(3-0) 3 credits. Prerequisites: MET 320 or graduate standing. Chemical reactions and heat and mass transport phenomena associated with the production of steel. Unit operations studied include the blast furnace, the basic oxygen furnace, the electric arc furnace, and selected direct reduction processes. Students enrolled in MET 526 will be held to a higher standard than those enrolled in MET 426.

MET 430 WELDING ENGINEERING AND DESIGN OF WELDED STRUCTURES
(3-0)3 credits. Introduces the state-of-art in welding processes and technology. Discusses fundamentals of the fabrication welded structures by introducing basics of solidification in welds, metallurgy of welds, fatigue and fracture in welds, joint design and weld defects and inspection. The technology focus is friction stir and laser welding. This course is cross-listed with ME 430.

MET 433 PROCESS CONTROL
(3-0) 3 credits. Prerequisite: MATH 321 and senior standing. Analysis and design of process control systems for industrial processes, including control tuning and design of multi-variable control scheme. This course is cross-listed with CHE 433.

MET 440/540 MECHANICAL METALLURGY
(3-0) 3 credits. Prerequisites: MET 232 and concurrent or completion of EM 217 or EM 321. A course concerned with responses of metals to loads. Areas covered include elastic and plastic deformation under different force systems, dislocation theory, fracture, internal friction, fatigue, creep, residual stresses, and general fundamentals of metal working. Students enrolled in MET 540 will be held to a higher standard than those enrolled in MET 440.

MET 440L/540L MECHANICAL METALLURGY LABORATORY
(0-1) 1 credit. Prerequisites: MET 232, and concurrent or completion of EM 217 or EM 321. A course designed to expose the student to practical experience on the mechanical behavior of metals and alloys including deformation processing and failure analysis.

MET 443 COMPOSITE MATERIALS
(3-0) 3 credits. Prerequisites: ME 316 or concurrent enrollment in MET 440. The course will cover heterogeneous material systems; basic design concepts and preparation; types of composite materials; advances in filaments, fibers and matrices; physical and mechanical properties; failure modes; thermal and dynamic effects; and applications to construction, transportation and communication. This course is cross-listed with ME 443.

MET 445/545 OXIDATION AND CORROSION OF METALS
(3-0) 3 credits. Prerequisites: MET 320 or CHE 222 or ME 312 or graduate standing. Initially, the thermodynamics of electrochemical processes are covered; use of the Nernst equation and Pourbaix diagram is presented in this material. Fundamentals of electrode kinetics are then discussed with special emphasis on the derivation of the Butler-Volmer equation and application of the Evan's diagram. Following presentation of these fundamental concepts, phenomena observed in corrosion and oxidation such as uniform attack, pitting, stress corrosion cracking, and corrosion fatigue are discussed. Finally, selection of materials for site specific applications is covered. Students enrolled in MET 545 will be held to a higher standard than those enrolled in MET 445. This course is cross-listed with ENVE 445/545, CHE 445/545, ME 445/545.

MET 454/554 AQUEOUS MATERIALS PROCESSING
(3-0) 3 credits. Prerequisites: MET 320 or CHE 321 or CHEM 342. An advanced level course in aqueous materials processing. It covers the physical chemistry of aqueous solutions, ionic processes of solution, complex ions and coordinate compounds, reaction kinetics, high temperature and pressure aqueous chemistry electrolysis and crystallization. Students enrolled in MET 554 will be held to a higher standard than those enrolled in MET 454.

MET 464 ENGINEERING DESIGN III
(0-2) 2 credits. Prerequisite: MET 352. A continuation of the design sequence.

MET 465 ENGINEERING DESIGN IV
(1-0) 1 credit. Prerequisite: MET 451. A continuation of the design sequence, which includes a final technical design report and appropriate display material for the SDSM&T Design Fair. The Fundamentals of Engineering Exam must be completed as part of the course.

MET 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments

are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

MET 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

MET 614 ADVANCED METALLURGICAL SIMULATION TECHNIQUES
(3-0) 3 credits. An advanced course in the simulation of metallurgical processes. Topics covered include numerical solution of partial differential equations, optimization techniques and numerical integration and interpolation. Although the course is intended primarily for metallurgy majors, the coverage is sufficiently broad that non-metallurgy majors are encouraged to enroll.

MET 624 ADVANCED CHEMICAL METALLURGY
(3-0) 3 credits. Prerequisites: MET 320, MET 321 and MET 422. Application of metallurgical thermodynamics and transport phenomena to extractive metallurgical processes.

MET 625 STRENGTHENING MECHANISMS IN METALS
(3-0) 3 credits. Prerequisite: Permission of instructor. Study of the scientific fundamentals leading to the improvement of the mechanical properties of metallic materials. The treatment includes strengthening by strain hardening, grain and twin boundaries, solute atoms, precipitates, dispersed particles and fibers, martensitic transformations, texturing, point defects, and thermomechanical treatments. Enhancement of fracture, fatigue, and creep behavior is also treated.

MET 632 THEORY OF DISLOCATIONS
(3-0) 3 credits. Prerequisite: MET 440 or permission of instructor. A study of defect theory in solids and their role in governing material behavior. Topics covered include the concept, properties, and mutual interaction of dislocations, point defects, stacking faults, dislocation dynamics (motion and multiplication). Application of defect theory to the phenomena of slip, plastic yielding, thermally-activated plastic flow, microstrain, internal friction, strain hardening, and mechanical twinning.

MET 636 THERMODYNAMICS OF SOLIDS
(3-0) 3 credits. Prerequisite: MET 320 or permission of instructor. The principles of chemical thermodynamics applied to solids encountered in metallurgical engineering. Topics covered include the effect of temperature and pressure upon phase equilibria, surface free energy and its relationship to nucleation and crystal structure, statistical estimation of thermodynamic functions, calculation of thermodynamic functions from phase diagrams and the compositional variation of the activity of components comprising non-stoichiometric compounds.

MET 638 SOLID STATE PHASE TRANSFORMATIONS
(3-0) 3 credits. Prerequisites: MET 332, MET 440 or permission of instructor. Advanced study of phase transformations in condensed systems. Topics covered include kinetic theory of nucleation, rate and morphology of precipitate growth, significance of crystallographic factors, role of lattice defects on transformation, martensitic phase transformation, and relation between structure and properties.

MET 676 ADHESION AND SURFACE ENGINEERING IN POLYMER COMPOSITES
(1-0) 1 credit. Prerequisites: Permission of instructor. The study of the scientific fundamentals leading to adhesion in polymer composites and engineering of surface phenomena to improve polymer composite properties. This course is cross-listed with CHE 676.

MET 791 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor.

MET 792 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

MINE 301/301L MINE SURVEYING
(1-2) 3 credits. Prerequisite: Sophomore standing. Topics include coordinate calculations, errors and adjustments, closed and open traverses, area and volume calculations, surface and underground techniques, and topographic mapping. Laboratory work includes the use of Brunton compass, plane table, level, transit, EDM, and total station.

MINE 316/316L ENGINEERING AND CONSTRUCTION MATERIALS
(2-1) 3 credits. Prerequisite: Preceded by or concurrent with EM 321, and CEE 284. Principles that govern physical and mechanical properties of ferrous and nonferrous metals, plastics, bituminous materials, portland cement, aggregates, concrete, and timber. Laboratory exercises to demonstrate basic principles and standard laboratory tests (ASTM Standards) of structural materials. Computer-aided

graphics and word processing are required for lab reports. This course is cross-listed with CEE 316/316L.

MINE 326 ENVIRONMENTAL ENGINEERING PROCESS FUNDAMENTALS
(3-0) 3 credits. Prerequisites: CHEM 114, EM 331, and CEE 284. The first course in the theory and practice of Environmental Engineering. Emphasis is on the mass-balance approach to problem solving with consideration of water chemistry, environmental process kinetics, ideal reactors, and biological process fundamentals. This course is cross-listed with CEE and ENVE 326.

MINE 346/346L GEOTECHNICAL ENGINEERING
(2-1) 3 credits. Prerequisites: EM 321. Composition, structure, index, and engineering properties of soils; soil classification systems; introduction to soil engineering problems involving stability, settlement, seepage, consolidation, and compaction; and laboratory work on the determination of index and engineering properties of soils. Computer-aided graphics and word processing required for lab reports. This course is cross-listed with CEE 346/346L.

MINE 347 GEOTECHNICAL ENGINEERING II
(3-0) 3 credits. Prerequisite: CEE 346. Composition of soils, origin and deposition, exploration, frost problems, swelling of soils, erosion protection, soil improvement, groundwater flow and dewatering, slope stability of retaining structures, and rigid and flexible pavement design. The application of these topics to highway engineering will be stressed. Computer applications are required. This course is cross-listed with CEE 347.

MINE 411/411L ROCK MECHANICS I
(3-1) 4 credits. Prerequisite: Junior standing. The study of mechanical properties of rocks and the design of structures in rock. Topics include failure criteria for rock, techniques of underground stress measurement, slope stability, and the application of elasticity theory to the design of underground openings. Laboratory work includes the measurement of the mechanical properties of rocks.

MINE 412/512 ROCK MECHANICS III
(3-0) 3 credits. Prerequisite: MINE 411 or equivalent. Experimental laboratory and field techniques for determining the properties and behavior of rock materials. Topics include determination of the properties of anisotropic rocks, discussion of field stresses, influence of joints, strain energy, rockburst mechanics, and rheological behavior of rocks. Field project will include engineering design of a structure in a rock mass. Students enrolled in MINE 512 will be held to a higher standard than those enrolled in MINE 412.

MINE 440/540 ENVIRONMENTAL AND RECLAMATION PRACTICES IN THE MINING INDUSTRY
(3-0) 3 credits. A study of various environmental problems that are associated with mining and the reclamation practices that have been developed or are being evaluated to alleviate these problems. Federal, state, and local reclamation regulations are examined for their effects on present and future mining practices and costs. Field trips to several mining operations are taken for on-site observation of actual reclamation problems and the mining practices used to resolve these problems. Students enrolled in MINE 540 will be held to a higher standard than those enrolled in MINE 440. This course is cross-listed with ENVE 440/540.

MINE 441 ECONOMICS OF MINING
(3-0) 3 credits. Prerequisite: Junior standing. The significance of the mineral industries in the economy, mineral and engineering economics with special emphasis on the valuation of mineral properties, and mine administration economic decision methodologies. This course is cross-listed with ENVE 441.

MINE 450/550 ROCK SLOPE ENGINEERING
(3-0) 3 credits. Prerequisite: CEE 346 or MINE 411. Modes of slope failure. Economic consequences of instability in mining and construction. Geological factors controlling stability of rock slopes. Shear strength of highly jointed rock mass and discontinuities. Projection methods. Vectoral analysis of 3-D problems by means of the sterographic projection method. Analytical, graphical and computer analysis of planar, wedge and toppling failures. Probabilistic methods. Students enrolled in MINE 550 will be held to a higher standard than those enrolled in MINE 450.

MINE 451 COAL MINING
(3-0) 3 credits. Prerequisite: MINE 411 or permission of instructor. Geology and characteristics of coal and lignite. Modern surface and underground coal mining methods together with pillar design, mining equipment selection, mechanized equipment requirements, permitting, reclamation, and coal preparation.

MINE 461/461L MINE VENTILATION AND AIR CONDITIONING
(2-1) 3 credits. Prerequisites: Senior standing, EM 327. A study of the mine atmosphere and its control. Solution of air-flow networks by numerical techniques. Ventilation and air conditioning of deep mines. Design of mine ventilation systems.

MINE 464 UNDERGROUND MINE DESIGN
(4-0) 4 credits. Prerequisite: MINE 411, and at least MINE 441, MINE 461, EM 327 and EE 301

concurrently. A comprehensive study of the principles and practices involved in the selection of mining equipment and choosing the proper method for developing an ore deposit starting with drill hole data following through to a completed feasibility study covering ore reserve calculations, selection of underground mining methods and equipment selection. Computer use will be an integral part of the course.

MINE 465 SURFACE MINE DESIGN
(4-0) 4 credits. Prerequisite: MINE 411, MINE 441 and at least EM 327 concurrently. A comprehensive study of the principles and practices involved in developing an ore deposit starting with drill hole data, following through to a completed feasibility study covering ore reserve calculations, and selection of surface mining methods and equipment. Computer use will be an integral part of the course.

MINE 471 THEORY AND APPLICATION OF EXPLOSIVES
(3-0) 3 credits. Prerequisite: Senior standing, or permission of instructor. The characteristics, composition, and mode of detonation of explosives are studied as related to drill hole pattern and blast design. Smooth blasting techniques and controlled blasting are studied for application to all phases of mining and to other field situations. The techniques used to control airblast and ground vibration and the equipment used for airblast and ground vibration monitoring are studied.

MINE 474/574 ENGINEERING PROJECT MANAGEMENT
(3-0) 3 credits. Prerequisite: Senior standing or permission of instructor. Study of owner, engineer, and contractor organizational structures, project work break down structures, resource and asset allocation, computer and non-computer scheduling by Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT). Students enrolled will be required to perform an engineering project with written and oral presentations. Students enrolled in MINE 574 will be held to a higher standard than those enrolled in MINE 474. This course is cross-listed with CEE 474/574.

MINE 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

MINE 492 TOPICS
1 to 3 credits. Prerequisite: Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

MSL 101 FOUNDATIONS OF OFFICERSHIP
(1-0) 1 credit. Corequisite: MSL 101L. Make your first peer group at college one committed to performing well and enjoying the experience. Increase self-confidence through team study and activities in basic drill, physical fitness, rappelling, leadership reaction course, first aid, making presentations and basic marksmanship. Learn fundamental concepts of leadership in a profession in both classroom and outdoor laboratory environments.

MSL 101L FOUNDATIONS OF OFFICERSHIP LAB
(0-1) 1 credit. Corequisite: MSL 101. Designed to accompany MSL 101. Provides the students with hands-on experience to supplement and reinforce classroom instruction. Subjects addressed include drill and ceremonies, physical fitness training, marksmanship first aid, rappelling and basic mountaineering skills, voluntary off campus activities reinforce course work. This course is cross-listed with PE 101L.

MSL 102 BASIC LEADERSHIP
(1-0) 1 credit. Corequisite: MSL 102L. Learn and apply principles of effective leadership. Reinforce self-confidence through participation in physically and mentally challenging exercise with upper-division ROTC students. Develop communication skill to improve individual performance and group interaction. Relate organizational ethical values to the effectiveness of a leader.

MSL 102L BASIC LEADERSHIP LAB
(0-1) 1 credit. Corequisite: MSL 102. Designed to accompany MSL 102. Provides the students with hands-on experience to supplement and reinforce classroom instruction. Subjects addressed include drill and ceremonies, physical fitness training, marksmanship first aid, rappelling and basic mountaineering skills, voluntary off campus activities reinforce course work. This course is cross-listed with PE 102L.

MSL 120/120L ORIENTEERING
(1-2) 3 credits. Students participate in in-depth instruction and practical application of land navigation techniques with emphasis on orienteering in both an urban and field setting. Students will participate in one hour of instruction and two (2)

hours of lab per week. Practical application will include team orienteering in the local community and in the surrounding Black Hills. Types of orienteering will include Route, Line, Cross Country, and Score Orienteering.

MSL 201 INDIVIDUAL LEADERSHIP SKILLS
(1-0) 12 credit. Corequisite: MSL 201L. Learn/apply ethics-based leadership skills that develop individual abilities and contribute to the building of effective teams of people. Develop skills in oral presentations, writing concisely, planning events, coordination of group efforts, advanced first aid, land navigation, and basic military tactics. Learn fundamentals of ROTC's leadership assessment program.

MSL 201L INDIVIDUAL LEADERSHIP SKILLS LAB
(0-1) 1 credit. Corequisite: MSL 201. Students will develop leadership and management skills by being given the opportunity to perform duties in various leadership positions. Emphasis is placed on the development of leadership and managerial skills. Course is supplemented with instruction on the use of a lensatic compass and a topographic map. As well as various survival skills. Voluntary off campus activities reinforce course work.

MSL 202 LEADERSHIP AND TEAMWORK
(1-0) 1 credit. Corequisite: MSL 202L. Introduction to individual and team aspects of military tactics in small unit operations. Includes use of radio communications, making safety assessments, movement techniques, planning for team safety/security and methods of pre-execution checks. Practical exercises with upper-division ROTC students. Learn techniques for training others as an aspect of continued leadership development.

MSL 202L LEADERSHIP AND TEAMWORK LAB
(0-1) 1 credit. Corequisite: MSL 202. Students are provided the opportunity to reinforce classroom leadership and management training with practical experience. Students will also receive training in small unit tactics and use of the m-16 rifle. Voluntary off campus activities reinforce course work.

MSL 290 BASIC SMALL UNIT LEADERSHIP
(2-0) 2 credits. Concurrent registration in either MSL 101/111 or MSL 201/211 is required. Provides the student with practical experience in small unit leadership development, team building, and the technical and tactical skills needed to be a professional officer in the United States Army. Course includes instruction in and practical application of rifle marksmanship, orienteering, mountaineering, weapons proficiency, physical training, and small unit leadership skills. May be repeated for a maximum of four (4) credit hours.

MSL 291 INTERNSHIP IN LEADERSHIP I
(2-0) 2 credits. This course is designed for ROTC Cadets who have completed M.S. I and II but are not academically aligned to contract as M.S. III's. The course will expand on their applied leadership skills. Upon approval of the instructor, students will develop training plans, schedules, evaluation outlines and classroom instruction. Students may also do department approved research. The class may be repeated up to two (2) times, for a maximum of four (4) credits, with permission of department chair.

MSL 294 ROTC SUMMER LEADERSHIP INTERNSHIP
(0-4) 4 credits. The mission of ROTC Basic Camp is to serve as an alternative for the first two (2) years of on-campus ROTC enrollment. Basic Camp offers students who did not take ROTC courses during their first two (2) years of school the opportunity to enroll in ROTC at the start of their junior year. Basic Camp is a six week training period in which the student undergoes basic military training within a regular Army environment. Instruction consists of both classroom instruction and practical exercises along with considerable field training. All students are closely supervised and carefully evaluated by military officers.

MSL 301 LEADERSHIP AND PROBLEM SOLVING
(2-0) 2 credits. Corequisite: MSL 301L. Series of practical opportunities to lead small groups, receive personal assessments and encouragement, and lead again in situations of increasing complexity. Uses small unit tactics and opportunities to plan and conduct training for lower division students both to develop such skills and as vehicles for practicing leadership.

MSL 301L LEADERSHIP AND PROBLEM SOLVING LAB
(0-2) 2 credits. Corequisite: MSL 301. Provides the student with practical experience to supplement and reinforce classroom instruction. Subjects include drill and ceremonies, physical training instruction techniques and leadership, which will complement the student's preparation for ROTC advanced camp. Off campus.

MSL 302 LEADERSHIP AND ETHICS
(2-0) 2 credits. Prerequisite: MSL 301. Continues methodology of MSL 301. Analyze tasks; prepare written or oral guidance for team members to accomplish tasks. Delegate tasks and supervise. Plan for and adapt to the unexpected in organizations under stress. Examine and apply lessons from leadership case studies. Examine importance of

ethical decision making in setting a positive climate that enhances team performance.

MSL 302L LEADERSHIP AND ETHICS LAB
(0-2) 2 credits. Corequisite: MSL 302. Provides student with additional training in land navigation, drill and ceremonies, physical training, instruction techniques and leadership, which will complement the students' preparation for ROTC advanced camp. Off campus training is required.

MSL 394 ADVANCED MILITARY SCIENCE INTERNSHIP
(0-4) 4 credits. Contracted ROTC Advanced Course Cadets will attend a six-week intensified military training phase at Ft. Lewis, Washington which will provide both classroom and practical experience in the military and leadership skills required by a commissioned officer.

MSL 401 LEADERSHIP AND MANAGEMENT
(2-0) 2 credits. Corequisite: MSL 401L. Introduces formal management skills including problem analysis, planning techniques, and the delegation and control of activities, providing an understanding of the command and staff organization used in the modern army and creating a forum for discussing professional and ethical decisions faced by commissioned officers.

MSL 401L LEADERSHIP AND MANAGEMENT LAB
(0-2) 2 credits. Corequisite: MSL 401. Provides practical experience supplementing and reinforcing classroom instruction, including drill and ceremonies, physical fitness training, instruction techniques, and operation of the cadet battalion. Off-campus training required.

MSL 402 ETHICAL DECISION MAKING FOR LEADERS/OFFICERSHIP
(2-0) 2 credits. Corequisite: MSL 412. Provides information for transition to active or reserve commissioned service, developing administrative controls essential in managing a military organization, introducing the management of financial and personal affairs, and allowing time for discussion and analysis of the ethical decision-making process.

MSL 402L ETHICAL DECISION MAKING FOR LEADERS/OFFICERSHIP LAB
(0-2) 2 credits. Corequisite: MSL 402. Provides practical experience supplementing and reinforcing classroom instruction, including drill and ceremonies, physical fitness training, instructional techniques, small unit leadership and familiarization with duties of commissioned officers. Off-campus training is required.

MSL 403 THIRD YEAR ADVANCED MILITARY SCIENCE
(2-0) 2 credits. Prerequisites: MSL 401 and MSL 402. Provides a transition to entering active or reserve commissioned service, including an in-depth study of military decision making, giving experience in planning and conducting squad and platoon level military exercises and leadership.

MSL 404 THIRD YEAR ADVANCED MILITARY SCIENCE
(2-0) 2 credits. Prerequisite: MSL 401 and MSL 402. Provides an in-depth study of military decision-making, giving experience in planning and conducting military exercises at squad and platoon level, including an opportunity to develop leadership techniques.

MSL 411 DEVELOPING SUBORDINATE LEADERS I
(2-0) 2 credits. Corequisite: MSL 401 Provides practical experience supplementing and reinforcing classroom instruction, including drill and ceremonies, physical fitness training, instruction techniques, and operation of the cadet battalion. Off-campus training required.

MSL 412 DEVELOPING SUBORDINATE LEADERS II
(2-0) 2 credits. Corequisite: MSL 402 Provides practical experience supplementing and reinforcing classroom instruction, including drill and ceremonies, physical fitness training, instructional techniques, small unit leadership and familiarization with duties of commissioned officers. Off-campus training is required.

MSL 480 ADVANCED SMALL UNIT LEADERSHIP
(2-0) 2 credits. Corequisite: MSL 301/301L or MSL 401/411 Provides practical experience in small unit leadership development, team building, and officers' technical/tactical skills, including rifle marksmanship, orienteering, mountaineering, weapons proficiency, physical training, and small unit leadership skills. May be repeated for a maximum of four (4) credit hours.

MSL 491 ADVANCED INTERNSHIP IN LEADERSHIP
(2-0) 2 credits. This course is designed for ROTC Cadets who have completed M.S. IV, but have not completed graduation requirements. The course will allow students to fully develop and conduct training on advanced military subjects. Students may also do department approved research. The class may be repeated two (2) times, for a maximum of four (4) credits, with the permission of department chair.

MSL 494 LEADERSHIP DEVELOPMENT AND ASSESS COURSE
3 to 4 credits. This course is designed for ROTC Cadets who have completed M.S. IV but have not completed graduation requirements. The course will allow students to fully develop and conduct training on advanced military subjects. Students may also do department approved research. The class may be repeated two (2) times, for a maximum of four (4) credits, with the permission of department chair.

MUAP 200 APPLIED MUSIC-VOICE
1 to 4 credits. Prerequisite: Permission of instructor. One (1) to two (2) semester hours credit for private lessons is given for one half-hour lesson per week. Music majors studying in the major performance area may elect two (2) half-hour lessons per week for two (2) to four (4) hours of credit. Adequate preparation through practice is expected of all students. (May be used to fulfill the humanities credit for graduation.)

MUAP 201 APPLIED MUSIC-VOICE
1 to 4 credits. Class voice instruction is open to anyone interested. Emphasis is placed on the development of the fundamental voice techniques. (May be used to fulfill the humanities credit for graduation.)

MUEN 101 CHORAL ENSEMBLES
1 to 2 credits. Prerequisite: Permission of instructor. An ensemble performing accompanied and unaccompanied literature for mixed voices. Membership determined by instructor's permission and audition only. School of Mines does not require an audition. (Any combination of P.E. and MUEN 101/121/122 may be allowed toward fulfillment of the physical education credit for graduation.)

MUEN 121 SYMPHONIC BAND
(1-0) 1 credit. Members are selected by audition to perform the finest in original and transcribed literature in concert performances on and off-campus. (Any combination of P.E. and MUEN 101/121/122 may be allowed toward fulfillment of the physical education credit for graduation.)

MUEN 122 CONCERT BAND
(1-0) 1 credit. A joint enterprise open to university students and interested area musicians. Includes rehearsals and performance of band literature culminating in a public performance. (Any combination of P.E. and MUEN-101/121/122 may be allowed toward fulfillment of the physical education credit for graduation.)

MUEN 250 VOCAL OR INSTRUMENTAL ENSEMBLE
(1-0) 1 credit. Development of vocal or instrumental skills and aesthetic perception through the study and performance of music. This course cannot count as social science/humanities credit.

MUEN 260 NON-CREDIT MUSIC ENSEMBLE
No credit. Development of vocal or instrumental skills and aesthetic perception through the study and performance of music. This course cannot count as social science/humanities credit.

MUEN 330 MUSIC IN PERFORMANCE
(1-0) 1 credit. Prerequisite: Three previous semesters of music ensemble and/or permission of instructor. Development of aural and aesthetic perception through the study and performance of music from Western culture.

MUS 100 MUSIC APPRECIATION
(3-0) 3 credits. A non-technical discussion designed to increase the enjoyment and appreciation of music. Fulfills the music requirement in the general education program.

MUS 110 BASIC MUSIC THEORY I
2 to 4 credits. An integrated study and application of tonality, melody, harmony, texture and form, from basic notation through modulation. Includes sight singing, ear training, and dictation. Introduction to composition and arranging, ie: instrument ranges, transposition, tessitura and preliminary score analysis.

MUS 250 THE SINGING VOICE
(2-0) 2 credits. The study and development of knowledge pertaining to solo vocal techniques with attention to the physiology of the voice mechanism and to literature for the solo voice.

MUS 326 SPECIAL STUDIES IN MUSIC
(1-0) 1 credit. Prerequisite: Junior or senior standing or permission of instructor. Studies on specific topics related to the field of music (e.g. History of Rock and Roll, Recording and Mastering Compact Disc Recordings, etc.). May be taken up to three (3) times with different topics.

PALE 671 ADVANCED FIELD PALEONTOLOGY
(0-2) 2 credits. A field-oriented course stressing collection and detailed documentation of vertebrate fossils. Taphonomic factors, measured sections, and some geologic maps may be required, as well as detailed field notes.

PALE 672/672L MICROPALEONTOLOGY
(2-1) 3 credits. A study of the morphology, ecology, and stratigraphic significance of selected groups of protozoans and invertebrate and plant microfossils with special emphasis on Formaminifera and conodonts. This course is cross-listed with GEOL 672/672L.

PALE 673/673L COMPARTIVE OSTEOLOGY
(2-1) 3 credits. A comparison of recent and fossil vertebrate skeletons and dentitions with emphasis on the skeletons and teeth of sharks, bony fish, salamanders, frogs, turtles, alligators, lizards, birds, and mammals to establish a thorough understanding of the diversity of the form and function of the vertebrate skeleton. A major objective is the identification of vertebrates based upon osteology and odontology. This course is cross-listed with GEOL 673/673L.

PALE 674/674L STRATIGRAPHIC PALEONTOLOGY OF THE CONTINENTAL MESOZOIC AND PALEOGENE
(2-1) 3 credits. Prerequisite: GEOL/PALE 676. The stratigraphic section of the Mesozoic and Paleogene vertebrate-bearing formations of North America is reviewed. Evolution of mammalian faunas and the succession of land-mammal ages are coordinated with this section. Extensive use is made of the published literature and the Museum of Geology collections. This course is cross-listed with GEOL 674/674L.

PALE 675/675L STRATIGRAPHIC PALEONTOLOGY OF THE CONTINENTAL NEOGENE
(2-1) 3 credits. Prerequisite: GEOL/PALE 676. The stratigraphic section of the Neogene vertebrate bearing formations of North America is reviewed. Evolution of mammalian faunas and the succession of land mammal ages are coordinated with this section. Extensive use is made of the published literature and the Museum of Geology collections. This course is cross listed with GEOL 675/675L.

PALE 676/676L VERTEBRATE PALEONTOLOGY
(3-1) 4 credits. An in-depth assessment of the fossil record of vertebrates with special emphasis on current problems in the evolution of vertebrates and the tangible record preserved in the collections of the Museum of Geology. This course is cross-listed with GEOL 676/676L.

PALE 678/678L VERTEBRATE BIOSTRATIGRAPHY
(3-1) 4 credits. Prerequisite: GEOL/PALE 676. The principles and practices for establishing the distribution of vertebrate fossils in the rock record. This course will include a brief history of biostratigraphy, methodology, and the content and assessment of vertebrate ages, particularly of Mesozoic and Cenozoic mammals. This course is cross-listed with GEOL 678/678L.

PALE 684/684L PALEOENVIRONMENTS
(2-1) 3 credits. This course will integrate topics from paleobotany, vertebrate paleontology, and paleoclimatology in a study of paleontological communities through time. Laboratories will include studies of fossil materials. Note: This course is to be offered both through Black Hills State University and South Dakota School of Mines and Technology. This course is cross-listed with GEOL 684/684L.

PALE 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor. A description of the work to be performed must be filed in the Geology/Geological Engineering Office. This course is cross-listed with GEOL 691.

PALE 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. A description of the work to be performed must be filed in the Geology/Geological Engineering Office. This course is cross-listed with GEOL 692.

PALE 770 SEMINAR IN VERTEBRATE PALEONTOLOGY
(2-0) 2 credits. Studies by a group of advanced students, under the guidance of one or more selected instructors, on topics of special and current interest to the group. Involves a combination of lectures, and discussions. Review of current literature in vertebrate paleontology of special topics and/or analysis of new procedures and techniques. Emphasis will be on mammalian paleontology. This course is cross-listed with GEOL 770.

PALE 790 SEMINAR
(1-0) 1 credit. May not be repeated for degree credit. Preparation, oral and/or written presentation, and group discussion of a research problem. The student is expected to present orally the results of his/her own research. This presentation normally will directly precede the final oral defense of the thesis. This course is cross-listed with GEOL 790.

PALE 798 MASTER'S THESIS
Credit to be arranged; not to exceed six (6) credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the M.S. thesis option. Supervised original or expository research culminating in an acceptable thesis. Oral defense of thesis and research findings are required. This course is cross-listed with GEOL 798.

PE 100 ACTIVITY COURSES
(1-0) 1 credit. Activities stressing individual physical fitness and lifetime activities according to student needs and interests. The same activity course can not be counted toward graduation credit.

PE 101L FOUNDATIONS OF OFFICERSHIP LAB
(0-1) 1 credit. Corequisite: MSL 101. Designed to accompany MSL 101. Provides the students with hands-on experience to supplement and reinforce classroom instruction. Subjects addressed include drill and ceremonies, physical fitness training, marksmanship first aid, rappelling and basic mountaineering skills, voluntary off campus activities reinforce course work. This course is cross-listed with MSL 101L.

PE 102L BASIC LEADERSHIP LAB
(0-1) 1 credit. Corequisite: MSL 102. Designed to accompany MSL 102. Provides the students with hands-on experience to supplement and reinforce classroom instruction. Subjects addressed include drill and ceremonies, physical fitness training, marksmanship, first aid, rappelling and basic mountaineering skills, voluntary off campus activities reinforce course work. This course is cross-listed with MSL 102L.

PE 103 NUTRITION FOR EVERYDAY LIVING
(1-0) 1 credit. This course will teach nutritional components of healthy diet, impact on body composition, and overall health. Course includes lecture and activity. This course can only be taken one time for credit.

PE 105 WELLNESS AND PHYSICAL FITNESS
(1-0) 1 credit. For men and women. An activity course with lecture instructing students in many different aspects of personal wellness and physical fitness with practical application. This course can only be taken one time for credit.

PE 113 VARSITY SPORTS I
(1-0) 1 credit. This course is an introduction/conditioning course offered fall semester. A student must be a member of a varsity sports team that is sponsored by SDSM&T to be enrolled in this course. This course can only be taken four times for credit, however it may only be used two times to fulfill Physical Education graduation requirements.

PE 118 BEGINNING AND INTERMEDIATE SWIMMING (MEN AND WOMEN)
(1-0) 1 credit. This course will provide instruction in basic skills and fundamental strokes of swimming. After developing basic skills, the fundamental strokes are perfected along with elementary forms of rescue. This course can only be taken one time for credit.

PE 160 MODIFIED PHYSICAL EDUCATION ACTIVITY
(1-0) 1 credit. This course is designed to adapt a variety of activities to the special needs and interests of students who qualify under the Americans with Disabilities Act. The course will seek to adapt physical fitness and sports activities for the special needs student within the limitations of current staffing and facilities. Course can be repeated once for additional credit.

PHIL 100 INTRODUCTION TO PHILOSOPHY
(3-0) 3 credits. Introduces competing philosophical views of reality, perception, learning, and values, emphasizing their relevance to the contemporary world.

PHIL 200 INTRODUCTION TO LOGIC
(3-0) 3 credits. Introduces the formal study of argumentation, including forms of logic, inductive and deductive reasoning, proofs, refutations, and fallacies.

PHIL 220 INTRODUCTION TO ETHICS
(3-0) 3 credits. Examines the major currents and components of ethical theory from classical times to the present, investigating problems arising from specific theories, as well as critically analyzing the validity of these theories for current ethical concerns.

PHIL 233 PHILOSOPHY AND LITERATURE
(3-0) 3 credits. Examination of selected topics from the Western World's literary tradition and analysis of their contributions in the areas of philosophy of life, philosophy of religion, and the concepts of duty and human nature. Study and discussion of topics in relation to their significance for the individual.

PHYS 111 INTRODUCTION TO PHYSICS I
(3-0) 3 credits. Prerequisite: MATH 102 or MATH 123 or permission of instructor. This is the first course in a two (2) semester algebra-level sequence, covering fundamental concepts of physics. This sequence is appropriate for pre-professional majors requiring two (2) semesters of physics. Topics include classical mechanics, thermodynamics, and waves. SDSM&T covers classical mechanics only. May not be used for credit toward an engineering or science degree (except Interdisciplinary Science, Geology (Paleontology emphasis), Applied Chemistry, and Associate of Arts).

PHYS 111L INTRODUCTION TO PHYSICS I LAB
(0-1)1 credit. Prerequisite or corequisite: PHYS 111. This laboratory accompanies PHYS 111. May not be used for credit toward an engineering or science degree (except Interdisciplinary Science, Geology (Paleontology emphasis), Applied Chemistry, and Associate of Arts).

PHYS 113 INTRODUCTION TO PHYSICS II
(3-0) 3 credits. Prerequisite: PHYS 111. This course is the second course in a two (2) semester

algebra-level sequence, covering fundamental concepts of physics. Topics include electricity and magnetism, sound, light, optics, and some modern physics concepts. SDSM&T course covers electricity and magnetism only. May not be used for credit toward an engineering or science degree (except Interdisciplinary Science, Geology - Paleontology emphasis, Chemistry - Applied Chemistry Option, and Associate of Arts).

PHYS 113L INTRODUCTION TO PHYSICS II LAB
(0-1) 1 credit. Prerequisite or corequisite: PHYS 113 This laboratory accompanies PHYS 113. May not be used for credit toward an engineering or science degree (except Interdisciplinary Science, Geology - Paleontology emphasis, Applied Chemistry, and Associate of Arts).

PHYS 183 ELEMENTS OF MODERN ASTRONOMY
(3-0) 3 credits. This course presents a broad view of astronomy in a straightforward and descriptive manner without complex mathematics. It introduces students to basic concepts and the historic and modem foundations of the science of astronomy. Students will gain some insight into the basic physics underlying conclusions drawn from observational and theoretical astronomy, astrophysics, and cosmology. The course provides descriptions of a wide variety of objects found in the universe, from gas and dust particles of stars, planets, and galactic clusters.

PHYS 211/211A UNIVERSITY PHYSICS I
(3-0) 3 credits. Prerequisite: MATH 123 or permission of instructor. This is the first course in a two (2) semester calculus-level sequence, covering fundamental concepts of physics. This is the preferred sequence for students majoring in physical science or engineering. Topics include classical mechanics and thermodynamics. SDSM&T course covers classical mechanics only.

PHYS 213/213A UNIVERSITY PHYSICS II
(3-0) 3 credits. Prerequisite: PHYS 211. This course is the second course in a two (2) semester calculus-level sequence, covering fundamental concepts of physics. This is the preferred sequence for students majoring in physical science or engineering. Topics include electricity and magnetism, sound, light, and optics. SDSM&T course covers electricity and magnetism only.

PHYS 213L UNIVERSITY PHYSICS II LABORATORY
(0-1) 1 credit. Prerequisite or corequisite: PHYS 213. This laboratory accompanies PHYS 213. Introduction to physical phenomena and measurements. Recording and processing data, determining uncertainties, reporting results. The experiments supplement the work in PHYS 211 and PHYS 213.

PHYS 275 RELATIVITY
(3-0) 3 credits. Prerequisites: A working knowledge of elementary algebra and trigonometry. Michelson-Morley experiment, inertial reference frames, the principle of relativity, space-time coordinates of an event, Lorentz Transformations, clock paradox, momentum-energy 4-vector, equivalence of energy and rest mass, the principle of equivalence, curved space-time and qualitative features of general relativity and cosmology, relevance of relativity to space travel.

PHYS 291 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

PHYS 292 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

PHYS 312 EXPERIMENTAL PHYSICS DESIGN I
PHYS 314 EXPERIMENTAL PHYSICS DESIGN II
(0-2) 2 credits each. Prerequisite: CENG 244 or permission of instructor. This course is structured to acquaint the student with the experimental design methods. The experiments are chosen to cover as many areas as possible in keeping with the backgrounds of faculty and abilities of the students.

PHYS 341 THERMODYNAMICS
(3-0) 3 credits. Prerequisite: PHYS 213 and MATH 225 or permission of instructor. This is an intermediate level thermodynamics course dealing with systems from a macroscopic perspective. Topics include the first and second laws of thermodynamics, phase diagrams, and equilibria.

PHYS 361 OPTICS
(3-0) 3 credits. Prerequisite: PHYS 113 or PHYS 213 and MATH 225 or permission of instructor. This is an intermediate level study of geometrical and physical optics. Topics include analysis of

Courses

refraction phenomena, thick lenses, wave nature of light, interference, diffraction, and polarization.

PHYS 363 ACOUSTICS
(3-0) 3 credits. Prerequisite: PHYS 213. Basic principles of vibration and sound with applications to musical instruments, sound reproduction systems, architectural acoustics, and control of noise and vibration.

PHYS 386/386L OBSERVATIONAL ASTRONOMY
(2-1) 3 credits. Prerequisite: PHYS 185. This course is designed to help students expand their knowledge of astronomy through interactive seminars and observing sessions. The focus of this course will be on: 1) developing a more comprehensive background in stellar and galactic astronomy as well as solar system structure, and 2) developing observational and data collection skills using state of the art telescopes. Background knowledge in the above mentioned subjects will be fostered through instructor-supervised seminars led by the students. Students will use current web-based and advanced amateur/professional publications to lead the seminar sessions. Current theories on the formation of the solar system, stars, galaxies, and the universe will also be covered. Advanced observing sessions will be held off-campus at the Badlands Observatory in Quinn, SD. Observing sessions will incorporate advanced 18 inch and 26 inch telescopes provided by the instructors also with CCD cameras and software for data collection and image manipulation. Observing sessions will involve students in ongoing searches for near-earth asteroids.

PHYS 391 INDEPENDENT STUDY
1 to 4 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

PHYS 392 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

PHYS 412 ADVANCED DESIGN PROJECTS I
PHYS 414 ADVANCED DESIGN PROJECTS II
(0-2) 2 credits each. The student designs and carries out original projects. The aim is to involve the student in project design and the application of knowledge to a realistic problem. Students will be significantly engaged in the research efforts of the department.

PHYS 421/521 ELECTROMAGNETISM
(4-0) 4 credits. Prerequisite: PHYS 213 and MATH 321. This is a course in the principles of electricity and magnetism, with applications to dielectric and magnetic materials. Topics include the development of Maxwell's equations, and applications. Students enrolled in PHYS 521 will be held to a higher standard than those enrolled in PHYS 421.

PHYS 433/533 NUCLEAR AND ELEMENTARY PARTICLE PHYSICS
(3-0) 3 credits. Prerequisite: PHYS 471 or permission of instructor. This course covers fundamental topics in nuclear physics and elementary particles. Topics include radioactivity, nuclear spectra and structure, nuclear models, elementary particle theories and high energy physics. Students enrolled in PHYS 533 will be held to a higher standard than those enrolled in PHYS 433.

PHYS 439/539 SOLID STATE PHYSICS
(4-0) 4 credits. Prerequisite: MATH 321 or permission of instructor. This course looks at solid materials from a microscopic level. Topics include basic crystal structure, mechanical and thermal properties, and electronic processes with reference to electrical properties of metals, semiconductors, and insulators. Students enrolled in PHYS 539 will be held to a higher standard than those enrolled in PHYS 439.

PHYS 445 STATISTICAL MECHANICS
(4-0) 4 credits. Prerequisite: PHYS 451 and MATH 321 or permission of instructor. This course provides a systematic introduction to the use of statistical principles applied to the study of thermodynamic systems.

PHYS 451/551 CLASSICAL MECHANICS
(4-0) 4 credits. Prerequisite: PHYS 113 or PHYS 213 and prerequisite or corequisite MATH 321. This is a systematic introduction to classical mechanics emphasizing motion in three dimensions. Topics include central forces, harmonic oscillations, non-inertial reference frames, rigid body motion, and Lagrangian and Hamiltonian Mechanics. Students enrolled in PHYS 551 will be held to a higher standard than those enrolled in PHYS 451.

PHYS 471/571 QUANTUM MECHANICS
(4-0) 4 credits. Prerequisite: MATH 321 or permission of instructor. This is a systematic introduction to quantum mechanics, emphasizing the Schrödinger equation. Topics include simple soluble problems, the hydrogen atom, approximation

methods and other aspects of quantum theory. Students enrolled in PHYS 571 will be held to a higher standard than those enrolled in PHYS 471.

PHYS 481/581 MATHEMATICAL PHYSICS
(4-0) 4 credits. Prerequisite: Permission of instructor. This course looks at mathematical methods used to formulate and solve problems in various fields of physics. Topics are chosen from: series solutions, special functions, computational methods, complex variables, multi-variate methods, transform methods, and other areas of mathematical applications to physics. Students enrolled in PHYS 581 will be held to a higher standard than those enrolled in PHYS 481.

PHYS 491 INDEPENDENT STUDY
1 to 4 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

PHYS 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement.

PHYS 671 MATHEMATICAL PHYSICS I
(3-0) 3 credits. Prerequisite: MATH 432 or equivalent. The formulation and solution of problems in the various fields of physics. Topics include the use of series, complex variables, Green's functions, transform methods, variational methods, eigenfunctions, and an introduction to perturbation theory.

PHYS 673 MATHEMATICAL PHYSICS II
(3-0) 3 credits. Prerequisite: MATH 432 or equivalent. The formulation and solution of problems in the various fields of physics. Topics include the use of series, complex variables, Green's functions, transform methods, variational methods, eigenfunctions, and an introduction to perturbation theory.

PHYS 691 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor.

PHYS 692 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

PHYS 721 ADVANCED ELECTRICITY AND MAGNETISM I
(3-0) 3 credits. Prerequisite: PHYS 423 or equivalent. A continuation of PHYS 421 and PHYS 423, this course treats advanced problems with special emphasis on solutions of the wave equation, Laplace's equation, and Poisson's equation. Through introduction of the methods of special relativity, the unity of electrical and magnetic phenomena and the covariance of Maxwell's equations are demonstrated. If time permits, topics such as MHD and plasma physics are also introduced.

PHYS 743 STATISTICAL MECHANICS
(3-0) 3 credits. Prerequisite: PHYS 343. Review fundamentals of thermodynamics, introduce Legendre transforms and develop the concepts of phase equilibria and stability, ensembles, partition functions, and the role of fluctuations. Statistical mechanics of non-interacting ideal systems and phase transformations, mean field theory, renormalization group theory and Monte Carlo calculations applied to the Ising Model.

PHYS 751 ADVANCED DYNAMICS I
(3-0) 3 credits. Prerequisite: PHYS 357 or equivalent. Advanced treatment of classical mechanics, including Lagrange's and Hamilton's equations, rigid-body motion, canonical transformations, calculus of variations, and relativity using vectors, matrices, and tensors.

PHYS 777 QUANTUM MECHANICS I
PHYS 779 QUANTUM MECHANICS II
(3-0) 3 credits each. Physical basis of quantum mechanics, Schroedinger's equation and its solution, matrix mechanics, operator methods, approximate methods with an introduction to the relativistic wave equation.

PHYS 791 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor.

PHYS 792 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

POLS 100 AMERICAN GOVERNMENT
(3-0) 3 credits. A study of the basic principles of the American system of government with emphasis on

problems relating to governmental structure and policies.

POLS 210 STATE AND LOCAL GOVERNMENT
(3-0) 3 credits. An analysis of the legal status, powers and functions, intergovernmental relations and political problems of state and local governments.

POLS 350 INTERNATIONAL RELATIONS
(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. How nations/states behave and why they behave as they do in their relations with each other.

POLS 407 ENVIRONMENTAL LAW AND POLICY
(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. An examination of the political issues involved with environmental and ecological concerns such as land use, population, air and water pollution, energy, and public policy.

POLS 430 CONSTITUTIONAL LAW
(3-0) 3 credits. A study of the interpretation of the federal constitution through leading decisions of the Supreme Court.

POLS 440 COMPARATIVE GOVERNMENT
(4-0) 4 credits. A comparative study of the governmental institutions and processes of leading countries of the world. May be repeated for credit if topic varies.

POLS 453 AMERICAN FOREIGN POLICY
(3-0) 3 credits. An analysis of the formulation and execution of American foreign policy. Emphasis will be placed on national security issues and American policies with regard to particular regions and countries.

PSYC 101 GENERAL PSYCHOLOGY
(3-0) 3 credits. This course is an introductory survey of the field of psychology with consideration of the biological bases of behavior, sensory and perceptual processes, learning and memory, human growth and development, social behavior and normal and abnormal behavior.

PSYC 261 THE PSYCHOLOGY OF BEING
(3-0) 3 credits. A course designed to help students identify, clarify, and act upon shared experiences common to all people including personal and interpersonal dynamics as these impact the behaviors of individuals and groups.

PSYC 323 HUMAN DEVELOPMENT THROUGHOUT THE LIFESPAN
(4-0) 4 credits. Prerequisite: PSYC 101 or permission of instructor. Focus will be upon physiological/biological, intellectual, emotional, social, and psychological development. Includes the normal sequence of development as well as developmental irregularities.

PSYC 331 INDUSTRIAL AND ORGANIZATION PSYCHOLOGY
(3-0) 3 credits. Prerequisite: PSYC 101 and junior standing or permission of instructor. This course covers the application of psychological principles to such problems as employee selection, supervision, job satisfaction, and work efficiency.

PSYC 391 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

PSYC 392 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. May be repeated twice with different topics for a maximum of six credits.

PSYC 441 SOCIAL PSYCHOLOGY
(3-0) 3 credits. Prerequisite: PSYC 101 or permission of instructor. This course covers basic principles of social psychology including concepts and methods utilized in analyzing individual and group interactions.

PSYC 451 PSYCHOLOGY OF ABNORMAL BEHAVIOR
(3-0) 3 credits. Prerequisite: PSYC 101 or permission of instructor. This course is a comprehensive survey of abnormal personality and behavior. It includes an examination of the origin, symptoms and treatment of psychological disorders.

PSYC 461 THEORIES OF PERSONALITY
(3-0) 3 credits. Prerequisite: PSYC 101 or permission of instructor. Students will learn about the role of philosophy and science and their contributions to the development of personality theory. Students will examine, in depth, the theoretical contributions made in the areas of psychoanalytic, behavioristic, and humanistic personality theories. The students will be able to

articulate their own beliefs concerning the development of human personality.

REL 230 INTRODUCTION TO THE BIBLE
(2-0) 2 credits. Survey of the main books of the Old and New Testaments with analysis of some of the more important passages. Examines Biblical materials in the light of current literary, historical, theological, and archaeological research.

REL 250 WORLD RELIGIONS
(3-0) 3 credits. Introduces the major religions of humankind, examining the function and diversity of religious expression in human experience, and the role of these religions in international relations.

SOC 100 INTRODUCTION TO SOCIOLOGY
(3-0) 3 credits. Comprehensive study of society, with analysis of group life, and other forces shaping human behavior.

SOC 150 SOCIAL PROBLEMS
(3-0) 3 credits. A study of present day problems in contemporary societies, such as racism, sexism, ageism, alcoholism, drug addiction, physical and mental health, war and environmental issues-their significance and current policies and action.

SOC 250 COURTSHIP & MARRIAGE
(3-0) 3 credits. Courtship and marriage period given special emphasis, as are problems of mate selection, marital adjustments, reproduction, child-parent relations, divorce and later years of marriage.

SOC 351 CRIMINOLOGY
(3-0) 3 credits. Prerequisite: SOC 100 or 150. Focuses on theories of crime, juvenile delinquency and justice, law, systems of criminal behavior, victimization, and corrections.

SOC 391 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

SOC 392 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six (6) credits of special topics will be allowed for degree credit.

SOC 402 SOCIAL BEHAVIOR
(3-0) 3 credits. Prerequisite: SOC 100 or SOC 150. This course examines the nature of negatively evaluated behaviors and the process by which customs, rules and normative structure of society are constructed.

SOC 411/511 LICIT AND ILLICIT DRUGS
(3-0) 3 credits. Prerequisite: SOC 100, 150 or PSYC 101. A survey of the use, abuse, and addictive properties of psychoactive drugs other than alcohol; approaches to prevention, treatment, and identification of use. Will apply toward certification for chemical dependency counseling. Students enrolled in SOC 511 will be held to a higher standard than those enrolled in SOC 411.

SOC 420/520 ALCOHOL USE AND ABUSE
(3-0) 3 credits. Prerequisite: SOC 100, 150 or PSYC 101. A survey of the use, abuse, and addictive nature of beverage alcohol, some of the problems associated with excessive use of alcohol, and approaches to prevention and treatment. Will apply toward certification for chemical dependency counseling. Students enrolled in SOC 520 will be held to a higher standard than those enrolled in SOC 420.

SOC 459 SOCIOLOGY OF DEATH AND DYING
(3-0) 3 credits. Prerequisite: SOC 100 or permission of instructor. This is a study of the beliefs, attitudes, and values toward death and dying, as well as a probe of the customs, laws, social norms, scientific information, and anthropolical and sociological viewpoints of death and dying.

SOC 483 SOCIOLOGY OF GENDER ROLES
(3-0) 3 credits. Prerequisite: SOC 100 or SOC 150. Female and male roles in relation to one another in a changing world are foci of this course. The nature of gender roles, their origin and maintenance, institutional features, and their variations over time, and across cultures are examined.

SOC 491 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Includes directed study, problems, readings, directed readings, special problems and special projects. Students complete individualized plans of study which include significant one-on-one student-teacher involvement. The faculty member and students negotiate the details of the study plans. Enrollments are usually 10 or fewer students. Meeting depending upon the requirements of the topic.

SOC 492 TOPICS
1 to 3 credits. Includes current topics, advanced topics and special topics. A course devoted to a

particular issue in a specified field. Course content is not wholly included in the regular curriculum. Guest artists or experts may serve as instructors. Enrollments are usually 10 or fewer students with significant one-on-one student/teacher involvement. A maximum of six (6) credits of special topics will be allowed for degree credit.

SOCW 200 FIELD OF SOCIAL WORK
(3-0) 3 credits. Provides a basic understanding of social work, including where it is practiced, ways of working, philosophy, and functions. The course also provides a current and historical examination of the nature and scope of social welfare systems, institutions and practice.

SOCW 210 INTERACTIONAL SKILLS
(3-0) 3 credits. This course focuses on students gaining understanding and mastery of interactional helping skills used by social workers in practice. Students learn through lecture, in-class exercises, and role play.

SPAN 101 INTRODUCTORY SPANISH I
SPAN 102 INTRODUCTORY SPANISH II
(4-0) 4 credits each. Prerequisite for SPAN 102 is SPAN 101 or permission of instructor. Introduces the fundamental elements of Spanish sentence structure and vocabulary. Promotes speaking, listening and writing within a cultural context. Classwork may be supplemented with required aural/oral practice outside of class.

SPCM 101 FUNDAMENTALS OF SPEECH
(3-0) 3 credits. Introduces the study of speech fundamentals and critical thinking through frequent public speaking practice, including setting, purpose, audience, and subject. This course can not count as social science/humanities credit.

TM 620 QUALITY MANAGEMENT
(3-0) 3 credits. This course is intended as an introduction to the philosophies, concepts, and tools of Total Quality Management. Topics include: An introduction to the philosophies of Juran, Deming, and Taguchi; total quality and quality improvement; quality and technology; and managing a quality environment. Elements of statistical process control, including pareto diagrams, box plots, histograms, and control charts will also be investigated using a commercial software package. Special projects and current readings in quality management will be assigned.

TM 625 INNOVATION AND COMMERCIALIZATION
(3-0) 3 credits. This course covers the practical aspects of developing an innovative idea or new technology from conceptualization through commercialization. Course topics include product innovation, product development, technology forecasting, technology transfer, small business development resources, and commercialization.

TM 631 OPTIMIZATION TECHNIQUES
(3-0) 3 credits. The course develops basic judgment and competence in using quantitative methods in engineering or management decisions. Students will study various types of linear programming techniques, including simplex, transportation and assignment methods and post-optimal sensitivity analysis. In addition, network-type problems, critical-path methods, dynamic and decision tree techniques will be covered. Some basic mathematical theory is taught and the computer is used to solve both assigned problems and problems developed by the student in a particular field of interest.

TM 640 BUSINESS STRATEGY
(3-0) 3 credits. This course provides a financial management approach within a systems context approach. Financial concepts are analyzed from the perspective of three basic types of decisions for any ongoing business: investment, operations, and financing. Course materials are structured around the viewpoints of major parties interested in the performance of business: managers, owners, and creditors. Financial concepts are reinforced by simulating the impact various business strategies have on the financial health of the virtual enterprise.

TM 650 SAFETY MANAGEMENT
(3-0) 3 credits. Management aspects of occupational safety and health. Topics include: Development and implementation of safety programs and ergonomics programs, risk management, economic impact, legislation (including OSHA, Workers Compensation, and ADA), legal issues, wellness programs, system safety, certification, ethics, and professionalism.

TM 655 ERGONOMICS FOR MANAGERS
(3-0) 3 credits. Management aspects of ergonomics and human factors engineering. Topics include: Introduction to ergonomics and human factors principles, the business case for ergonomics, understanding cumulative trauma and neurovascular disorders, development and implementation of ergonomics programs, economic and regulatory aspects, work organization, job satisfaction, quality and productivity aspects, strategic issues and trends, and certification.

TM 661 ENGINEERING ECONOMICS FOR MANAGERS
Credit: Variable 1 to 4. Students are expected to have prerequisite skills in the time value of money and basic probability. Students not having these skills require the permission of instructor. The

course is divided into four (4) one-credit modules, which include: economic valuation for decision making, problems with uncertainty and risk, budgeting and cost management, and financial statements and enterprise management. (Manufacturing elective) This course is cross-listed with ME 661.

TM 663 OPERATIONS PLANNING
(3-0) 3 credits. Organization, functions, and responsibilities of the production control department and some related functions in industry. It includes: planning, authorizing, routing, scheduling, dispatching, and controlling the flow of production. The course also introduces the student to the fundamentals of inventory control, statistical quality control, pert-cpm, and operations research. (Manufacturing elective)

TM 665 PROJECT PLANNING AND CONTROL
(3-0) 3 credits. Prerequisites: PSYC 101 preferred. Project planning, execution and control of less repetitive types of work. This includes quantitative aspects such as costs, time and performance specifications; and qualitative aspects such as organization structures, psychological and sociological relationships. This course is cross-listed with GE 665.

TM 675 ETHICS AND PROFESSIONALISM FOR TECHNOLOGY MANAGERS
(3-0) 3 credits. This course will introduce students to many of the professional and ethical issues from a manager's perspective. Professionalism topics include: networking, business etiquette, professional dress, and helping employees raise their level of professionalism. Ethics topics include: harassment, dealing with an employee's disclosure, ant the Whistle Blower Act.

TM 720 STATISTICAL PROCESS CONTROL
(2-0) 2 credits. This course covers the application of statistical methods to problems in quality and process control. Statistical topics include: basics of processes and variability, statistically controlled processes, variable and attribute control charts, moving averages, and process capability.

TM 732 STOCHASTIC MODELS IN OPERATIONS RESEARCH
(3-0) 3 credits. Probabilistic quantitative methods are developed. These include project control (PERT), decision trees, risk analysis, queuing, Markov chains, mathematical modeling and Monte Carlo simulation. Computer programs are used to solve practical problems after the techniques are developed and understood.

TM 742 ENGINEERING MANAGEMENT AND LABOR RELATIONS
(3-0) 3 credits. Principles of management, supervision, administrative policies, human-factors engineering, and labor-management relationships.

TM 745 FORECASTING FOR BUSINESS AND TECHNOLOGY
(3-0) 3 credits. This course provides an introduction to the quantitative and qualitative tools that may be used to identify and assess emerging technological advances. Topics include multiple regression, ARIMA forecast models and estimation, econometric models, and delphi techniques. Special projects and current readings in technology may be assigned.

TM 788 MASTER'S RESEARCH PROBLEMS/PROJECTS
Credit to be arranged: not to exceed three (3) credits toward fulfillment of M.S. degree requirements. Open only to students pursing the M.S. non-thesis option. Directed research investigation of a selected problem culminating in an acceptable written report. An oral defense of the report and research findings is required.

TM 791 INDEPENDENT STUDY
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparation of papers, as agreed to in advance, by student and instructor. Student may enroll in this course only twice and for no more than a total of six credits.

TM 792 TOPICS
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. Student may enroll in this course only twice and for no more than a total of six credits.

TM 798 MASTER'S THESIS
Credits to be arranged; not to exceed six credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the Master of Science in Technology Management thesis option. Supervised original or expository research culminating in an acceptable thesis. Oral defense of the thesis and research findings are required.

TTL 514 FUNDAMENTALS OF NETWORKING
(1-0) 1 credit. This session will cover the basics of NT, hardware, and applications. It is intended for participants who will go on to the session/course, TTL 515. This is a five-day course presented during the summer session as part of the Technology for Teaching and Learning - Network Administration (TTL-NA) program.

TTL 515/545 NETWORK ADMINISTRATION

(3-0) 3 credits. Prerequisite: TTL 514 or equivalent. Students will learn how to set up an NT server, trouble shooting skills, techniques for backing-up and restoring data, policies and procedures for administering a server environment, and network protocols. Students will also learn network infrastructure, connectivity and security with applications. This course is presented as part of the TTL-NA training for the K-12 educational environment.

TTL 516 ADVANCED COMPUTER NETWORKS
(2-0) 2 credits. Prerequisite: Attendance at TTL-NA Core Curriculum, or equivalent as determined by instructor. The course is designed to provide the student with an understanding of the fundamental concepts involved in computer networking including the OSC network model, industry standards, IP addressing, subnet masks, network topologies and components, basic network design, beginning router configurations and routed and routing protocols. The Cisco Academy curriculum for Semester One and Two will be primary source for students, along with additional information specific to K-12 networking in South Dakota. Students will be expected to take and pass the CCNA (Cisco Certified Network Associate) tests for each "Semester" of the curriculum. Students who are, or will be, certified K-12 secondary teachers will be expected to take and pass the CCAI (Cisco Certified Academic Instructor), and will then be qualified to teach Semester One and Two of the Cisco Academy to students in their home schools.

TTL 517/527/547 NETWORK SUPPORT
1 to 2 credits. Prerequisite: Attendance at TTL-NA Core Curriculum, or equivalent as determined by instructor. This course will cover topics relevant to multi-platform, multi-site interconnectivity. A list of topics will include administration for Mac/Win 95/Win 98/NT; Novell, Linux, and Unix; Networking security and scripting, troubleshooting NT, NT 2000 server migration, network design and performance improvements and multi-domain administration, and TCP/IP with applications for the K-12 educational environment.

TTL 518/548 MULTIMEDIA SUPPORT
(1-0) 1 credit. Prerequisite: Attendance at TTL-NA Core Curriculum, or equivalent as determined by instructor. Students will learn Vtel support, M.S. Proxy server, JDL/Cyberlibrary and Net Nanny with applications for the K-12 educational environment. Speakers from the business world will also discuss applications in today's world.

TTL 519/529/549 INSTRUCTIONAL AND ADMINISTRATIVE NETWORK SUPPORT
(1-0) 1 credit. Prerequisite: Attendance at TTL-NA Core Curriculum, or equivalent as determined by instructor. Topics included in this course include Outlook 2000, web development, intranet and distributed applications, local web servers, and internet information server. Students will give presentations at the conclusion of the course.

2005-2006 ACADEMIC YEAR
(As of July 2005)

EXECUTIVE COUNCIL

RUCH, CHARLES P. (2003) President. B.A., College of Wooster; M.A., Ph.D., Northwestern University.

STURM, CAROL A. (2004) Assistant to the President. A.A., Chadron State College; B.A., Western Illinois University

HENDERSON, TIMOTHY G. (1981) Vice President, Business and Administration. B.S., University of South Dakota.

LANGERMAN, MICHAEL A. (1992) Chair of the Faculty Senate; Professor, Department of Mechanical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Idaho.

MAHON, PATRICIA G. (2000) Vice President, Student Affairs and Dean of Students. B.S., M.S., Montana State University-Billings; Ph.D., Kansas State University.

PAPPEL, L. ROD (1991) President, South Dakota School of Mines and Technology Foundation. B.S., M.S., South Dakota School of Mines and Technology. Registered Professional Engineer (South Dakota).

PILLAY, GAUTAM (2004) Vice President, Office of Research Affairs; Research Professor, Department of Chemical and Biological Engineering. B.S., New Mexico State University; Ph.D., Texas A&M University.

SMORAGIEWICZ, JULIE A. (1994) Vice President, University and Public Relations. B.A., M.Ed., University of Toledo.

VOTTERO, TIMOTHY J. (1998) Director, Alumni Association. B.S., South Dakota School of Mines and Technology.

WHITEHEAD, KAREN L. (1981) Provost and Vice President, Academic Affairs. B.A., Ph.D., University of Minnesota.

FACULTY

ADAMSON, JACKIE L. (2002) Assistant Professor, Department of Social Sciences. B.A., M.A., California State University-San Bernandino; Ph.D., University of Nebraska-Lincoln.

ANDERSEN, PATRICIA M. (1984) Director, Devereaux Library. B.S., University of South Dakota; M.L.I.S., Louisiana State University.

ANTONEN, KATHY (1988) Professor, Department of Humanities. B.A., M.A., Augustana College, Ph.D., University of Minnesota.

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MOE, GEORGE R. (1966-1983) Professor Emeritus, Department of Humanities and Social Sciences. B.S., U.S. Military Academy; M.A., University of Maryland; Ph.D., American University.

MORGAN, BRADFORD A. (1982-2004) Professor Emeritus, Department of Humanities. B.A., University of California-Berkeley; M.A., Ph.D., University of Denver.

MUNRO, JAMES M. (1977-2005) Professor Emeritus, Department of Chemistry and Chemical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Utah. Registered Professional Engineer (South Dakota).

MUSIL, DENNIS J. (1967-1990) Research Associate Professor Emeritus, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., University of Wisconsin, Superior; B.S., Pennsylvania State University; M.S., South Dakota School of Mines and Technology.

NEWSTROM, BOOTS (1967-1994) Associate Professor Emerita, Department of Humanities. B.S., M.Ed., Black Hills State College; M.A., University of California.

OPP, ROGER L. (1966-2003) Professor Emeritus, Department of Mathematics and Computer Science. B.S., Northern State College; M.S., South Dakota School of Mines and Technology.

ORVILLE, HAROLD D. (1965-1996) Distinguished Professor Emeritus, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.A., University of Virginia; M.S., Florida State University; Ph.D., University of Arizona.

PENDLETON, RICHARD L. (1973-1997) Professor Emeritus, Department of Mechanical Engineering. B.S., M.S., Missouri School of Mines; Ph.D., University of Missouri-Rolla. Registered Professional Engineer (South Dakota, Wyoming).

PETERSON, HOWARD C. (1957-1992) (2001) Dean of Students Emeritus. B.S., South Dakota School of Mines and Technology; M.S., Northern State College; Ed.D., University of South Dakota.

PROPSON, THOMAS P. (1968-1996) Professor Emeritus, Department of Civil and Environmental Engineering. B.S.E., M.S.E., Ph.D., University of Michigan. Professional Engineer.

RAHN, PERRY H. (1968-1997) Professor Emeritus, Department of Geology and Geological Engineering. B.A., B.S., Lafayette College; Ph.D., Pennsylvania State University. Certified Professional Geological Scientist; Registered Professional Engineer (South Dakota).

RAMAKRISHNAN, VENKATASWAMY (1969-2002) Distinguished Professor Emeritus, Department of Civil and Environmental Engineering. B.E., D.S.S., University of Madras; D.I.C. (Conc. Tech.), D.I.C. (Hydro-Power), Imperial College of Science and Technology-London; Ph.D., University of London.

REDDEN, JACK A. (1969-1991) Professor Emeritus, Department of Geology and Geological Engineering. A.B., Dartmouth College; M.S., Ph.D., Harvard University.

REDIN, ROBERT D. (1962-1995) Professor Emeritus, Department of Physics. B.S., M.S., Ph.D., Iowa State University.

RIEMENSCHNEIDER, A. LOUIS (1967-1974) (1980-1998) Professor Emeritus, Department of Electrical and Computer Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Wyoming. Registered Professional Engineer (South Dakota).

ROBINSON, BLAINE B. (1966-1996) Professor Emeritus, Department of Humanities. B.A., University of Denver; M.S., South Dakota State University; Ed.D., University of South Dakota.

SANDVIG, ROBERT L. (1946-1987) Professor Emeritus, Department of Chemistry and Chemical Engineering. B.S., South Dakota School of Mines and Technology; M.S., University of Cincinnati; Ph.D., University of Colorado.

SCHILZ, CARL E. (1946-1973) Professor Emeritus, Department of Chemistry and Chemical Engineering. A.B., Albion College; M.S., University of Illinois.

SCHLEUSENER, RICHARD A. (1965-1987) President Emeritus. B.S., University of Nebraska; M.S., Kansas State University; Ph.D., Colorado State University.

SMITH JR., PAUL L. (1966-1996) Professor Emeritus, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., M.S., Ph.D., Carnegie Institute of Technology.

SNYDER JR, LESTER W. (1959-1984) Professor Emeritus, Department of Mechanical Engineering. B.S., Louisiana Polytechnic Institute; M.S., Carnegie Institute of Technology. Registered Professional Engineer (Louisiana).

SPELTS, CATHRYN A. (1967-1990) Associate Professor Emerita, Department of Humanities. B.S., Nebraska State College; M.Ed., Black Hills State College; Ed.D., University of South Dakota.

STONE, GLEN A. (1973-2005) Professor Emeritus, Department of Materials and Metallurgical Engineering. B.S., Drexel University; M.S., Ph.D., University of California-Berkeley.

THIELEN, A. CHARLES (1964-1993) Professor Emeritus, Department of Social Sciences. B.S., M.S., Northern State College; Ed.D., University of Wyoming.

THORSON, DONALD A. (1947-1985) Professor Emeritus, Department of Civil and Environmental Engineering. B.S., South Dakota School of Mines and Technology; M.S., Colorado A&M. Registered Professional Engineer (South Dakota); Registered Land Surveyor (South Dakota).

WEGER, RONALD C. (1967-1991) Professor Emeritus, Department of Mathematics and Computer Science; Research Associate, Institute of Atmospheric Sciences. B.A., William Jewell; M.S., Ph.D., University of Illinois-Urbana.

WILSON, ROBERT W. (1961-1975) Professor Emeritus, Department of Geology and Geological Engineering. B.S., M.S., Ph.D., California Institute of Technology.

Mines Matters: School of Mines faculty members are selected to mentor first-time freshmen because of their special interest in and commitment to new students. In addition to being the academic advisors for these first-time students, mentors provide encouragement, personal guidance, and a bridge to university services.

ADMINISTRATION
OFFICE OF THE PRESIDENT

RUCH, CHARLES P. (2003) President. B.A., College of Wooster; M.A., Ph.D., Northwestern University.

STURM, CAROL A. (2004) Assistant to the President, A.A. Chadron State College, B.A. Western Illinois University.

GREGOIRE, TAMARA L. (2003) Senior Secretary.

SDSM&T ALUMNI ASSOCIATION LIAISON

VOTTERO, TIMOTHY J. (1998) Director. B.S., South Dakota School of Mines and Technology.

SDSM&T FOUNDATION LIAISON

PAPPEL, L. ROD (1991) President. B.S., M.S., South Dakota School of Mines and Technology. Registered Professional Engineer (South Dakota).

ACADEMIC AFFAIRS

WHITEHEAD, KAREN L. (1981) Provost and Vice President, Academic Affairs. B.A., Ph.D., University of Minnesota.

STOLTZ, VIOLET M. (1988) Senior Secretary. A.A., Black Hills State University. Certified Professional Secretary.

MISKE, CRAIG M. (2001) Program Assistant II. A.A., Central Texas College; A.A., Community College of the Air Force-Alabama. B.S., Embry-Riddle Aeronautical University

ASSOCIATE VICE PRESIDENT FOR ACADEMIC AFFAIRS

ALLEY, KATHRYN E. (2001) Associate Vice President for Academic Affairs. B.A., University of Cincinnati; M.A., University of Akron; Ph.D., Kent State University.

VANBOCKERN, CONNIE E. (1995) Senior Secretary. A.A., Black Hills State University.

ACADEMIC AND ENROLLMENT SERVICES

DOLAN, BARBARA F. (1987) Director. B.A., South Dakota State University; B.S., South Dakota School of Mines and Technology; M.B.A., University of South Dakota.

BEU, PAT A. (2004) Director of Retention and Testing. B.S., M.Ed., Brigham Young University, Ed.D., Montana State University.

FAUBERT, ROBERT A. (2001) Institutional Research Analyst; Drama Director, Student Activities and Leadership Center. B.A., M.Ed., Boston College; M.H.A., Ohio State University.

MILLER, LINN A. (2003) Assistant Coordinator of Academic Support Development. B.S., South Dakota State University.

CENTER OF EXCELLENCE FOR ADVANCED MANUFACTURING AND PRODUCTION (CAMP)

BATCHELDER, MICHAEL J. (1974-1984) (1986) Co-Director; Professor, Department of Electrical and Computer Engineering. M.S., Oklahoma State University; Ph.D., Virginia Polytechnic Institute and State University.

DOLAN, DANIEL F. (1981) Co-Director; Professor, Department of Mechanical Engineering. B.S., M.S., Ph.D., University of Minnesota.

KOONTZ, RYAN H. (2002) Integrated Manufacturing Specialist. B.S., M.S., South Dakota School of Mines and Technology.

WARD, JASON R. (2003) Electronics Specialist. B.S., M.S., South Dakota School of Mines and Technology.

WOMEN IN SCIENCE AND ENGINEERING (WISE)

COOK, CURTIS (2005) Director. B.A., University of Alabama; M.A., George Washington University; M.B.A., University of Maryland.

COLLEGE OF ENGINEERING

VACANT. Dean.

DEPARTMENT OF CHEMICAL AND BIOLOGICAL ENGINEERING

WINTER, ROBB M. (1988) Chair and Professor, Department of Chemical and Biological Engineering. B.A., Dickinson State University; M.S., Ph.D., University of Utah.

SWIATKIEWICZ, JACEK (2002) Research Scientist III, Department of Chemical and Biological Engineering. M.Sc., Ph.D., Technical University-Wroclaw, Poland.

DEPARTMENT OF CIVIL AND ENVIROMNENTAL ENGINEERING

KENNER, SCOTT J. (1987-1988) (1993) Chair and Professor, Department of Civil and Environmental Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Florida. Registered Professional Engineer (South Dakota).

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

HASAN, ABUL R. (1988) Chair and Professor, Department of Electrical and Computer Engineering. B.S., Bangladesh; M.S., University of North Dakota; Ph.D., University of Wyoming.

Department of Geology and Geological Engineering

DAVIS, ARDEN D. (1982-83) (1984) Chair and Professor, Department of Geology and Geological Engineering. B.A., University of Minnesota; M.S., Ph.D., South Dakota School of Mines and Technology. Registered Professional Engineer (South Dakota).

Department of Industrial Engineering

KELLOGG, STUART D. (1990) Chair and Ervin Pietz Professor; Department of Industrial Engineering. B.S., South Dakota State University; M.B.A., University of South Dakota; M.S., South Dakota School of Mines and Technology; Ph.D., University of Texas-Austin. Registered Professional Engineer (South Dakota).

Department of Mechanical Engineering

KALANOVIC, VOJISLAV D. (1991) Chair and Professor, Department of Mechanical Engineering. B.S., M.S., University of Belgrade; Ph.D., Clemson University.

Department of Materials and Metallurgical Engineering

KELLAR, JON J. (1990) Chair and Professor, Department of Materials and Metallurgical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Utah.

ANDERSON, ALAN J. (2002) Research Scientist II, Department of Materials and Metallurgical Engineering. B.S., South Dakota School of Mines and Technology; Ph.D., Iowa State University.

CROSS, WILLIAM M. (1993) Instructor; Research Scientist III, Department of Materials and Metallurgical Engineering. B.S., South Dakota School of Mines and Technology; M.S., Ph.D., University of Utah.

HONG, HAIPING (2003) Research Scientist I (Postdoctoral Fellow), Department of Materials and Metallurgical Engineering. B.S., Hangzhou University; M.S., Institute of Chemistry-Chinese Academy of Science; Ph.D., Hebrew University-Jerusalem.

Department of Mining Engineering and Management

SHASHIKANTH, S.N. (1994) Chair, Department of Mining Engineering and Management. M.S., South Dakota School of Mines and Technology.

College of Science and letters

VACANT. Dean.

Department of Atmospheric Sciences

HJELMFELT, MARK R. (1988) Chair and Professor, Department of Atmospheric Sciences; Professor, Institute of Atmospheric Sciences. B.S., Kansas State University; M.S., South Dakota School of Mines and Technology; Ph.D., University of Chicago.

Department of Chemistry

HEGLUND, DANIEL L. (1997) Chair and Associate Professor, Department of Chemistry. B.S., Bemidji State University; M.S., Ph.D., University of North Dakota.

FILIPOVA, TSVETANKA S. (2002) Research Scientist II (Postdoctoral Fellow), Department of Chemistry. M.S., Ph.D., University of Chemical Technology and Metallurgy.

LIU, YI (2005) Research Scientist I. Department of Chemistry. B.S., Peking University; Ph.D., Lehigh University.

MANN, JAQUE M. (1994) Campus Chemicals/Hazardous Materials Officer, Department of Chemistry. B.S., M.S., South Dakota School of Mines and Technology.

PETERSON, HEIDI (2003) Laboratory Storekeeper, Department of Chemistry. B.S., Chemistry; ACS certified. B.S., South Dakota School of Mines and Technology.

Department of Humanities

RICE, RODNEY P. (1999) Chair and Associate Professor, Department of Humanities. B.A., Moorhead State University; M.A., University of Minnesota; Ph.D., University of Nebraska-Lincoln.

Department of Military Science

GUTHRIE, KENT R. (2000) Chair and Professor, Department of Military Science ROTC; Lieutenant Colonel. B.S., Dakota State University; M.S., Liberty University.

HALL, FRANKLIN L. (2000) Assistant Professor, Department of Military Science; Master Sergeant.

PORTER, CYNTHIA (2002) Assistant Professor, Department of Military Science; Captain. B.S., Michigan Technological University.

Department of Mathematics and Computer Science

JOHNSON, ROGER W. (1996) Chair and Associate Professor, Department of Mathematics and Computer Science. B.S., University of Minnesota; M.A., Ph.D., University of California-San Diego.

Department of Physical Education

SCHAFER, JERALD R. (1984) Chair and Associate Professor, Department of Physical Education; Assistant Director and Head Cross Country and Track Coach, Intercollegiate Athletics. B.A., M.A., Adams State College.

Department of Physics

COREY, ROBERT L. (1995) Chair and Associate Professor, Department of Physics. B.S., University of Missouri, St. Louis; M.A., Ph.D., Washington University-St. Louis.

Department of Social Sciences

DENDINGER, ROGER E. (1998) Chair and Associate Professor, Department of Social Sciences. B.S., University of Alabama; M.S., South Dakota State University; M.S., Clemson University; Ph.D., University of Tennessee.

Black Hills Natural Sciences Field Station

PATERSON, COLIN J. (1983) Director; Professor, Department of Geology and Geological Engineering. B.Sc., Ph.D., University of Otago, New Zealand.

Museum of Geology

HERBEL, CARRIE L. (1995) Museum and Collections Manager, Museum of Geology; Instructor, Department of Geology and Geological Engineering. B.S., M.S., University of Nebraska-Lincoln.

South Dakota Local Transportation Assistance Program

SWENSON, MERLE D. (2000) Western Satellite Coordinator.

Graduate Education

HAN, KENNETH N. (1981) Dean, Graduate Education; Distinguished and Douglas W. Fuerstenau Professor, Department of Materials and Metallurgical Engineering. B.S., M.S., Seoul National University-Korea; M.S., University of Illinois-Urbana/Champaign; Ph.D., University of California-Berkeley.

Information Technology Services

SCHUMACHER, BRYAN J. (1991) Director. B.S., South Dakota School of Mines and Technology.

BENDER, VICKIE M. (1986) Associate Director of Information Services. A.A., Northern State University.

Library

ANDERSEN, PATRICIA M. (1984) Director. B.S., University of South Dakota; M.L.I.S., Louisiana State University.

DAVIES, CINDY L. (1987) Associate Librarian. B.A., University of South Dakota; M.L.I.S., Louisiana State University.

TAYLOR, JANET L. (1973) Coordinator of Library Operations. B.S., National College of Business.

OFFICE OF RESEARCH AFFAIRS

PILLAY, GAUTAM (2004) Vice President; Research Professor, Department of Chemical and Biological Engineering. B.S., New Mexico State University; Ph.D., Texas A&M University.

NILSON, JEANETTE R. (1991) Program Assistant II.

Sponsored Programs

REID, SHARON L. (1974) Proposal/Grant Services Manager. Certified Research Administrator.

Additive Manufacturing Laboratory (AML)

SEARS, JAMES W. (2002) Director. A.S., Black Hawk College; B.S., M.S., Ph.D., University of Illinois.

COSTELLO, AARON (2005) Research Scientist II. B.S., M.S., South Dakota School of Mines and Technology.

Advanced Materials Processing and Joining Laboratory (AMP)

ARBEGAST, WILLIAM J. (2001) Director. B.S., Colorado School of Mines.

ALLEN, CASEY D. (1998) Research Scientist II. B.S., M.S., South Dakota School of Mines and Technology.

Engineering and Mining Experiment Station (EMES)

DUKE, EDWARD F. (1984) Manager of Analytical Services; Professor, Department of Geology and Geological Engineering. B.S., Beloit College; M.A., Ph.D., Dartmouth College.

LINGENFELTER, DAVID R. (1997) Research Scientist I. B.S., Montana Tech.

Center for Accelerated Applications at the Nanoscale (CAAN)

DECKER, SHAWN P. (2004) Director. B.S., Northwestern Oklahoma State University, Ph.D., Kansas State University.

KIM, NAM-SOO (PETER) (2005) Research Scientist I (Postdoctoral Fellow); B.S., Korea University; M.S., Korea University; Ph.D., South Dakota School of Mines and Technology

Computational Mechanics Laboratory

LANGERMAN, MICHAEL A. (1992) Co-Director.; Chair of the Faculty Senate and Professor, Department of Mechanical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Idaho.

MUCI, KARIM, H. (2002) Co-Director.; Associate Professor, Department of Mechanical Engineering. B.S., M.S., ITESM, Monterrey Campus-Mexico; Ph.D., Iowa State University. Registered Professional Engineer (Mexico).

Polymer Technology, Processing, and Composites Laboratory (PTPCL)

WINTER, ROBB M. (1988) Interim Co-Director (Academics); Chair and Professor, Department of Chemical and Biological Engineering. B.A., Dickinson State University; M.S., Ph.D., University of Utah.

DOLAN, DANIEL F. (1981) Interim Co-Director (Research); Professor, Department of Mechanical Engineering; Co-Director, Center of Excellence for Advanced Manufacturing and Production. B.S., M.S., Ph.D., University of Minnesota.

Ultra-Lightweight Systems Laboratory

VACANT Director.

Institute of Atmospheric Sciences

ZIMMERMAN, PATRICK R. (1997) Director and Professor, Department of Atmospheric Sciences. B.S., M.S., Washington State University; Ph.D., Colorado State University.

BENSON, RANDALL P. (2002) Fire Meteorologist. B.F.A., Texas Christian University; M.S., University of Utah.

CAI, ZHONG TAO (1999) Research Scientist II. B.S., East China Institute of Chemical Technology-Shanghai.

CAPEHART, WILLIAM J. (1997) Associate Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., University of North Carolina-Asheville; M.S., Ph.D., Pennsylvania State University.

CHRISTOFFERSON, CABOT-ANN (2003) Research Scientist II, Institute of Atmospheric Sciences. B.S., M.S., South Dakota School of Mines and Technology.

CORBIN, TERESA S. (2004) Research Scientist II. B.S., M.S., Ph.D., South Dakota School of Mines and Technology

DETWILER, ANDREW G. (1987) Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., University of Michigan; M.S., Ph.D., State University of New York-Albany.

FARLEY, RICHARD D. (1974) Research Scientist IV. B.S., M.S., South Dakota School of Mines and Technology.

FARWELL, SHERRY O. (1995) Adjunct Research Scientist IV. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., Montana State University.

HELSDON JR., JOHN H. (1979) Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., Trinity College; M.S., Ph.D., State University of New York-Albany.

HJELMFELT, MARK R. (1988) Chair and Professor, Department of Atmospheric Sciences; Professor, Institute of Atmospheric Sciences. B.S., Kansas State University; M.S., South Dakota School of Mines and Technology; Ph.D., University of Chicago.

KLICHE, DONNA V. (1994) Research Scientist II and Computer Programmer. B.S., Faculty of Physics-Bucharest, Romania; M.S., Georgia Institute of Technology; M.S., South Dakota School of Mines and Technology.

LALONDE, KARL A. (1999) Research Scientist II and Research Computer Scientist, Institute of Atmospheric Sciences. B.S., M.S., South Dakota School of Mines and Technology.

SUMMERS, CHARLES M. (1992) Research Scientist III. B.S., University of Nebraska-Lincoln; M.S., Troy State University.

SUNDARSHWAR, PALLAOOR V. (2003) Assistant Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., M.S., University of Bombay; Ph.D., University of South Carolina-Columbia.

UPDEGRAFF, KAREN L. (2003) Research Scientist I. B.A., Earlham College; M.S., Ph.D., University of Minnesota.

WARNER, TOM A. (2000) Research Scientist II. B.S., University of California-Davis.

South Dakota Space Grant Consortium

DUKE, EDWARD F. (1984) Director; Professor, Department of Geology and Geological Engineering. B.S., Beloit College; M.A., Ph.D., Dartmouth College.

DURKIN, THOMAS V. (1999) Deputy Director and Outreach Coordinator. A.S., Nassau Community College; B.S., Adelphi University; M.S., South Dakota School of Mines and Technology. Licensed Professional Geologist (Wyoming); Certified Professional Geologist.

BUSINESS AND ADMINISTRATION

HENDERSON, TIMOTHY G. (1981) Vice President, Business and Administration. B.S., University of South Dakota.

PAINTER, AUDREY L. (1981) Senior Secretary.

Administrative Services (Accounting/Budget/Cashiering)

KIRSCH, JANET M. (2002) Director. B.S., Bemidji State University; M.B.A., University of Denver.

MARKEN, MARJORIE M. (1967) Budget Manager.

Business Services (Purchasing / Telecommunications)

FISCHER, SANDRA R. (1972) Director.

HARGENS, JANET K. (1979) Assistant Director.

Bookstore

KINZER, MARLIN L. (1993) Director. B.S., Black Hills State University.

Dining Services

KELLEN, TIMOTHY B. (2002) Director contracted through ARAMARK.

Facilities Services

GEBEKE, MICHAEL D. (1999) Director contracted through ARAMARK.

Human Resources

SLOAT, DEBORAH L. (1994) Director. B.S., South Dakota School of Mines and Technology; M.S,. University of South Dakota; PHR Certified.

Intercollegiate Athletics

WELSH, D. HUGH (1986) Director. B.S., Valley City State College, M.S., University of Mary.

BAKER, PATRICK (2005) Assistant Football Coach and Coordinator of Multicultural Activities.

BOYER, JOSHUA A. (2005) Assistant Football Coach, Assistant Intramural Director, and Wellness Center Supervisor. B.A., Muskingum College.

CADWALLADER, MARIA (2005) Assistant Women's Basketball Coach. B.S., South Dakota School of Mines and Technology.

COBLE, LORI D. (1984) Assistant Women's Basketball Coach. B.S., Dakota State College; M.A., University of Minnesota.

EVERHART, JON TRAVIS (2005) Assistant Football Coach and Strength and Conditioning Coach. B.A., Capital University; M.A., California University of Pennsylvania.

FELDERMAN, BARBARA A. (1981) Head Women's Basketball Coach and Assistant Director, Intercollegiate Athletics; Professor, Department of Physical Education; B.S., Northern State College; M.S., University of Wyoming.

GLENN, ERIC (2005) Assistant Men's Basketball Coach; Head Men's and Women's Golf Coach. B.S., M.A., Chadron State College.

GREER, DENNIS (2003) Equipment Manager / Certified Athletic Trainer. B.S., National American University.

HENRY, JASON P. (2002) Assistant Men's Basketball Coach; Assistant Professor, Department of Physical Education. B.S., Minot State University. M.S., North Dakota State University.

KRATZER, DANIEL L. (2005) Head Football Coach, Intercollegiate Athletics; Assistant Professor, Department of Physical Education. B.S., Missouri Valley College. M.S., Central Missouri State University.

KUSLER, JASON (2005) Sports Information Specialist. B.S., South Dakota School of Mines and Technology.

NOVICKI, LEAH. (2005) Assistant Volleyball and Track Coach. B.S., South Dakota School of Mines and Technology.

RUDEBUSCH, THOMAS R. (1980) Sports Information Director.

SCHAFER, JERALD R. (1984) Head Cross Country and Track Coach; Chair and Associate Professor, Department of Physical Education. B.A., M.A., Adams State College.

TABBERT, DOUGLAS E. (2003) Head Women's Volleyball Coach/Intramural Director. B.S., Baker University; M.Ed., Bowling Green State University.

STUDENT AFFAIRS

MAHON, PATRICIA G. (2000) Vice President, Student Affairs and Dean of Students. B.S., M.S., Montana State University-Billings; Ph.D., Kansas State University.

ROMANO, MARIE A. (1999) Senior Secretary.

Campus Ministry

CONROY, JOANN (2001) Lutheran Campus Ministry Representative.

DANIELS, ANNIE (2003) Newman Center.

DEMEREST, RICK (1987) Inter Varsity Christian Fellowship Representative.

FANNIN, HEATHER (1998) International Students, Inc. Representative.

FANNIN, KEVIN (1998) International Students, Inc. Representative.

HASAM, RAFIG (2004) Muslim Student Association Representative.

HERNANDEZ, PHILLIP (2004) United Campus Ministry Representative.

McCRAW, KEITH (2004) Christian Challenge Representative.

SIGMAN, TIM (1997) International Students, Inc. Representative.

CAREER PLANNING, PLACEMENT, AND COOPERATIVE EDUCATION

SAWYER, DARRELL R. (1997) Director. B.A., M.A., University of South Dakota.

CHILD-CARE SERVICES

Services contracted through Kids Kastle Little Miner's Clubhouse.

COUNSELING AND STUDENT ADA SERVICES

McCOY, JOLIE A. (1997) Director of Counseling; Student ADA Coordinator. B.S., M.S.W., University of Texas at Austin.

LINDSTROM, JOAN C. (2001) Educational Sign Language Interpreter. A.A., Camden Community College.

HEALTH SERVICES

Services contracted through Creekside Family Practice.

IVANHOE INTERNATIONAL CENTER

AADLAND, SUSAN R. (1989) Director. B.S., Northern State University.

MULTICULTURAL AFFAIRS

CARTER, BRUCE L. (2005) Director. B.A., Southwest State University.

BAKER, PATRICK (2005) Multicultural Activities Coordinator; Assistant Football Coach.

RESIDENCE LIFE, SURBECK CENTER, AND SCHEDULING AND CONFERENCES

WILSON, MAUREEN C. (1999) Director; Judicial Affairs. B.A., Northern State University; M.A., Eastern New Mexico University, Portales.

HOLT, CHERYL L. (2002) Assistant Director, Residence Life; Residence Hall Director for Peterson Hall. B.S., M.Ed., South Dakota State University.

MOULTON, SHAWN (2005) Residence Hall Director for Connolly Hall.

RAWLINGS, KRISTIAAN A. (2005) Residence Hall Director for Palmerton Hall. B.A., Franklin College.

STUDENT ACTIVITIES AND LEADERSHIP CENTER

SCHMIT, CHRISTINA (2004) Director. B.S. Black Hills State University.

UNIVERSITY AND PUBLIC RELATIONS

SMORAGIEWICZ, JULIE A. (1994) Vice President for University and Public Relations. B.A., M.Ed., University of Toledo.

KELLEY, LESLIE T. (2003) Senior Secretary.

ADMISSIONS

MUELLER, JOSEPH B. (2002) Director. B.S., M.S., University of Redlands.

ANDREWS, DEREK D. (2002) Admissions Counselor. B.A., Chadron State College.

HANSEN, BARABRA A. (2004) Admissions Counselor. AA., Central Wyoming College; B.A., Meredith College.

TSCHETTER, JASON M. (2003) Admissions Counselor. B.S., University of South Dakota.

FINANCIAL AID

MARTIN, DAVID W. (2000) Director. B.A., Tarkio College.

COMMUNICATIONS AND MARKETING

VACANT. Director

VACANT. Public Information Manager.

POYOUROW, MELINDA A. (2002) Publications Manager. B.F.A., Kearney State College.

SUMMER/EDUCATIONAL PROGRAMS AND PROFESSIONAL CONFERENCES

ANDERSON-SMITH, NANCY (2005) Director. B.S., St. Cloud State University.

GOVERNANCE

The South Dakota School of Mines and Technology is one of six universities operating under the authority assigned by the Constitution of the State of South Dakota to the nine member Board of Regents. The mission of the university is established by the Legislature of the State of South Dakota with programs and organization approved by the Board of Regents. The president is delegated to administer the operation of the university.

The traditional collegial process of shared governance for the formation of policies and oversight includes representative organizations to provide recommendations to the president for implementation as appropriate.

COUNCILS

Executive Council

The Executive Council is the principal administrative unit at the university. The council members are the President, Assistant to the President, Vice President for Academic Affairs, Vice President for Business and Administration, Vice President for Student Affairs and Dean of Students, Vice President for University Relations, Vice President for Research, SDSM&T Foundation President, Chair of the Faculty, and Director of the Alumni Association.

University Cabinet

The University Cabinet meets at the call of the President and advises the President concerning the development of policy, the governance of the university, strategic planning, and the fiscal operation of the university. The University Cabinet consists of: the President, Assistant to the President, Provost and Vice President for Academic Affairs, Vice President for Business and Administration, Vice President for Student Affairs and Dean of Students, Vice President for University Relations, Vice President for Research, SDSM&T Foundation President, Chair of the Faculty, Director of the Alumni Association, Dean of the College of Engineering, Dean of the College of Science and Letters, Chair of the Exempt Employees Council, Chair of the Career Service Council, and President of the Student Association.

Career Service Council

The Career Service Act employees elect the Career Service Council members.

Exempt Employees Council

The Exempt Employees Advisory Council is elected by the administrative employees who are exempt from the Career Service Act of the state of South Dakota.

Faculty Senate

The Faculty Senate consists of nine voting members, two non-voting (ex-officio) members and is chaired by the Chair of the Faculty. Three voting members each are elected from the engineering, science, and liberal arts faculty. The ex-officio members are the Vice President for Research and the Vice President for Academic Affairs. All faculty members may vote in the election of representatives from their discipline and each is eligible for election as a discipline representative.

Student Association

The Senate of the Student Association is the elected representative council for the formation of recommendations on behalf of enrolled students, including the fees charged to students and the operation of student activities funded through student fees.

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NOTES

Mines Matters: The School of Mines women's basketball team has a long tradition of excellence. The team represented S.D. Tech in the NAIA National Tournament in eight of the past nine years. The team advanced to the Final Four in the 1998 and 1999 tournaments.