



Welcome to the South Dakota School of Mines and Technology!

Simply the best! These three words describe well what the South Dakota School of Mines and Technology has become over the last century. You will find an exceptionally qualified faculty joined with outstanding students to provide an unparalleled environment of academic excellence.

Since 1885 students have found this technological university, nestled at the entrance of the Black Hills, to be a great place to develop their educational opportunities, their abilities, their character, and their spirit. We want you to experience the education and the friendships that bind the graduates of the South Dakota School of Mines and Technology together, wherever they may be around the world.

SDSM&T has received numerous prestigious awards in recognition of our academic excellence. These include: Barron's Best Buys in College Education; America's 100 Best College Buys; Kaplan Newsweek College Catalog 2000 singled out SDSM&T as a top school in schools for the academically competitive student, best co-op programs, best value for your money, and schools that are hidden treasures. The SDSM&T Center for Advanced Manufacturing and Production was also recognized by Boeing, as the most innovative education program for the year 2000.

We invite you to join the South Dakota Tech family and combine our traditions of excellence with the newest of technology. We want to help you become prepared to be a leader in solving tomorrow's problems in an increasingly complex society.

We look forward to your continued growth and success at the South Dakota School of Mines and Technology!

Sincerely,

A handwritten signature in cursive script, appearing to read "Richard J. Gowen".

Richard J. Gowen  
President

# TABLE OF CONTENTS

TABLE OF CONTENTS

Academic Calendar	Inside Front Cover
Reservation of Rights	Inside Front Cover
Message From the President	.1
University Information	.4
Admissions	.9
Tuition and Fees	.20
Financial Aid	.27
Academic Information	
General	.48
Registration	.55
Graduation Requirements	.59
Policies and Procedures	.65
Support Services	.71
Educational Resources and Outreach Services	.73
Student Information	
Services	.83
Activities	.89
Undergraduate Studies	
College of Earth Systems	.93
Atmospheric Sciences Minor	.94
Civil Engineering B.S.	.97
Geological Engineering B.S.	.100
Geology B.S. and Minor	.103
Mining Engineering B.S.	.106
College of Interdisciplinary Studies	.109
Associate of Arts Degree	.110
Interdisciplinary Sciences B.S.	.112
Humanities	.116
Military Science	.118
Physical Education	.120
Social Sciences	.121
College of Materials Science and Engineering	.123
Biology	.124
Chemical Engineering B.S.	.126
Chemistry B.S. and Minor	.130
Metallurgical Engineering B.S.	.134
Physics B.S. and Minor	.137
College of Systems Engineering	.140
Computer Engineering B.S.	.141
Computer Science B.S. and Minor	.145
Electrical Engineering B.S.	.149
Industrial Engineering B.S.	.153
Mathematics B.S. and Minor	.156
Mechanical Engineering B.S.	.160
Interdisciplinary Program	
Environmental Engineering B.S.	.163
Graduate Studies	.167
Graduate Student General Information	.168
College of Earth Systems	
Atmospheric Sciences M.S.	.186
Civil Engineering M.S.	.189

Geology and Geological Engineering M.S. and Ph.D. . . . .	191
Paleontology M.S. . . . .	196
College of Materials Science and Engineering	
Chemical Engineering M.S. . . . .	198
Chemistry . . . . .	200
Materials and Metallurgical Engineering . . . . .	201
Materials Engineering and Science M.S. . . . .	202
Physics . . . . .	204
College of Systems Engineering	
Computer Science M.S. . . . .	205
Electrical Engineering M.S. . . . .	207
Mechanical Engineering M.S. . . . .	210
Interdisciplinary Graduate Programs	
Atmospheric, Environmental, and Water Resources Ph.D. . . . .	213
Materials Engineering and Science Ph.D. . . . .	216
Technology Management M.S. . . . .	220
Courses . . . . .	223
Faculty, Administration, and Governance . . . . .	306
Index . . . . .	318
Campus Map . . . . .	Inside Back Cover

**DEGREE ABBREVIATIONS**

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

**MISSION AND OBJECTIVES**

**The mission of the South Dakota School of Mines and Technology is:**

- To prepare men and women for an enhanced quality of life by providing a broad educational environment which fosters a quality educational experience leading to baccalaureate and post-baccalaureate degrees emphasizing science and engineering.
- To contribute to the expansion of knowledge through programs of basic and applied research, scholarship, and other creative endeavors.
- To utilize the special capabilities and expertise on the campus to address regional, national, and international needs.

**The principal objectives in support of this mission are:**

- To make the South Dakota School of Mines and Technology an outstanding undergraduate educational institution, enhanced by quality graduate education.
- To enhance our national recognition as an educational institution with emphasis in science and engineering.
- To continue to develop centers of excellence in research and graduate education using faculty expertise, and to further develop interdisciplinary research that involves faculty from several departments.
- To create and continually ensure an environment which nurtures growth of the intellect, character, and spirit of students, faculty, and staff.
- To build mutually beneficial partnerships with the broader community.
- To increase significantly the resources available to the institution.

*This statement of mission and objectives serves as a framework for the continued growth of excellence at the South Dakota School of Mines and Technology.*

## UNIVERSITY INFORMATION

### SOUTH DAKOTA BOARD OF REGENTS

Mr. David Gienapp, Madison  
 Dr. James Hansen, Pierre  
 Mr. Harvey Jewett, Aberdeen  
 Mr. Curt Jones, Britton  
 Ms. Pat Lebrun, Rapid City  
 Mr. Randall Morris, Spearfish  
 Mr. Rudy Nef, Milbank  
 Mr. Shane Penfield, Vermillion  
 Mr. Jack Rentschler, Sioux Falls

#### **Officers of the Board**

President: Harvey Jewett  
 Vice President: Rudy Nef  
 Secretary: Randall Morris

#### **Executive Director**

Dr. Robert T. Tad Perry, Pierre

### 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  
 SDSM&T 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

Mathematics  
 Metallurgical Engineering  
 Mechanical Engineering  
 Mining Engineering<sup>1</sup>  
 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, Environmental, and Water  
 Resources<sup>2</sup>  
 Geology and Geological Engineering  
 Materials Engineering and Science

<sup>1</sup> By action of the South Dakota Board of Regents, the Mining Engineering Program at SDSM&T was placed on inactive status effective May 10, 2002. This action suspends enrollment of new students but continues to provide currently enrolled students with the courses needed to graduate no later than May 2005.

<sup>2</sup> Cooperative Ph.D. program with South Dakota State University

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

### ACCREDITATION

The South Dakota School of Mines and Technology is accredited by 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. The Accreditation Board for Engineering and Technology (ABET), which is the recognized

accrediting agency for engineering, has also accredited the undergraduate curricula for all SDSM&T engineering programs with the exception of Environmental Engineering which is a new program. The program in Computer Science is accredited by the Computer Science Accreditation Commission (CSAC) of the Computing Sciences Accreditation Board (CSAB), a special accreditation body recognized by the Council on Post-Secondary Accreditation (COPA) and the U.S. Department of Education.

### EQUAL OPPORTUNITY POLICY

The 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, national origin, military status, gender, religion, age, sexual orientation, political preference, or disability.

In adhering to this policy, South Dakota School of Mines and Technology abides by the South Dakota Board of Regents policy 1:19; by the Federal Civil Rights Act, 42 U.S.C. 2000e; by the requirements of Title IX of the Education Amendments of 1972; by Sections 503 and 504 of the Rehabilitation Act of 1973; by the Americans With Disabilities Act of 1990; by Executive Order 11246, as amended; by 38 U.S.C. 2012, the Vietnam Era Veterans Readjustment Assistance Act of 1972, as amended; and by other applicable statutes and regulations relating to equality of opportunity.

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 SDSM&T employees, students, and the general public. These services include administering campus payrolls and providing appropriate forms for pay purposes, such as time cards, pay authorizations, direct deposit forms, W-4 and I-9 forms, and all tax treaty forms for registered alien workers. This office also provides assistance related to issues regarding personnel, such as position openings,

benefits, employee discipline, interpretation and enforcement of policies and procedures, and workers compensation.

The Director of Human Resources is the campus EEO (Equal Employment Office) representative, the AA (Affirmative Action) representative, and Co-Coordinator of ADA (American with Disabilities Act).

### CAMPUS BUILDINGS

**The Arch** is located in the center of campus on 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 Chemistry and Chemical Engineering.

The **Civil/Mechanical Engineering Building**, completed and occupied in 1951, houses two major engineering departments. They are Civil and Environmental Engineering and Mechanical/Industrial Engineering. 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. Laboratories for the Center for Advanced Manufacturing and Processing (CAMP) and the Advanced Materials Processing (AMP) Center 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 a

classroom complex featuring divisible areas with a variety of built-in audio-visual aids.

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

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, and the Mining Engineering program are in this building. Also included are Atmospheric Sciences Department and the Institute of Atmospheric Sciences. The Engineering and Mining Experiment Station, Graduate Education and Research Office, Institute for Minerals and Materials, and the Mining and Mineral Resources Research Institute are also housed in this building. This structure provides classroom and laboratory facilities for undergraduate and graduate study in the several fields related to the mineral industries.

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 Physical Education Building** was completed and occupied in 1976. Seating for 2,100 spectators at athletic events is available. Two handball courts, one squash court, offices, training rooms, a 35 x 75 foot swimming pool, and a basketball court are provided for in this 60,000-square-foot structure.

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 Tech Print Center and campus mailroom.

The **Old Gymnasium** is used for intramural activities. It also houses the campus radio station offices and studios, graduate

student offices, the Office of Multicultural Affairs, and Museum of Geology laboratories.

**O'Harra Field** is one of the finest athletic fields in the region because of its unique design. 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 may view the field. The playing field is encircled by an all-weather running track. The stadium is located on the north side of the field. Both the track and stadium were renovated in 1994.

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

**March Hall** and **Dake Hall**, completed in 1959, accommodate both male and female students. A common lounge connects the buildings, and an additional lounge or "living room" is provided on each floor of each hall.

**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.

The **Devereaux Library**, completed in 1970, includes 56,000 square feet of modern space that is carpeted and air conditioned. The library houses the Minority Student Study Center, Tech Learning Center, and Ivanhoe International Center. It serves as the Patent and Trademark Depository for the state and is the location for the Information Technology Services help desk.

**Surbeck Student Center**, including an addition completed in December of 1971 and renovations in 1994, provides more than 71,000 square feet of space devoted to campus and community activities. The first floor houses the main lounges, the bookstore, banquet-ballroom, conference rooms, student offices, counseling, health service facilities, the alumni office, university scheduling center, career planning office, and the Surbeck Center offices. The dining hall, snack bar, recreation area including bowling lanes, additional student offices, and display facilities can be found on the ground floor.

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

and the Museum of Geology and is named in honor of Dr. C.C. O’Hara, 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. Effective in 2000, services are contracted through Kids Kastle.

## 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 college’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. SDSM&T offers programs leading to the doctor of philosophy

degree in geology and geological engineering, and materials engineering and science. The university also offers a doctorate degree in Atmospheric, Environmental, and Water Resources (AEWR) through a cooperative program with South Dakota State University.

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

## 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 early Gold Rush history of the area.

The Black Hills area is a naturalist’s dream, for there are many caves to explore, mountains to hike or 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 each year enjoy the Black Hills/Badlands area.

## CAMPUS SAFETY

The South Dakota School of Mines and Technology is committed to the safety of students and employees. Safety personnel regularly monitor the campus and work closely with the Rapid City Police Department in enforcing 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.

With the assistance of the Rapid City Police Department, SDSM&T provides safety and security education and awareness programs on a regular basis. 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 SDSM&T web site.

#### **SDSM&T ALUMNI ASSOCIATION**

The SDSM&T Alumni Association promotes communication and interaction among alumni, students, faculty, and administrators of the South Dakota School of Mines and Technology with the objective of strengthening the school's academic, research, and service roles. The association also provides an alumni network and support services for SDSM&T graduates throughout the world.

Services provided by the Alumni Association include maintenance of a database of all graduates of SDSM&T, a quarterly 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 and get-togethers, and an all-school reunion every five years. The next five-year reunion will be July 7, 8, and 9, 2005.

The Alumni Association also provides funds to support student activities. Students can apply for funding by contacting the Alumni Association Office. The Alumni Association 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 email at alumni@sdsmt.edu.

#### **SDSM&T FOUNDATION**

The SDSM&T 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 and maintains the same business hours as all other administrative departments.



# 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.

## 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. Alternate Criteria for Minimum Course Requirements**

- a. Students who do not successfully complete four years of English may meet minimum course requirements through one of the following:

ADMISSIONS

- i. An ACT English subtest score of 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 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 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 percent of their graduating class  
OR
- A composite score of 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 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 percent 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 18, ACT English sub-test score of at least 18, Mathematics sub-test score of at least 20, Social Studies/Reading, and Science reasoning sub-test scores of at least 17 and meet any university determined requirements for admission to baccalaureate programs. Students must be between 18 and 20 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 21 and has not previously attended any post-secondary institution is classified as a non-traditional student. It is the policy of SDSM&T 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 SDSM&T based on the minimum requirements as prescribed by the Board of Regents. 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 Coordinator of Educational Services, 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 percent of the previous year's freshman class, at the discretion of the university.

#### F. Regents Scholars

Effective Fall 2001 for students who graduated from high school in 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 24 transfer credit hours must meet the baccalaureate degree admission requirements. Students with 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 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 under 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 SDSM&T. 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 a semester or more. 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 SDSM&T'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 SDSM&T should begin by contacting the Admissions Office at SDSM&T 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 SDSM&T 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 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**

Each applicant, except non-traditional students, must submit Enhanced ACT (or SAT-I) results, and each high school graduate must submit an official high school transcript. Each applicant must also submit an official transcript bearing the original seal and signature of the official in charge of records from each college or university previously attended. He or she

shall also submit any other records or letters that are required to support the student's eligibility for admission, including competency test scores. SAT scores may be used in place of ACT scores according to conversion tables approved by the Board of Regents.

##### **D. Preadmission Immunization Requirements**

1. All new incoming freshmen, newly admitted graduate students, transfers, special students who reside on campus, and returning former students born after 1956 and who receive instruction on one of the residential campuses, and students admitted after May 1993 who are attending the Center for Public Higher Education in Sioux Falls (USDSU) must document their immune status for measles and rubella. Proof of two doses of measles vaccine or of the presence of an immune antibody titer against measles shall be required. Immunization for tetanus, diphtheria, poliomyelitis, and mumps, as well as a tuberculin test, is recommended. 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 February 1st.

### **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 under the age of 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 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 “Undergraduate Admission Requirements.”)

Transfer applicants will be notified of their admission status at SDSM&T 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 SDSM&T 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 Academic and Enrollment Services 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 60 days prior to the beginning of the term for which admission is desired.

2. Academic credentials (translated into English). All documents submitted to SDSM&T 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, SDSM&T will accept in lieu of the TOEFL examination a favorable recommendation from a Norwegian professor who has been on an SDSM&T exchange status, or who is familiar with admissions standards at SDSM&T. 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 visiting their web site at [www.toefl.org](http://www.toefl.org).

4. Recommendations from two professors or instructors familiar with the academic performance of the applicant.
5. Affidavit of Financial Responsibility. Admission to SDSM&T 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 SDSM&T 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.

#### **ELECTRONIC UNIVERSITY CONSORTIUM**

In Fall 2000, the Electronic University Consortium (EUC) came “on-line” at [www.WorldClassEducation.org](http://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. As the EUC develops, it will offer students a “one-stop” university from which



they will obtain their degree, but the consortium effort allows students access to a wider offering of courses from all six universities.

#### **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 Academic and Enrollment Services.

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 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 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 under 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.



*TECHFact: The Memorial Arch and Plaza is a link to SDSM&T's past and a central part of the campus culture. The historic structure, a popular spot on campus for meetings, also serves as a scenic backdrop for photographs, and a point of interest for campus visitors. The three arches symbolize the first three buildings built on campus. The center arch was the entry to the SDSM&T Liberal Arts Building completed in 1901.*

## TUITION AND FEES

The amount for tuition and fees will be set each year by the South Dakota Board of Regents. The Board of Regents reserves the right to make changes in any fee as and when it deems necessary.

Each course is assessed **tuition, university support fee, and a general activity fee**, based on its number of credit hours. In addition, courses that earn credit for laboratory work are assessed a **laboratory fee**. All courses in engineering, physics, computer science, mathematics, chemistry, and geology which are acceptable toward a degree in these areas of study are assessed a **program improvement fee** based on credit hours.

### TUITION RATES

All charges and procedures listed on page 26 are subject to change pending the Board of Regents action.

#### **Tuition Rate in Reference to Course Level**

All students are assessed at the undergraduate rate for courses numbered 000 through 499, and at the graduate rate for courses numbered 500 and higher. Military science credits are not included in the tuition assessment, but are included in the computation of a student's load.

### DESCRIPTIONS OF TUITION RATES

#### **Western Undergraduate Exchange (WUE)**

South Dakota School of Mines and Technology participates in regional programs with specific western states through the WUE program. First-time freshman undergraduate students from participating states may be eligible to receive a reduced tuition rate through WUE for the academic year. States participating currently are Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.

#### **Adjacent State Tuition**

The SD State Board of Regents has approved an adjacent state tuition rate for non-

resident students from Iowa and Nebraska. Undergraduate students from participating states may be eligible to receive a reduced tuition rate through this program for the academic year.

#### **Minnesota Reciprocity**

Residents of the state of Minnesota can apply for reciprocity status, which will qualify them for reduced non-resident tuition rates. The rates stated on page 27 reflect only summer 2002 tuition rates. These rates will be updated in August for the fall 2002 semester following MN setting their tuition rates.

#### **ROTC Tuition Reduction**

ROTC members who meet established criteria are eligible to receive a 50 percent reduction of their tuition costs. In order to be eligible for the tuition reduction the ROTC cadet shall: 1) be a resident of the state of South Dakota; 2) meet all eligibility requirements for the senior reserve officer training corps, including final signing of the contract; 3) maintain satisfactory academic progress; 4) not be receiving Army or Air Force scholarships or be a member of the simultaneous membership program.

#### **National Guard Tuition Assistance**

National Guard members who meet all of the requirements of SDCL 33-6-7, and who present a valid application for South Dakota National Guard Tuition Assistance, approved by their commanding officer, will be eligible for a 50 percent reduction of their tuition for undergraduate courses, providing that SDSM&T is properly notified at the time of registration for the term in which this benefit is sought. Notification received after the tenth day of classes will be disapproved. Proper notification is defined as the appropriately completed application form for SD National Guard Tuition Assistance.

#### **SD State Employee**

Employees of the state that meet certain criteria may be eligible for a 50 percent reduced tuition rate for a maximum of six credit hours per semester. Employees should contact their Human Resource departments for further information.

### **SD Teacher Certification**

Employees of accredited elementary, secondary, or vocational schools who meet certain criteria may be eligible for a 50 percent reduced tuition rate for a maximum of six credit hours per academic year.

### **Students 65 Years of Age or Older**

The tuition for students 65 years of age or older during the calendar year in which they are enrolled shall be one-fourth of the resident tuition, on a space available basis.

### **Self Support Courses - Outside Sioux Falls**

This fee alone financially supports these courses. This rate is comprised of the self-support tuition rate plus a surcharge equivalent to the resident tuition HEFF contribution, or twenty percent of the resident tuition rate for undergraduates and graduates respectively.

**Remedial:** These remedial courses are numbered within the 001-099 range. The credits may not be used toward any baccalaureate or associate degree.

### **Graduate Students**

Graduate students who hold a state contract for a teaching, research assistantship, or fellowship may be entitled to special reduced tuition. The contract will specify whether the award carries with it eligibility for reduced tuition. Campus fees remain unchanged. To be eligible for reduced tuition, a candidate must be under contract for \$2,118.00 or more per semester and must be carrying a minimum of nine credit hours (six for summer term). These must be required credits in the degree program of study (see Institutional Policy 11-C-07). Hourly wages alone cannot be used to satisfy the current posted minimum stipend earnings for tuition reduction.

Reduced tuition is not available for self-support courses during the academic year. The student must be registered for six credit hours and be under contract for at least the current posted minimum summer stipend; the grant or other source of funds from which the stipend is paid must cover the difference between full and reduced tuition.

If a student receiving reduced tuition withdraws from one or more courses at any time during the semester causing their credit-hour load to fall below the minimum

requirement for eligibility, then tuition will automatically be reassessed at the regular rate. The student is responsible for reimbursing SDSM&T for the difference between regular and reduced rates. At any time after registration for a semester, a student who receives an award or appointment which satisfies the financial eligibility criterion for reduced tuition and who already meets the minimum credit-hour criterion for reduced tuition will be considered eligible for reduced tuition. Tuition will be reassessed and the difference between regular and reduced tuition will be refunded. However, if a student who receives such an award or appointment does not satisfy the minimum credit-hour criterion for reduced tuition, registration for additional credits will not be permitted after the drop/add period.

Graduate students who are veterans on the "G.I. Bill" are eligible for full subsistence if taking nine or more credit hours per semester. They are considered to be in half-time attendance if taking five credit hours and three-fourths time attendance if taking six, seven, or eight credit hours.

### **DESCRIPTION OF FEES**

#### **Course Fees**

##### **General Activity Fee - \$17.63/credit**

**hour:** This fee, assessed per credit hour on each course with duration over two days. It supports student functions related to the co-curricular activities and operations of student union buildings, organizations, government, childcare, outpatient clinical services, and etc. This fee is refundable only in those cases that produce a refund of the tuition for the course. There shall be a simple majority of students on the committee that recommend to the President the establishment and allocation of general activity fees. The President of SDSM&T is the approving authority.

**Laboratory Fee - \$22.40/lab:** This fee, assessed on each laboratory course, is refundable only in those cases, which produce a refund of the tuition for the course.

##### **Salary Enhancement Fee (PIF) -**

**\$16.12/credit hour:** Also referred to as program improvement fee. This fee is assessed per credit hour for courses in engineering, physics, computer science, mathematics,

chemistry, and geology, which are acceptable toward a degree in those areas. This fee is used to improve the quality of programs at SDSM&T by retention of quality faculty through salary augmentation. This fee is refundable only in those cases, which produce a refund of the tuition for the course.

**University Support Fee - \$49.32/credit hour:** This fee, assessed per credit hour on each course, is used to purchase equipment, materials, and services in support of the instructional programs. It is also used to provide necessary student services such as: financial aid, counseling, catalogs and bulletins, student testing, administration, operation and maintenance costs, deferred maintenance, student information database software, and technological supplies and equipment. This fee is refundable only in those cases that produce a refund of the tuition for the course.

#### **Other Fees and Charges**

**Application Fee (Graduate) - \$35.00:** The application fee is charged upon initial application for admission to a state university. This fee must accompany the application form.

**Application Fee (Undergraduate) - \$20.00:** The application fee is charged upon initial application for admission to a state university. This fee must accompany the application form.

**Credit-by-Examination Fee - \$79.90/course:** This fee is charged for each course in which a student seeks credit by examination.

**Identification Card Replacement Fee - \$10.00/each:** The student's first identification card (ID) card is free of charge. All replacement cards cost \$10.00 each.

**International Student Enrollment Fee - \$106.50:** This is a one-time fee. This fee will be assessed at the time of enrollment for the student's first semester of attendance at SDSM&T. This is in addition to the regular application fee. The revenues from this fee are used to offset additional administrative costs that are incurred while processing international student enrollments.

**International Student Health, Major Medical, and Life:** All international students and their dependents must enroll in the Major Medical, Hospitalization, and Surgical

Insurance Plan authorized by South Dakota School of Mines and Technology. No outside insurance policies will be accepted as substitutes for SDSM&T's policy. The only exception is if the students are covered by their government's insurance. Documentation of this is necessary. If any of their dependents are with them in the United States, it is required that they purchase insurance coverage for them also. Questions about health insurance should be directed to the Ivanhoe International Center at (605) 394-6884.

**ITS Residence Hall Networking Agreement - \$100.00/academic year:** This fee is accessed only upon receipt of a completed residence hall networking agreement. If a student withdraws during the academic year, if requested at the ITS help desk, a \$40.00 refund will be made.

**Late Payment Fee - \$10.00 plus \$1.00/day:** A student who does not pay fees and charges during the regularly established payment period may be assessed a late charge of \$10.00 plus \$1.00 per day everyday thereafter. A student who fails to satisfy financial obligations when due may be withdrawn from the university and tuition and fee charges will still be owed.

**Payment Day Non-Payment Fine - \$25.00:** A student who does not make payment of fees and charges during the regularly established registration/payment day period may be assessed a late fine of \$25.00.

**Refrigerator Rental Charge - \$1.00 - \$3.50/week:** Students can rent a refrigerator/freezer for their residence hall room. Rental rates are \$1.00 per week for a small refrigerator, \$1.50 per week for a large refrigerator, and \$3.50 per week for a microfridge (microwave and refrigerator/freezer). Advance payment is required. Contact Residence Life at (605) 394-2348 for more information.

**Student Health Insurance:** An insurance package is available to students at an additional cost. This plan covers a 12-month period and does provide dependent coverage. Please contact the Vice President for Student Affairs and Dean of Students Office at (605) 394-2416 or the Health Services Office at (605) 394-2354 for more information.

**Testing Fee - \$15.00/each:** This fee is accessed when a student needs to re-test the

COMPASS or Proficiency Exam. Please contact Academic and Enrollment Services at (605) 394-2400 for more information.

**Transcript Fee - \$7.00/each:** 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. This charge is for additional requested copies.

**Vehicle Registration Fee:** All motor vehicles brought on campus must be registered with the Campus Safety Office and must display the appropriate parking permit. Parking permits can be purchased at Student Accounts/Cashiering Services located in the lower level of the Surbeck Center. Contact the Campus Safety Office at (605) 394-6100 for current rate details.

### **Residence Hall Fees**

An advance payment of \$100.00 must accompany all residence hall applications. This amount will be applied to the fees listed below. Included with these fees are local telephone service and basic cable television service. Computer network connections are also available in all rooms at an additional charge. All residence hall occupants are required to have a meal plan.

### **Campus Dining Meal Plans**

Freshmen students living in the residence halls must have either the Platinum, Gold, or Silver meal plan. For details regarding these plans, please contact the dining services office at (605) 394-1953 or (605) 394-2327.

### **Debit Card System**

The SDSM&T 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 the Tech Bookstore. To open a Debit Card Flex Account or to make a deposit go to the Debit Card Office in the lower level of the Surbeck Center.

### **PAYMENT OF TUITION AND FEES**

All tuition and fees will be required to be paid in full or other financial arrangements made, which must be approved in writing by Student Accounts/Cashiering Services no later than the Friday of the first week of classes.

### **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. At such time the account will be placed with a collection agency and reported to two national credit bureaus. The student will be responsible for all collection costs, attorney's fees, and any other costs necessary for the collections of any unpaid balance. This indebtedness applies to student indebtedness to the university and not to student organizations.

### **REFUNDS OF TUITION AND FEES**

#### **A. Refunds for Dropped Course**

A student receives a 100 percent refund of tuition and per credit hour fees for dropped courses within the drop/add period as defined in BOR policy 2:6. Any course meeting during a standard semester, which meets for less time than the standard semester shall be treated as a non-standard semester course for refund purposes. No refund shall be provided for courses dropped after that time other than by administrative action.

#### **B. Withdrawal from SDSM&T**

Students who withdraw, drop out, or are expelled from the institution within the drop/add period receive a 100 percent refund of tuition and per credit hour fees.

Students who withdraw, drop out, or are expelled from the institution after the seventh instructional class day of the period of enrollment for which they are assessed may be entitled to refund as set forth herein.

#### **C. Calculating Refunds**

##### **1. Students Who Receive Federal Title IV Financial Aid**

- a. Students who receive Federal Title IV student financial aid may receive a

refund of tuition, fees, and institutional charges if they withdraw from the university during the first 60 percent of the term. The university would retain that portion of the tuition, fees, and institutional charges presumed to cover costs it incurred during the time that the student remained enrolled at the university. Students who withdraw after sixty percent of the term has been completed receive no refunds.

- b. The date of withdrawal is determined as follows: that date on which (1) a student provides to the Academic Enrollment Services (AES) office notification of their intent to withdraw; (2) the AES office becomes aware that the student ceased attendance; (3) the AES office becomes aware that the student ceased attendance without providing written notification to the university because of illness, grievous personal loss, other such circumstances beyond the student's control, the date on which the AES office determines is related to that circumstance; (4) the earlier the date on which the student does not return from an approved leave of absence or the date the student notifies the university that they will not be returning to the institution; (5) the date the student fails to meet the terms of a repayment agreement while maintaining their eligibility for Title IV funds; (6) the date on which a student begins an academic leave of absence; or (7) the date for which a student who withdrawals from an institution after rescinding an intent to withdraw is the date that the student first provided notification to the university's AES office or began the withdrawal process, unless the university chooses to document a last date of attendance at an academically related activity.
- c. For purposes of determining the date of withdrawal, approved leaves of absences may be used.
- d. Students who receive a refund may be required to repay the appropriate Title IV aid program from which they received assistance for any sums that have not been retained by the institution

for services rendered or that will no longer be required to support other on-going expenses for attending the university. Specific information about possible repayment obligations may be obtained through the financial aid office.

## **2. Students Who Do Not Receive Federal Title IV Financial Aid**

Students who do not receive Federal Title IV student financial aid and withdraw from the university may be entitled to a refund of tuition, fees, and institutional charges calculated through 60 percent of an enrollment period. The refund shall be determined by computing the percentage of an enrollment period remaining, after the date of withdrawal, times the tuition, fees, and institutional charges originally assessed the student. Dates of withdrawal will be determined in the same manner as is done for students receiving Title IV federal financial aid. At no time will refunds be awarded after the 60 percent point of the enrollment period.

### **D. Cancelled Registration**

If a student's registration is cancelled, no tuition and fee payment is due. If payments have been made, a student is eligible for a full refund.

### **E. Extensions and Waivers**

The president may extend the time periods in sections A through D above or waive sections A through D above in the following circumstances: the death of the student; the student's disabling condition or severe illness; the death, disability, or severe illness of an immediate family member causing severe financial hardship to the student; or, other extenuating circumstances beyond the student's control.

### **Military Service - Withdrawal Without Penalty**

Students required to withdraw from state supported institutions before completing a semester may receive credit or refund privileges if they are regularly enrolled and belong to a military unit called for duty or are drafted and not eligible for deferment, and, the



discontinuance of class attendance is on the last practicable day before reporting for duty as determined by the college or university in which they are enrolled. Eligible students who are required to report for military duty not earlier than four calendar weeks prior to the date a semester ends as stated in the official catalog of the institution, or after completion of at least 75 percent of the enrollment period in a non-standard semester course, may, when authorized by the instructor, be given full credit for all courses for which they have an average of "C" or better. Eligible students who receive credit or an incomplete for any course for which they are enrolled shall not be entitled to any refund of tuition or fees paid. Eligible students who do not receive an incomplete or credit for a course in which they are enrolled shall be entitled to a full refund of tuition and academic fees.

Course Grade is as determined by the instructor, either the grade to date or the final grade earned to date.

SOURCE: RR 10:03, 1977, (Revised BOR, June 1991); RR 10:14, 1977; BOR, April 1992, BOR, December, 1992; BOR, October, 1993; BOR, June, 2000; 64 Fed. Reg. 59016 (1999)

#### **Residence Hall Refund Policy**

Students with a room contract who withdraw from the institution will receive a proportional refund at the time of withdrawal up to the 60 percent point after which no refund is available.

#### **Campus Dining Refund Policy**

Students with a food service contract who withdraw from the institution will receive a

proportional refund at the time of withdrawal up to the 60 percent point after which no refund is available. The balance of flex plan dollars will be refunded at 100 percent.

#### **TEXTBOOK REFUND POLICY**

##### **Fall and Spring Semesters**

**With receipt only**, a full refund will be given on textbooks purchased no earlier than one week before classes begin and returned no later than two weeks after classes begin. New textbooks that are damaged or that have ANY marks on them will be refunded at USED retail price. No refunds will be issued after the designated drop/add deadline.

##### **Summer Sessions, Extension, and Continuing Education Classes**

**With receipt only**, a full refund will be given on textbooks purchased no earlier than one week before classes begin and returned no later than one week after classes begin. New textbooks that are damaged or that have ANY marks on them will be refunded at the USED retail price. No refunds will be issued after the second week of classes. It is recommended that students attend class before purchasing their textbooks.

##### **Tech Bookstore Buyback Policy**

The bookstore buys back textbooks during final test week of the fall and spring semesters. Summer school buyback will be held the last day of classes. Books will be purchased according to procedures outlined in the official SDSM&T policy book. This is not a guarantee that textbooks will be bought back by the bookstore.

#### **MILITARY SERVICE OPTIONS FOR FINAL GRADES AND REFUNDS**

##### **Weeks remaining in standard semester**

<b>Course Grade</b>	<b>More Than Four Weeks</b>	<b>Less Than Four Weeks Student's Option</b>
A	Refund	A or Refund
B	Refund	B or Refund
C	Refund	C or Refund
D	Refund	Refund
F	Refund	Refund
P	Refund	P or Refund
I	Refund	I or Refund

## TUITION RATES

Tuition Category	Undergraduate Rate/Cr. Hr.	Graduate Rate/Cr. Hr.
SD Resident	\$65.00	\$98.65
SD Non-Resident	\$206.65	\$290.75
Western Undergraduate Exchange	\$97.50	N/A
Adjacent State (AY01) <sup>1</sup>	\$155.35	N/A
Adjacent State (AY02) <sup>2</sup>	\$97.50	N/A
Minnesota Reciprocity	\$75.85	\$136.75
ROTC and National Guard	\$32.50	N/A
SD Employee and SD Teacher Certification	\$32.50	\$49.35
Students 65 years of age or older	\$16.25	\$24.65
Self Support Classes - Outside Sioux Falls	\$153.65	\$203.40
Self Support Classes - Remedial	\$166.65	N/A
Graduate Assistant	\$32.90	\$32.90

<sup>1</sup> Students and transfers enrolled in academic year 2001.

<sup>2</sup> New students and transfers enrolling for academic year 2002.

## SCHEDULE OF FEES

Course Fees	Amount
General Activities Fee (GAF)	\$17.63/credit hour
Laboratory Fee	\$22.40/lab
Salary Enhancement Fee (PIF)	\$16.12/credit hour
University Support Fee (USF)	\$49.32/credit hour
<b>Other Fees and Charges</b>	
Application Fee (Graduate)	\$35.00
Application Fee (Undergraduate)	\$20.00
Credit-by-Examination Fee	\$79.90/course
ID Replacement Card Fee	\$10.00/each
International Student Enrollment Fee	\$106.50/one-time
International Student Insurance Fee	call for amount
ITS Residence Hall Networking Fee	\$100.00/academic year
Late Payment Fee	\$10.00 + \$1.00/day
Payment Day Non-Payment Fine	\$25.00
Refrigerator Rental Charge	\$1.00 - \$3.50/week
Student Health Insurance	call for amount
Testing Fee	\$15.00/each
Transcript Fee	\$7.00/each
Vehicle Registration Fee	call for amount
<b>Residence Hall Fees</b>	
Double Occupancy	\$795.09/semester
Single Occupancy	\$1,060.47/semester
<b>Campus Dining Meal Plans</b>	
Platinum PLUS	\$947.00/semester
Gold PLUS	\$947.00/semester
Silver PLUS	\$947.00/semester
Copper PLUS	\$680.00/semester
Bronze PLUS	\$535.00/semester
Titanium PLUS	\$723.00/semester
Commuter Plan - Emerald	\$68.00
Commuter Plan - Sapphire	\$95.00
Commuter Plan - Ruby	\$50.00 - \$199.99

## 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 \$8 million for 2001-2002. Staff members are available in the Academic and Enrollment Services - 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, grant, and scholarship) 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 and considered ready for packaging by the March 15th 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](http://www.sdsmt.edu), click on "Current" or "Prospective" student, and then click on "Financial Aid."

### POLICIES GOVERNING FINANCIAL AID AWARDS

#### **Federal Awards are Subject to Final Funding**

Often, financial aid awards are made prior to the notice of final federal allocations. For this reason, some Federal Student Aid (Pell Grants, Perkins Loans, Supplemental Educational Opportunity Grants, and Work-Study) is awarded subject to confirmation of funding. However, it is rare that final funding would be significantly different to the point that we would have to adjust awards. The dollar amounts that appear on the student's award letter are estimates and assume that students will be enrolled on a full time basis.

#### **Authorization to Apply Aid to the Student's SDSM&T Account For All Billed Expenses**

All charges on the student's account are the result of their attendance at SDSM&T. As a result, it is expected that their financial aid will be used to satisfy charges on their account that they have incurred (such as tuition, fees, room, and board, authorized bookstore charges, etc.). A written notification must be provided to the Financial Aid Office to restrict the use of aid funds to satisfy other charges on the student's account, such as parking fines or residence hall room network hookups. However, doing so will require the use of other means to pay any unpaid charges on their account. Charges of any nature left unpaid may result in a hold being placed on academic records, thus affecting the ability to enroll, change enrollment, or obtain an academic transcript until the balance is paid in full.

#### **Complete All Forms**

In order to finalize an award, students must sign, date, and return the original copy of the award letter. In addition, all forms that require the student's signature must be completed and returned to the Financial Aid Office within the time specified on the award letter.

#### **Additional Awards**

Students must report any other resources received during the year that do not appear on the award letter (such as, but not limited to, Active Duty, National Guard, Reserves, ROTC or VA educational benefits, Voc-Rehab, BIA, or Tribal Higher Education funding, scholarships, fellowships, loans, gifts, assistance received from a Cooperative Education or internship employer, etc). Failure to do so may result in a partial or total cancellation of aid and repayment of any aid already disbursed. In the event additional funding is received, the financial aid package will be reevaluated and adjustments made, if necessary. In such cases a revised award letter may be sent for confirmation.

#### **Entrance Loan Counseling**

All first time student loan borrowers at SDSM&T must complete entrance loan counseling prior to receiving their loan funds. Entrance loan counseling for both the Stafford and Perkins Loan programs is provided via the

Internet by going to the web site at [www.sdsmt.edu](http://www.sdsmt.edu), clicking on either “Current” or “Prospective” student, then on “Financial Aid,” and then on the link to “Loan Counseling.” Once the student completes the counseling session, the SDSM&T Financial Aid Office is automatically notified that this requirement has been met. Students should also make a printout of the Confirmation Page for future reference.

### **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. The Stafford and PLUS loan programs will be processed electronically and disbursed via Electronic Funds Transfer to the student’s account at SDSM&T. If the financial aid exceeds the student’s institution costs, a cash disbursement will be available during fee payment, or in Student Accounts/Cashiering Services after the final add/drop date each semester. Aid will not be released to the student before a semester begins. In the event that there are unforeseen delays in disbursing 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**

Course work taken at any one of the other Board of Regent universities in South Dakota (BHSU, DSU, NSU, SDSU, or USD), can be used to determine aid eligibility at SDSM&T (except for Tech scholarships, for which students must be enrolled full time at SDSM&T). However, restrictions apply to course work taken through a non-Board of Regent institution. Contact the Financial Aid Office for more information.

### **Correspondence Studies**

SDSM&T does not offer courses via correspondence. However, for SDSM&T students who may be considering taking a correspondence course through another college

or university, they should contact the Financial Aid Office to discuss possible options with the Financial Aid Director for receiving assistance to help pay for that type of course work.

### **Summer Financial Aid**

The results of the FAFSA used for determining aid eligibility for the fall and spring semesters will be used for the following summer as well. As a result, the only Federal Student Aid that is available for summer is what is remaining in eligibility from the fall and spring semesters (exceptions may apply to students who will be graduating in the summer or the following fall). Students who know that they will be taking summer classes should either set aside some of their aid for summer, or if borrowing student loans, do not borrow all of the eligibility stated on the award letter for the fall and spring semesters. As a general rule, students must be taking at least a half time course load (six credits for undergraduate and five for graduate students) to be eligible for summer financial aid. Additional restrictions apply to remaining eligibility under the Pell Grant Program. A SDSM&T Summer Aid Application, which is available late March or early April, must be completed before aid will be considered for summer.

### **Satisfactory Academic Progress**

In order for students to remain eligible for Federal Student Aid, the U.S. Department of Education requires that Satisfactory Academic Progress must be maintained toward the completion of an SDSM&T degree. Federal Student Aid includes Pell Grant, Supplemental Educational Opportunity Grant, Work-Study, Perkins Loan, Stafford Loan (subsidized and unsubsidized), and PLUS Loan. (Students receiving non-federal sources of financial aid should review the academic requirements for continued eligibility for that assistance, since most programs have requirements that exceed those stated here.)

The basic criteria for continued eligibility is that students must successfully complete 70 percent of the credit hours attempted and have a cumulative grade point average consistent with the academic requirements for their grade level based on successfully completed credit hours (1.80 for 0 – 31.99 credit hours, 1.90 for 32 – 63.99 credit hours, and 2.00 for 64 or

more credit hours). Graduate students must contact the Graduate Education and Research Office for degree program continuation requirements. Where their standards exceed those stated here, Graduate Office requirements will take precedence over the financial aid requirements.

If at any time the student fails to make satisfactory academic progress, he or she will be placed on Financial Aid Probation. However, a subsequent failure to meet the mentioned standards will result in the termination of Federal Student Aid eligibility at SDSM&T. For a more complete discussion of the satisfactory academic progress requirements, go to the web site at [www.sdsmt.edu](http://www.sdsmt.edu), click on “Current” or “Prospective” student, and then follow the links on the “Financial Aid” 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 point in the semester that withdrawal occurs, the student may be entitled to a full or partial refund of tuition and fees, and if contracting with the university, room and board. Students who are also taking classes at any one of the other five South Dakota Board of Regent universities will not be entitled to a refund unless they withdraw from all classes at all campuses.

A withdrawal is considered to be official when the student comes to the Office of Academic and Enrollment Services (AES) and initiates the necessary paperwork. In the event that the student leaves school without notifying AES, 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.

For a more complete discussion of Withdrawal and Refunds, go to the web site at [www.sdsmt.edu](http://www.sdsmt.edu), click on “Current” or “Prospective” student, then follow the links on the “Financial Aid” web site. Examples are provided regarding what a student could expect to receive based on when they withdraw.

## **PROGRAM DESCRIPTIONS**

The following information on the Federal Aid Programs is meant to give a brief overview of the programs available at SDSM&T. Detailed information is available from the U.S. Department of Education at [www.ed.gov/prog\\_info/SFA/StudentGuide](http://www.ed.gov/prog_info/SFA/StudentGuide).

Except for the PLUS loan program described below, eligibility for all Federal Aid Programs is determined first by completing a new Free Application for Federal Student Aid (FAFSA) or Renewal FAFSA each year. Students must be degree-seeking at SDSM&T in order to be awarded aid of any type. Unless otherwise noted, these programs are available to both graduate and undergraduate students.

### **FEDERAL GRANT AND WORK-STUDY**

#### **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. However, the actual amount the student will receive will be based on their enrollment status as of the final add/drop date each semester. If they are not enrolled in at least 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. As a result, they could have an unpaid balance due on their account. Students enrolled less than half time may be eligible.

#### **Federal Supplemental Educational Opportunity Grant (SEOG)**

Available only to Undergraduate students, priority for awarding is given to Pell Grant recipients who have met the March 15th 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.

#### **Federal Work-Study (FWS)**

Priority for awarding is given to students who have met the March 15th priority awarding date. This program provides both on

and off campus jobs for students who show financial need through the FAFSA. Students normally will work 10 to 12 hours per week and be paid no less than \$6.00 per hour (departments can increase the hourly rate), with their class schedule in mind. Off campus employment emphasizes community service work and the America Reads Program. On registration day of each semester, at either 10:00 a.m. or 2:00 p.m., students must attend an information session to go over in more detail their FWS responsibilities. Students must bring to the meeting a photo ID (driver's license or Tech ID card) and their Social Security Card. Students not awarded FWS should contact the Financial Aid Office to see if they would be eligible to be placed on a waiting list.

#### **FEDERAL STUDENT LOAN PROGRAMS**

##### **Federal Perkins Loans**

This loan program is administered by SDSM&T and like any loan, must be repaid. Awarding priority is given to students who show financial need through the FAFSA and who have met the March 15th priority awarding date. Students must be enrolled at least half time in order to receive loan funds. 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 needed to attend college. Arrangements will be made to obtain the student's signature on the promissory note before the loan funds are applied to their account. Repayment is to be worked out with the Business Office when the student graduates or is no longer enrolled at least half time. No payments are required for any period of at least half time enrollment at an eligible post-secondary institution or when approved for one of the many available deferments. During the repayment period, the interest rate on this loan is 5 percent on the unpaid principal balance. Depending on the amount borrowed, students may have up to 10 years to repay.

##### **Direct Loan Program**

SDSM&T 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 SDSM&T.

##### **Federal Stafford Loan Program**

This loan is obtained from a bank or credit union and like any loan, must be repaid. Eligibility is determined by the results of the FAFSA. The award letter shows the eligible loan program (subsidized or unsubsidized) and the maximum amount that the student is eligible to receive based on grade level, estimated cost of attendance, expected family contribution, and any other financial assistance to be received by the student. 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 is really needed to attend college. The interest rate is variable, subject to change as of July 1st of each year, and is currently capped at 8.25 percent. While the student is in school, the Federal Government pays interest on the subsidized Stafford; however, the student is responsible to pay the interest on the unsubsidized Stafford. The guarantee agency is authorized to withhold up to 4 percent from the loan proceeds as an origination fee and insurance premium to offset the processing of the loan. Repayment is to be worked out with the lender when the student graduates or is no longer enrolled at least half time. Depending on the amount borrowed, the student may have up to 10 years to repay.

With few exceptions, SDSM&T electronically processes Stafford Loans and receives loan funds via electronic funds transfer (EFT) to be applied directly to the student's account at the SDSM&T Student Accounts/Cashiering Services. Students are advised to carefully read and respond immediately to information received from their lender or guaranty agency, especially if they must complete, sign, and return forms to them. Keep copies of any correspondence sent for future reference. Loan proceeds are sent to the school for disbursement. Students are not required to make payments on the principal balance until six months after they cease to be at least a half time student or during any eligible deferment period.

### **Consolidation Loans**

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. Applying for financial aid using the FAFSA is not required but is highly recommended. The PLUS Loan Program is available to parents with good credit histories who wish to borrow for their dependent student enrolled at least half time. The annual loan limit is the estimated cost of attendance minus any financial aid received by the student (i.e., grants, loans, scholarships, work, etc.). The guarantee agency is authorized to withhold up to 4 percent from the loan proceeds as an origination fee and insurance premium to offset the processing of the loan. The interest rate is variable, subject to change as of July 1st of each year, and is currently capped at 9 percent. Loan applications are available from any PLUS loan lender or through the Financial Aid Office and will be mailed upon request. The family should complete the application and return it to the Financial Aid Office for processing. School information will be added on the paper application or submitted electronically, and then mailed to the lender indicated by the parents. If the lender participates in the Electronic Funds Transfer (EFT) process, the proceeds will be applied directly to the student's account at the SDSM&T Student Accounts/Cashiering Services. If not, then a paper loan check will be sent to the office for disbursement. In either case, any funds received in excess of what is needed to pay the

student's account at SDSM&T is for the use of the student, not the parents. Parents should carefully consider how much they agree to borrow and not borrow more than what is needed for the academic year. Repayment begins within 60 days of the final disbursement on the loan for the loan period. Instructions for repayment are included with the application.

### **OTHER SOURCES OF FINANCIAL AID**

#### **Alternative Loans**

Larger banking institutions often offer private loan programs to further assist students who are unable to obtain sufficient Federal Student Aid in order to attend college. If students do not have any type of credit history, or have had credit problems in the past, they may be required to have a credit-worthy cosigner. Contact the Financial Aid Office for further information.

#### **Outside Agency Assistance**

Students at SDSM&T are eligible to receive assistance from various outside agencies, such as the Department of Rehabilitation Services, Tribal Higher Education Offices, National Guard, Reserves, Active Duty, Veterans Administration, Army ROTC, and others. Information on ROTC Scholarships is available elsewhere in this catalog. Students receiving these or other types of benefits must notify the Financial Aid Office of the amount and duration of the award. Failure to do so could result in the partial or total cancellation of Federal Student Aid already awarded and repayment of Federal funds already received.

#### **Part-Time Employment**

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

### **SCHOLARSHIPS**

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 SDSM&T. The Foundation Office matches scholarship recipients to the various donors based on the donor’s criteria. The Application for New Incoming Freshman Scholarships is available in the fall from the Financial Aid Office (also on the web site listed below) and must be received no later than February 1st prior to the academic year the student plans to attend. If February 1st falls on a weekend, applications must be received by 4:30 p.m. the following Monday. Incomplete scholarship applications will not be considered; however, late applications may be considered if funds are available. All current students are automatically considered for continuing scholarships based on academic performance at SDSM&T and scholarship criteria. All scholarship recipients must maintain full time enrollment (at least 12 credit hours per semester at SDSM&T) and maintain the grade point average as required by the donor.

Graduate students seeking information regarding fellowships available at SDSM&T should contact the Graduate Education and Research Office at SDSM&T.

Occasionally the Financial Aid Office is notified of scholarship opportunities that are awarded outside the university. Information is posted on the bulletin board outside the AES Office, O’Harra Building, Room 216. Awards that are awarded annually from outside organizations are also posted on the web site at [www.sdsmt.edu](http://www.sdsmt.edu) (click on “Prospective” or “Current” student, then on “Financial Aid,” and then “Scholarship Information”). Links to free Internet scholarship searches are also available at this location.

Students who receive a scholarship that was not awarded by SDSM&T 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.

The following is a listing of scholarships at SDSM&T. 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
MINE	Mining Engineering
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 towards 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 by 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.

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

**VERNON A. MERRITT** - Established by Frank A. Richardson (GEOE '55) to honor his uncle.

**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 Trittipio 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 by 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 SDSM&T. 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 SDSM&T Chapter of AISES.

**ELROSE AND REUBEN ANDERSON SCHOLARSHIP -** SCI or ENGR with cumulative 3.0 GPA.

**FRANK APLAN -** Native American, MET.

**D. SHERWIN ARTUS SCHOLARSHIP -** So, Jr, or Sr in GEOE with cumulative 3.0

GPA and financial need.

**ASCE CONCRETE CANOE SCHOLARSHIP -** Participates in concrete canoe competition or related ASCE activities.

**MACY BARESCH SCHOLARSHIP -** GEOE and GEOL with financial need.

**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 MINE.

**GUY N. BJORGE SCHOLARSHIP -** GEOL, MET, or MINE.

**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. BORGEM 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.

**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 MINE 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.

**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 SCHOLARSHIP** - One to a male athlete and one to a female athlete with 3.0 GPA or above majoring in SCI or ENGR.

**RALPH AND MARY ELLEN CRAIG SCHOLARSHIP** - ENGR 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, MINE, or MET; one award to an EE or CENG, and one award to a female in ENGR or SCI.

FINANCIAL AID

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

**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.

**DELTA SIGMA PHI MEMORIAL SCHOLARSHIP** - So, Jr, or Sr with cumulative GPA of 3.0 or above who is a member of SDSM&T 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 MINE.

**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 Interdisciplinary Studies.

**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. ENGBRETSON LEADERSHIP SCHOLARSHIP** - Jr or Sr in MINE 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 MINE with 2.5 GPA or above.

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

**ARTHUR W. FAHRENWALD SCHOLARSHIP** - Unrestricted.

**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.

**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.

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

**CATHERINE D. FOWDEN MEMORIAL SCHOLARSHIP** - Unrestricted.

**HARVEY R. FRASER SCHOLARSHIP** - Unrestricted.

**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 MINE. 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 in GEOE, GEOL, MET, or MINE from Clark, SD; then MET.

**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 MINE.

**WILLIAM A. GRIFFITH SCHOLARSHIP** - U.S. Citizen Jr or Sr in GEOL, GEOE, CHE, MET, or MINE.

**GUKEISEN-HIEB FAMILY MEMORIAL SCHOLARSHIP** - ENGR or SCI Fr who graduated in the top 25 percent from 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 G. HANSEN SCHOLARSHIP** - CE.

**JOHN AND BLANCHE HANTEN MEMORIAL ATHLETIC SCHOLARSHIP** - 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 MINE with initiative and leadership qualities; preference: resident of SD with need if all other candidate qualifications are equal.

FINANCIAL AID

**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.

**BOB AND HELEN HUNT ATHLETIC SCHOLARSHIP** - 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 MINE.

**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** - MINE.

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

**WILLIAM AND MARY JONES MEMORIAL SCHOLARSHIP** - Resident assistants.

**CHERYL L. KAUFMAN MEMORIAL SCHOLARSHIP** - So, Jr, or Sr female in SCI or ENGR with financial need; preference: female in EE.

**EARL AND BLANCHE KELLER SCHOLARSHIP** - Unrestricted.

**GERRY KELLER ATHLETIC SCHOLARSHIP** - Athlete.

**MARK J. KENNER MEMORIAL SCHOLARSHIP** - Jr or Sr in CE with 2.7 GPA or above; preference: SD native and 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.

**RAY E. LEMLEY, M.D., MEMORIAL - GEOL/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 SDSM&T 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, GEOLE, MET, or MINE.

**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.

FINANCIAL AID

**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, MINE, or MET with 3.25 GPA or above.

**RICHARD J. MONHEIM SCHOLARSHIP** - Jr, 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** - Eight scholarships to 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** - MINE.

**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.

**POMPY FAMILY SCHOLARSHIP** - Cumulative 3.0 GPA.

**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.

**LESLIE AND VALETA ROGGENTHEN SCHOLARSHIP** - GEOL, GEOE, MET, or MINE; 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 and CENG.

**MARLYS AND LESLIE SIMONSON ELECTRICAL AND COMPUTER ENGINEERING SCHOLARSHIP** - 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.

**A. L. SLAUGHTER MEMORIAL SCHOLARSHIP** - So, Jr, or Sr in GEOL, GEOE, MET, or MINE; preference: Black

FINANCIAL AID

Hills area.

**SDSM&T MEMORIAL SCHOLARSHIP -**

Memorial contributions from relatives, alumni, and friends of the college for general scholarship purposes. Memorials of five hundred dollars or more are recognized as follows: THEODORE J. ANDERSON, 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, CHARLES HALLSTROM, 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, WAYNE L. OLSON, ROBERT H. OSBORN, G.G. OSTERHOF, ROBERT A. QUINTAL, MILO SCHNEIDER, ROBERT F. SHERMAN, DAN TUSCHER, ARNOLD ULMER, WALLACE DIXON WARD, and BOYD E. WILSON.

FINANCIAL AID

**SDSM&T MUSIC SCHOLARSHIP -** 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 MINE 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.

**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 SCHOLARSHIPS -** Unrestricted.

**HOMER SURBECK PHYSICS PRIZE -** Jr in PHYS.

**AGNES AND HARRY TALICH MEMORIAL SCHOLARSHIP -** Hermosa, SD.

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

**GEORGE TLUSTOS MEMORIAL SCHOLARSHIP -** Preference: student from Gregory, SD, then central SD; if candidates are equal, then CE student with financial need.

**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). If earnings are sufficient, a \$50 cash award will also be included.

**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.

**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 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 SDSM&T.

**ALCOA SCHOLARSHIP** - EE, ME, and MET.

**AMERICAN SOCIETY OF CIVIL ENGINEERS AWARD** - 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.

**AMOCO** - Unrestricted.

**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.

**BARRICK - MINE.**

**BEAVERS HEAVY CONSTRUCTION SCHOLARSHIP** - Jr, Sr, or Grad in CE, have goal of career in heavy construction industry; U.S. citizen.

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

**BLACK HILLS SECTION OF SME - GEOE, MET, and MINE.**

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

**JAMES C. AND DORIS H. BURRITT MEMORIAL SCHOLARSHIP** - SCI or ENGR.

**CARGILL FOUNDATION SCHOLARSHIP** - CHE, ME, and MET.

FINANCIAL AID

**CARVER-CORNELISSEN SCHOLARSHIP** - GEOL or GEOE.

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

**CHEMISTRY/CHEMICAL ENGINEERING DEPARTMENT ALUMNI SCHOLARSHIPS** - CHE and CHEM.

**CIVIL ENGINEERING SCHOLARSHIPS** - CE.

**CLEVELAND CLIFFS FOUNDATION SCHOLARSHIPS** - MINE or Mineral Processing and Extractive Metallurgy; U.S. citizen.

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

**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.

**D.A.R. - BEAR BUTTE CHAPTER SCHOLARSHIP** - Jr or Sr in ENGR, MATH, or SCI; preference: DAR members, children, or grandchildren of DAR members.

**DACOTAH CEMENT UNDERGRADUATE SCHOLARSHIPS IN CIVIL ENGINEERING** - Sr in CE who is a resident of SD. Recipients shall be selected based on scholastic achievement, participation in extra-curricular activities, and an interest in the design of concrete structures and pavements.

**DACOTAH CEMENT GRADUATE SCHOLARSHIPS IN CIVIL ENGINEERING** - Grad in CE who is a member of American Concrete Institute, Dakota Chapter.

**S.K. DASH INDIA STUDENT FELLOWSHIP** - Grad that participates in the India Club.

**SUSAN DAVIDSON SCHOLARSHIP** - CHEM or CHE; preference: incoming Fr from Mitchell, SD.

**BRIANT L. DAVIS SCHOLARSHIP** - Grad in Atmospheric Sciences.

**DOW CHEMICAL SCHOLARSHIP** - CHEM or CHE.

**DOW CORNING SCHOLARSHIP** - CHEM or CHE.

**EARLY COLLEGE ENROLLMENT ASSISTANCE** - Aspiring high school students who enroll in classes on campus or via distance education.

**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.

**ERICSSON SCHOLARSHIP AWARD** - 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.

**DOUGLAS W. FUERSTENAU SCHOLARSHIP** - Incoming Fr in MET.

**GEOLOGY/GEOLOGICAL ENGINEERING GENERAL SCHOLARSHIP FUND** - 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.

**HARDROCK CLUB ATHLETIC GRANTS** - Athlete.

**HATTERSCHEIDT FOUNDATION  
EDUCATIONAL SCHOLARSHIPS** -

Entering Fr who rank in the upper 25 percent of their graduating class and are in need of financial assistance.

**DALE HJERMSTAD MEMORIAL**

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

**LARRY E. HUISENGA SCHOLARSHIP** -

Upon recommendation by the Music Program Director.

**GORDON INGWERSEN SCHOLARSHIP** -

Fr ENGR who graduated from a Sioux Falls, SD, high school; special application from Sioux Falls high schools required.

**IS ADVISORS AWARD** - IS.

**SRINIVASA L. AND SARADA IYER**

**AWARD** - Outgoing India Club President.

**CHERYL PUTNAM JAGANNATHAN**

**SCHOLARSHIP** - Preference: student who had cancer as a child; then who graduated from Bristol High School; then female in MET.

**CLINTON JOHNSON MEMORIAL**

**SCHOLARSHIP** - IE Jr with leadership qualities and involved in activities.

**KENNECOTT SCHOLARSHIP** - Awards to

four Jrs, one to each in GEOL/GEOE, ME, MET, and MINE. Summer employment available between So and Jr year, and possibly between Jr and Sr year. Sophomores should contact their department for more information.

**KRUSE EDUCATION TRUST** - Native

American.

**GORDON A. LARSON SCHOLARSHIP** -

Preference: student from North Dakota.

**DAVE AND LORI LITZEN**

**SCHOLARSHIP** - One to Jr or Sr women's basketball player and one to Jr or Sr football player.

**LIVE YOUR DREAMS SCHOLARSHIP** -

IS Jr or Sr, U.S. citizen.

**MASTER BUILDERS RESEARCH**

**FELLOWSHIP** - CEE grad with interest in concrete technology.

**MATH DEPARTMENT SCHOLARSHIP** - MATH.

**METALLURGICAL ENGINEERING  
DEPARTMENT SCHOLARSHIP** - MET.

**METALLURGICAL ENGINEERING  
FACULTY/ALUMNI SCHOLARSHIP** - MET.

**3M COMPANY SCHOLARSHIP** - CHE, EE, and ME.

**MINING ENGINEERING DEPARTMENT  
SCHOLARSHIP** - MINE.

**MONSANTO** - Unrestricted.

**MONTANA-DAKOTA UTILITIES CO.**

**SCHOLARSHIP** - One to entering freshman and 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.

FINANCIAL AID

**FRANK AND MARILYN RICHARDSON SCHOLARS** - Outstanding current So, Jr, and Sr from Earth Systems College, Materials Science and Engineering College, and Systems Engineering College. (Nine awards.)

**DOROTHEA RITER AWARD FOR EXCELLENCE IN ENGLISH** - Awards to students in Freshman English, Tech Comm I, and Tech Comm II.

**WILLARD L. "BILL" ROBERTS SCHOLARSHIP** - Jr or Sr in Geology field; scholarship from Western Dakota Gem and Mineral Society.

**DICK AND MARY SCHLUMBERGER CIVIL ENGINEERING SCHOLARSHIP** - CE.

**SHELL COMPANIES FOUNDATION SCHOLARSHIP** - CHE, CE, GEOE, ME, and MINE.

**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 SDSM&T employees to support general scholarships at the college. Unrestricted.

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

**SOUTH DAKOTA WATER AND WASTEWATER ASSOCIATION SCHOLARSHIP** - CE.

**TAU BETA PI SCHOLARSHIP FOR SOUTH DAKOTA ALPHA** - ENGR.

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

**TSP THREE SCHOLARSHIP FUND** - 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 SDSM&T 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 SDSM&T Civil Engineering Department.

#### **SHORT TERM LOANS**

**SDSM&T FOUNDATION MEMORIAL STUDENT LOAN FUND** - In addition to Federal Perkins and Stafford Student Loans, SDSM&T 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

**ADDITIONAL INFORMATION**

Requests for additional information should be directed to the Academic and Enrollment Services - Financial Aid Office, SDSM&T, 501 East Saint Joseph Street, Rapid City, SD 57701-3995, or call locally 394-2274, or toll free (800) 544-8162, ext. 2274.

FINANCIAL AID

**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 SDSM&T are eligible for assistance from the various loan funds but must have satisfactory scholastic records. Information regarding loans may be obtained from the Office of Academic and Enrollment Services.

## GENERAL

### ACADEMIC ORGANIZATION

Academic organization of the South Dakota School of Mines and Technology centers around four colleges and thirteen departments. Colleges are organized to promote interdisciplinary interaction between the sciences and engineering and to provide leadership for strong undergraduate and graduate degree programs.

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 Earth Systems**

Atmospheric Sciences  
Civil and Environmental Engineering  
Geology and Geological Engineering

GENERAL

#### **College of Interdisciplinary Studies**

Humanities  
Military Science  
Physical Education  
Social Sciences

#### **College of Materials Sciences and Engineering**

Chemistry and Chemical Engineering  
Materials and Metallurgical Engineering  
Physics

#### **College of Systems Engineering**

Electrical and Computer Engineering  
Mathematics and Computer Science  
Mechanical Engineering

### MINORS

The following policy on minors at the undergraduate level has been adopted by the

faculty of SDSM&T.

- 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.
- A minimum of 18 semester credit hours is required for a minor.
- No less than nine semester credit hours in a minor must be taken at SDSM&T.
- 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.

### INSTRUCTIONAL PLAN

The South Dakota School of Mines and Technology operates on a semester plan of instruction; each semester is approximately 15 weeks in length.

### 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 semester. A recitation or lecture is scheduled as one fifty-minute period plus two hours of preparation for an average student per week per credit hour. Each credit hour of laboratory work is scheduled as 110 to 170 minutes per week. Laboratories scheduled for



two hours per credit hour are expected to require one 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 SDSM&T.
2. Special: An enrolled student who has not been admitted, and is not pursuing a degree, will be permitted to accumulate more than 30 hours only on an exceptional basis. Special Students do not qualify for federal student aid or institutional scholarships.

An Academic and Enrollment Services 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 12 credit hours during a regular semester, or at least six credit hours total during the summer term. A three-quarter time undergraduate student is one who is enrolled in nine to 11 credit hours during a regular semester or four to five credit hours total during the summer term. A half-time undergraduate student enrolls in six to eight credit hours during a regular semester or at least three credit hours total during the summer term. A student on a cooperative education assignment who is registered for CP 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** (carry undergraduate credit only)

- 100-199 Freshman level
- 200-299 Sophomore level

**Undergraduate Courses** (open to graduate students for credit under restricted conditions - see graduate section of this catalog)

- 300-399 Junior level
- 400-499 Senior level (may be dual listed with 500 level graduate courses)

Tuition for courses numbered 500 and higher 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) Also see "Graduate Credit."

600-699 Graduate level (undergraduate enrollment only by exception) Also see "Graduate Credit."

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 times before formal approval is received, but they must be reported through the system curriculum approval process.

### **GRADUATE CREDIT**

Graduate credit for SDSM&T seniors, per faculty adopted regulations: "An undergraduate student who has senior standing at SDSM&T and is ranked in the upper one-half of the class, may petition the Dean of Graduate Education and Research 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. The student must file a petition with the Dean of Graduate Education and Research and this form must be signed by the student, the student’s advisor, and the chair of the student’s major department. This petition should be filed at the time of registration for the course, but no later than the tenth week of classes during the semester in which the course is attempted. Registrations not so petitioned will be cancelled.
6. Not more than 12 hours of graduate credit taken as a SDSM&T 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 and Research may approve a minor variance from this limit.
7. 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.)
8. Grades for courses so taken will not be included in undergraduate honor-point average or class standing.

GENERAL

## GRADING SYSTEM

Grade (Honor Points) and Meaning

### **A (4) Excellent**

### **B (3) Good**

### **C (2) Satisfactory**

### **D (1) Poor, lowest passing mark**

### **E (0) Used Only at Mid-term**

Never used as a final grade. Indicates unsatisfactory progress, potentially failing, but the student may continue in class.

### **F (0) Failure**

An “F” is a final grade used to indicate that the work prescribed for the course has not been satisfactorily completed. This grade is used in the computation of the honor point ratio earned. A professor may award a final grade of “F” after the tenth class day of the semester and thus drop the student from the course and prohibit further attendance in that class. The student, advisor, and the Director of Academic and Enrollment Services must be advised in writing if this action is taken.

### **I Incomplete** (Omitted in calculation of GPA)

A temporary grade issued when work is passing in quality but deficient in quantity, as determined by the instructor. The missing work must be completed within one year or during the next semester that the student is in attendance, whichever occurs first, or this grade automatically becomes a final grade of “F.”

### **NC No Credit** (Omitted in calculation of GPA)

An “NC” is a final grade used to indicate that the work prescribed for the course has not been satisfactorily completed, and no credit for the course is given. This grade is available only for courses taken as part of the individualized mathematics program.

### **IP In progress** (Omitted in calculation of GPA)

A temporary grade, at least passing in quality, issued when work on which to base a grade is not yet due. Can be issued at the end

of a semester only if the course is being continued into another semester; otherwise, an “I” or some other grade must be used. This grade converts to a final grade of “F” if a student is not enrolled at SDSM&T for 12 consecutive months.

**LR Laboratory Registration** (Omitted in calculation of GPA)

This is a final grade used to indicate that this is a laboratory course associated with a lecture. The grade and credit for the laboratory are included with the lecture course.

**SP Satisfactory Progress** (Omitted in calculation of GPA)

A grade that may be issued any semester. “SP” grades may be changed only to “S” at any time and must be changed to “S” for a completed graduate program. “SP” grades will stand permanently on transcripts of uncompleted programs. For research credits only.

**UP Unsatisfactory Progress** (Omitted in calculation of GPA)

A grade that may be issued any semester that reflects inadequate quality or insufficient quantity of work. May be changed to “U,” “S,” or “SP” at any time and must be changed for a completed program. “UP” grades will stand permanently on transcripts of uncompleted programs. For research credits only.

**S Satisfactory** (Omitted in calculation of GPA)

A final grade issued any semester or final grade issued in changing “SP” or “UP” grades given previously. Credits are applicable to a degree. For research credits only.

**U Unsatisfactory** (Omitted in calculation of GPA)

A final grade issued any semester or final grade issued in changing “SP” or “UP” grades given previously. An “S” grade awarded for a previous semester cannot be changed to “U” as a final grade for that semester. Credits not applicable to a degree. For research credits only.

The following marks are not issued by an instructor, but are posted under the circumstances indicated. These marks do not

enter into the calculation of the earned honor-point ratio.

**AU Audit**

The student must file a petition with the Office of Academic and Enrollment Services at the time of registration stating intent to audit the course. If, in the instructor’s opinion, a student should not be given recognition for auditing the course due to very poor performance or lack of attendance, the instructor may so inform the Office of Academic and Enrollment Services in writing, and this grade will be changed to one of “W.” (Also see “audited courses and registrations for no credit.”)

**W Withdrawal From Course(s)**

Students enrolled for any regular semester of instruction may adjust that term’s load of credit hours during the first 10 percent of the term with a full refund. When calculating 10 percent of the term, breaks of five or more days are not included in the total number of days but Saturdays, Sundays and holidays are. This date is listed on the Academic Calendar in the front of this catalog. There is NO refund of tuition for a dropped course after the 10 percent of the term, unless withdrawing from all courses; see Refund of Tuition and Fees section of the catalog. Before the end of the tenth week a no-penalty grade of “W” is assigned if a course is dropped with approval of the advisor, unless the professor-in-charge has previously turned in a final grade. To be eligible for a “W” grade the student must process a Request for Late Class Drop/Add Form by securing the signatures of his or her instructor and advisor and submitting the form to the Office of Academic and Enrollment Services.

A student may not drop a course with a passing grade after the tenth week of the semester. Each semester after the tenth week of classes, a grade of “F” will automatically be assigned by the Office of Academic and Enrollment Services to all courses dropped unless the instructor has previously issued a final grade. 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

and/or his or her instructor may appeal in writing to the Student Enrollment Appeals Committee for change of grade of the automatically assigned “F” to “W.” Such appeal must be filed within one semester after the semester in which the drop 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.

A dropped course can only have a grade of “W” or “F.” No other grade will be recorded. A grade of “W” is interpreted as a course registration or attempt.

**P Pass**

A passing grade issued in a course attempted under the Pass/Fail option. This grade will not be used in the calculation of grade point ratios. However, such credit hours earned, if appropriate and applicable, may be used to reduce graduation requirements. (Also see “undergraduate pass-fail option.”)

**OPTIONAL GRADES A PROFESSOR MAY USE**

If further refinement of the standard 4.0 system is desired for a course or an individual student in a class, the following grades will be accepted with the honor-points shown. The marks “A+,” “D-,” and “F-” will not be accepted; only those marks shown as valid will be accepted:

Grade	Honor Points
A-	3.66
B+	3.33
B-	2.66
C+	2.33
C-	1.67
D+	1.33

**SEMESTER HONORS LIST - DEAN’S LIST**

All regular undergraduate students who carry nine or more credit hours and receive a semester GPA of 3.4 or better are listed as

honor students. The Dean’s list is determined at the end of each semester at the time grades are due. Students with “F” or “I” grades are not listed, regardless of average attained.

**WITHDRAWAL FROM THE UNIVERSITY**

Dropping courses and withdrawal from the university are effective only on the date that notice is received in the Office of Academic and Enrollment Services. This notice must be given by the student using the appropriate forms. Dates for dropping courses and 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 the last day of the tenth week will result in 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 university counselor or the Coordinator of Educational Services. A withdrawal from the university will be processed only when all courses are being dropped by a student.

If a student withdraws from the university after the tenth week of classes, 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

GENERAL

recommendations provided by the course instructor(s) and the student's advisor.

### TRANSCRIPT OF CREDITS

A transcript of credits is an authentic copy of the student's academic record. The fee is \$7.00 for each copy. A transcript must include all courses attempted. Transcripts are released only on written request of the individual concerned. This order must be placed in person, by mail, or by FAX to the Office of Academic and Enrollment Services. Each student is entitled to one complete transcript of the credits earned upon graduation 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 that carefully conceived and implemented school-sponsored activities are an important and integral component of education. In light of this recognition, the Faculty Advisory Council offers the following policy:

1. Students must not be penalized for absence from classes when they are participating in school-sponsored activities, provided arrangements are made with the instructor prior to the class missed; and
2. Students must be given the opportunity to take make-up exams for those exams missed while participating in school-sponsored activities, provided arrangements are made with the instructor prior to the class missed.
3. The determination of a school-sponsored activity will rest with the Chair of the sponsoring department and/or the Vice President for Student Affairs and Dean of Students.

### 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 and final transcripts will be released.

### CONDUCT

Among the widely recognized traditions and lawful missions of tax-supported higher education in the United States, to which South Dakota School of Mines and Technology subscribes are the following: (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. It is assumed that students come to college for a serious purpose and will support such policies and those that may be developed from time to time.

The students' responsibilities and obligations for conduct are generally much higher than those imposed on all citizens by the civil and criminal law, and such high standards may apply to conduct off campus as well as on the campus. 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*

GENERAL

*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)*

*Any student may be placed on Involuntary Administrative Withdrawal or Emergency Suspension from the SDSM&T. Such suspension includes exclusion from classes, activities, and other privileges on an emergency, temporary basis. Emergency suspension, involuntary administrative withdrawal, academic failure, and scholastic probation are not regarded as disciplinary sanctions.*

*A student who causes disruption or obstruction of teaching, research, administration, disciplinary proceedings, student activities, or other institution activities because of a mental or emotional disorder in which the student poses a danger to him/herself or to others, or who directly and substantially impedes the lawful activities of others on campus may be subject to disciplinary action.*

*The institution may make a preliminary investigation to determine if the charges can be disposed of informally without the initiation of formal disciplinary proceedings.*

*If, following the preliminary investigation, the Administration finds that it is in the best interests of the institution, faculty, or students, the Administration may temporarily suspend the student on an emergency basis. A due process hearing will be held as soon as is feasible.*

*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. The South Dakota School of Mines and*

*Technology Judicial Council 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, and 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.*

GENERAL

# REGISTRATION

## 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, must be approved by the assigned mentor/advisor. The advisor assignment may be changed in the Office of Academic and Enrollment Services.

## CREDIT BY EXAMINATION

Credit by examination includes Advanced Placement (AP), College Level Examination Program (CLEP), and Credit by University Examination. Up to 36 credit hours (usually for freshman and sophomore level courses) earned through credit by examination may be applied toward the student's baccalaureate degree requirements. A grade of "P" will be assigned and therefore the hours will not be used in the computation of grade point averages. These credits will not count toward full-time student status. Credit will be awarded only when the student is registered as a regular student at SDSM&T.

Credit by examination (for CLEP and for Credit by University Examination) is not permitted if: (a) The student has received prior college level credit for the same course or its equivalent; (b) The student has been enrolled previously in the course on the college level and received a failing grade; (c) The student has enrolled previously in the course but withdrew after more than six weeks of instruction; or (d) The student has been unsuccessful in a previous attempt to obtain credit by examination for that course.

Specific information about the credit by examination program may be obtained from either the Vice President for Student Affairs and Dean of Students Office or the Office of Academic and Enrollment Services.

### **Advanced Placement Program (AP)**

Entering freshmen 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.ris.sdbor.edu/Universities/admissions/APguide.htm](http://www.ris.sdbor.edu/Universities/admissions/APguide.htm).

Other advanced placement: A few selected students whose entrance ratings and high school transcripts indicate exceptionally high-level preparation and ability are also chosen for advanced placement and subsequent credit if they successfully pass the advanced course attempted.

### **College Level Examination Program (CLEP)**

The student may receive course credit through the CLEP program. The CLEP score must meet or exceed the minimum qualifying scores for Subject Examinations that are equivalent to SDSM&T courses. Students may take these examinations either before or after they enroll at SDSM&T.

Only one attempt to challenge a given course by means of the CLEP Examination will be permitted. Applicability of this credit to SDSM&T graduation requirements is subject to approval by the student's department chair. No credit will be awarded for the General Examinations.

### **Credit By University Examination**

The 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." No entry will be made on the permanent record if the examination is failed.

### **International Baccalaureate (IB)**

SDSM&T 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 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. SDSM&T encourages talented high school students to extend their educational background in this manner.

South Dakota law provides that students in grades eleven and twelve may have such courses applied towards Bachelor of Science degree requirements at SDSM&T. With the school district's approval, these courses may be applied to high school graduation requirements. Documentation and additional admission procedures will be required.

### **UNDERGRADUATE PASS-FAIL OPTION**

1. Any undergraduate student with a minimum cumulative GPA of 2.00 at the 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 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 first four weeks 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 "Pass;" a grade of "F" will be recorded as a "Fail" and the "F" grade will be used in the calculation of the student's semester and cumulative GPA.
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 "P" is recorded. A passing grade will be recorded as "P" 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.

### **REPEATED COURSES**

The grades earned in all courses attempted are permanently recorded on the student's academic transcript. A grade is entered in the record of a student if the course is not officially and properly dropped during the first 10 percent of a semester. Recorded grades of "W" shall be interpreted as course registrations or attempts, however the "W" grade does not enter into the calculation of a student's grade point average. For the undergraduate student only credit hours earned in the last attempt of a repeated course will be counted toward the graduation credit hour requirement, and calculated in the cumulative grade point average.

### **THIRD REGISTRATION**

No more than three registrations, including transfers, will be permitted in any single course. A grade of "W" shall be interpreted as a course registration. This policy may be appealed to the Student Enrollment Appeals Committee for approval of a fourth attempt. Appeal form and information may be obtained



from the Vice President for Students Affairs and Dean of Students Office. If a course, required for the student's degree program, is not passed by the third attempt, the student may no longer be enrolled in that program unless they appeal this policy successfully.

#### **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 registration by written petition to the Office of Academic and Enrollment Services. The petition has no effect on the tuition charges for a course.

#### **OVERLOADS**

For a fall or spring semester, a normal student load is 18 credit hours or less. A heavy load is from 18.5 to 21 hours for freshmen, and from 18.5 to 23 hours for sophomores, juniors, and seniors. An overload is greater than 21 hours for freshmen, and greater than 23 hours

for sophomores, juniors, and seniors. For a summer term, an overload is greater than 12 hours. For a four-week mini-term, an overload is greater than six hours.

To register for heavy loads, students must consult with their academic advisors. To register for overloads, students must have a cumulative GPA of 2.50 or greater. Student requests for overload enrollments should be submitted in writing to their department chairs, with signed endorsements from their academic advisors. The department chair's written recommendation must accompany the registration requests to the Office of Academic and Enrollment Services.

Appeals must be made to the Faculty through the Chair of the Faculty.

#### **DEADLINES FOR ADDING COURSES**

1. Students may add daytime or night courses to their schedules through the first 10 percent of the term. When calculating 10 percent of the term, breaks of five or more days are not included but Saturdays, Sundays, and holidays are. The date to add courses is listed in the Academic Calendar, which is in the front 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 percent of the term. When calculating 10 percent of the term, breaks of five or more days are not included but Saturdays, Sundays, and holidays are. The date to add courses is listed in the Academic Calendar, which is in the front of this catalog.
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 student should be encouraged 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 “W Withdrawal From Course(s)” on page 52 for information about dropping a course.

#### **MANDATORY PLACEMENT PROCEDURE**

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



*TECHFact: Rapid City is the second largest city in South Dakota, with a population of more than 60,000. It is small enough to find your way around easily, yet large enough to provide plenty of entertainment and part-time job opportunities. 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, and biking.*

# BACHELOR OF SCIENCE GRADUATION REQUIREMENTS

## GRADUATION WITH HONORS

Recognition is given by the university to students who complete Bachelor of Science degree requirements with high academic attainment. For students with transfer credit, a minimum of 64 semester credits of "residence credit" is required to be considered for graduation with honors. Class standing is determined by grade point average of courses taken at South Dakota School of Mines and Technology.

A student will be recognized with "Highest Honors" if the grade point average is 3.80 or better; a student will be recognized with "High Honors" if the grade point average is 3.60-3.79; and a student will be recognized with "Honors" if the grade point average is 3.40-3.59.

## TWO BACHELOR OF SCIENCE DEGREES FROM SDSM&T

An undergraduate student who wishes to qualify for a second Bachelor of Science degree conferred by SDSM&T must complete a minimum of 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 Bachelor of Science degrees to the Office of Academic and Enrollment Services. This action will initiate the assignment of an advisor in each discipline.

## GRADUATION REQUIREMENTS

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.

### **General Requirements**

The following rules on graduation requirements apply for the Bachelor of Science degree in any curriculum offered by the university. 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**

At the January 1999 meeting of the South Dakota Board of Regents a system-wide general education core for undergraduate education was established. This core will be required for all students accepted to the university for the fall 1999 semester or later. General education core requirements must be completed within the first 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.

**Criteria:** Courses meeting this goal will collectively require students to:

1. Write logically and persuasively;
2. Use a variety of rhetorical strategies (e.g. expository, argumentative, descriptive);
3. Read critically the writing of others;
4. View writing as a process requiring planning, drafting, and revising;
5. Write for a variety of audiences, including academic audiences;
6. Incorporate formal research and documentation in the writing;
7. Use standard English; and
8. Use computer technology for basic communication-related tasks such as word processing and research.

**Credit Hours:** Six hours

**Courses:**

ENGL 101	Composition I
ENGL 201	Composition II
ENGL 279/289	Technical Communications I and II <sup>1</sup>

<sup>1</sup>Engineering and sciences students at SDSM&T 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.

**Criteria:** Courses satisfying this goal will require students to:

1. Plan and create speeches for a variety of audiences and settings;
2. Develop speaking competencies including choice and use of topic, supporting materials, organizational pattern, language, presentation aids, and delivery as appropriate to topic, audience, occasion, purpose, and communicator; and
3. Develop listening competencies including listening with literal and critical comprehension to ideas, perspectives, and emotions in messages.

**Credit Hours:** Three hours

#### **Courses:**

ENGL 279/289	Technical Communications I and II <sup>1</sup>
SPCM 101	Fundamentals of Speech

<sup>1</sup>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 structures and possibilities of the human community through studies of the social sciences.

**Criteria:** Courses in Anthropology, Economics, Geography, History, Political Science, Psychology, and Sociology meeting this goal will collectively require students to:

1. Learn and apply the basic concepts, terminology, and theories of the social sciences;
2. Examine the origin and evolution of human institutions;
3. Examine human behavior in different spatial, temporal, cultural, and/or institutional contexts;

4. Examine the allocation of human or natural resources within societies; and
5. Apply social science concepts and theories to contemporary issues in a responsible manner.

**Credit Hours:** Six hours (in two disciplines)

#### **Courses:**

ANTH 210	Cultural Anthropology <sup>1</sup>
ANTH 220	Physical Anthropology <sup>1</sup>
ECON 201	Principles of Microeconomics
ECON 202	Principles of Macroeconomics
GEOG 101	Introduction to Geography <sup>1</sup>
HIST 151/152	American History <sup>1</sup>
POLS 100	American Government
POLS 210	State and Local Government
PSYC 101	General Psychology
PSYC 251	The Psychology of Being
SOC 100	Introduction to Sociology
SOC 150	Social Problems <sup>1</sup>
SOC 250	Marriage and the Family

<sup>1</sup>Course meets requirement for Goal #7 Cultural Diversity.

### **Goal #4**

Students will understand and appreciate the human experience through arts and humanities.

**Criteria:** Courses in History, Literature, Philosophy, Religion, Non-English Languages, Art, Music, and Theatre meeting this goal will require students to:

1. Develop knowledge of the range of values, beliefs, and ideas embodied in the human experience;
2. Understand and interpret basic concepts and theories of the humanities and arts; and
3. Develop creative sensitivity and aesthetic understanding

#### **OR**

4. Understand and interpret formal and stylistic elements of the literary or fine arts;

#### **OR**

5. Demonstrate foundational competency in reading, writing, and speaking a non-English language.

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

**Courses:**

ART 111/112	Drawing and Perception I and II
ARTH 211	Art History
ARTH 151	Indian Art History <sup>1,2</sup>
ENGL 221/222	British Literature I and II <sup>1</sup>
ENGL 241/242	American Lit I and II <sup>1</sup>
ENGL 250	Science Fiction
FREN 101/102	Introductory French I and II <sup>1</sup>
GER 101/102	Introductory German I and II <sup>1</sup>
HIST 121/122	Western Civilization
HUM 100	Introduction to Humanities <sup>1</sup>
HUM 200	Connections: Humanities and Technology <sup>1</sup>
HUM 211/212	Development of Western Thought <sup>1</sup>
JAPN 101/102	Japanese Culture and Language I and II <sup>1</sup>
LAK 101/102	Introductory Lakota I and II <sup>1,2</sup>
MUS 100	Music in Our Lives
PHIL 100	Introduction to Philosophy
PHIL 200	Introduction to Logic
PHIL 220	Introduction to Ethics
PHIL 233	Philosophy and Literature
REL 230	Introduction to the Bible
REL 234	History of Christianity
REL 250	World Religions <sup>1</sup>
SPAN 101/102	Introductory Spanish I and II <sup>1</sup>

<sup>1</sup> Course meets requirement for Goal #7 Cultural Diversity.

<sup>2</sup> This course is part of the collaborative agreement between SDSM&T and Oglala Lakota College.

**Goal #5**

Students will understand and apply fundamental mathematical processes and reasoning.

**Criteria:** Courses meeting this goal will require students to:

1. Use mathematical symbolism and mathematical structure to model and solve problems;
2. Communicate in mathematical terms; and
3. Order and analyze quantitative information to make judgments of real world situations.

**Credit Hours:** Three hours

**Courses:**

MATH 102	College Algebra <sup>1</sup>
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<sup>1</sup> Any math course with college algebra as a prerequisite.

**Goal #6**

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

**Criteria:** Courses in Biology, Chemistry, Physics, Earth Science, and Physical Geography meeting this goal will require students to:

1. Participate in scientific inquiry in a laboratory experience;
2. Gather and critically evaluate data;
3. Demonstrate an understanding of fundamental principles of natural sciences;
4. Explore the development of ideas through time; and
5. Understand the implications science has for the modern world.

**Credit Hours:** Six 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	Introduction to Physics II and Laboratory
PHYS 211	University Physics I
PHYS 213/213L	University Physics II and Laboratory

**Goal #7**

Students will understand and be sensitive to cultural diversity so that they are prepared to live and work in an international and multicultural environment.

**Criteria:** Courses meeting this goal require students to:

1. Explore global issues and/or diverse philosophical, ethical, and religious views;
2. Explore social and aesthetic values of different cultures; and
3. Examine the contributions of different cultures from a historical perspective.

**Credit Hours:** Students are required to select six credit hours that provide a global and/or cultural diversity perspective. These six credit hours can be chosen from those completed to satisfy the social science and humanities/arts requirements listed above where the courses substantially address cultural diversity and/or global issues.

#### **Information Technology Goal**

Students will understand and utilize computer and other emerging technologies in the practice of their disciplines.

**Criteria:** Courses meeting this goal will require students to:

1. Learn and apply the basic concepts, terminology and principles of computer languages, applications software and/or systems; and
2. Utilize computers and emerging technologies to seek knowledge, solve problems, gather information, and interpret the world.

**Credits Hours:** Two hours (minimum)

#### **Courses:**

GE 112	Personal Computer Programming
GE 113	Introduction to Personal Computer
GE 115	Professionalism in Engineering and Science
CHEM 182	Chemical Computations
CSC 105	Introduction to Computers
CSC 150	Computer Science I
CEE 284	Digital Computer Applications in Civil Engineering
CEE 285	Microcomputer Applications in Civil Engineering
GEOE 211	Earth Systems Engineering Analysis

#### **Semester Credit and Grade-Point Average**

The graduation credit hour 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.

#### **Military Science Credits**

Military Science credits may apply to all degrees as free electives. This option varies with the number of free electives 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.

#### **University Undergraduate Residency**

##### **A. Purpose**

1. Expose students to the knowledge, competencies, and experience deemed essential for degrees conferred by the institution.
2. Certify that students have met institutional standards.
3. Provide faculty with the basis to act as a reference for students seeking employment.

##### **B. Course in Residence**

A "Course in Residence" is a course offered by the degree-granting Regental institution at any of its approved sites using any approved method of delivery. Courses that are part of a formal collaborative agreement among Regental institutions are considered to be "in residence."

##### **C. Residency Requirements for Degree-Seeking Students**

1. Minimum number of credit hours that must be earned in residence:
 

Baccalaureate	32 hours
Associate	16 hours
2. Number of the last credit hours earned preceding completion of the degree that must be earned in residence.
 

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

3. Minimum number of credit hours in the discipline that must be completed in residence: 50 percent.

### Required Check-out Procedure

All graduating seniors and students terminating enrollment at the South Dakota School of Mines and Technology 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 the South Dakota School of Mines and Technology.

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

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.

### Curricular Requirements

Each engineering curriculum requires 136 hours of credit for graduation and each science curriculum requires 128 hours of credit.

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 SDSM&T. These include:

**A. Mathematical Sciences:** all programs, with the exception of Interdisciplinary Science and Chemistry-Applied Option, require a minimum of 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 SDSM&T 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 SDSM&T mathematics placement examination scores. 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.

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

**C. Humanities and Social Sciences:** minimum of 16 credit hours - This subject area must include six credits in humanities and six credits in social sciences. Students majoring in engineering must complete at least three of these credits at an advanced level. See page 61 for courses that also meet general education core requirements.

### Humanities

Art: ART 111, 112, 280; ARTH 151, 211, **320, 491, 492**

English: ENGL 221, 222, 241, 242, 250, **300, 330, 343, 350, 360, 374, 383, 391, 392, 468**

Foreign Language: FREN 101, 102, 201, 202, GER 101, 102, JAPN 101, 102, LAK 101, 102, SPAN 101, 102 (All foreign language credit may be used as a humanities credit unless the language is the student's native language.)

History: HIST 121, 122 (For students enrolled in Fall 1999 or later these courses are a humanities, prior to Fall 1999 these courses were a social science.)

Humanities: HUM 100, 200, 291, 292, **300, 350, 375, 410, 491, 492**

Music: MUAP 150, MUEN **330**, MUS 100, 201, 250, **326**

Philosophy: PHIL 100, 200, 220, 233

Religion: 230, 250

### Social Sciences

Anthropology: ANTH 210

Business Administration: BAD **350, 360**

Economics: ECON 201, 202

Geography: GEOG 101, 240, 250, **300**

History: HIST 151, 152, **360**  
 Law: LAW **457**  
 Political Science: POLS 100, 210, **301, 330, 340, 350, 353, 412**  
 Psychology: PSYC 101, 251, **327, 331, 341, 361, 391, 392, 451**  
 Sociology: SOC 100, 150, 250, **320, 350, 391, 392, 410, 420, 459, 510, 520**  
 Social Work: SOCW 200, 210

All courses in bold indicate 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 credit hours.

**F. Electives:** Free Electives vary with the individual department. Any course may be selected which is not at a content level lower than the prescribed freshman year. 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 meteorology.

For information regarding the Associate of Arts degree requirements, see page 113.

#### **CAAP PROFICIENCY AND INFORMATION TECHNOLOGY EXAMS**

##### **CAAP Proficiency Exams Required for Graduation**

Effective Spring Semester 1998, meeting the minimum performance standards on the proficiency exam is mandated, by the South Dakota Board of Regents, for all students seeking a baccalaureate degree from the South Dakota Unified System of Higher Education. To be eligible to receive an associate or baccalaureate degree from a Regental university, students must fulfill the proficiency examination requirement as specified within Board of Regents' policies.

Criteria for exam eligibility:

1. Degree-seeking students registered for credit; and

2. Completion of 48 passed credit hours in courses at or above the 100 level.

Effective Fall Semester 1999, satisfactory performance on the proficiency examination is required for all incoming students seeking an associate degree from the South Dakota unified System of Higher Education. Students completing 32 hours at the 100 level or above and seeking an associate degree will sit for the CAAP exam the following semester.

The proficiency exam will be administered once in the fall term and once in the spring term. Students will sit for the exam during the first semester in which they become eligible based upon the criteria listed above. Failure to do so will result in denial of subsequent registration at all South Dakota Regental institutions. Additional information about the CAAP Proficiency Exam may be obtained from the Coordinator of Educational Services, in the Office of Academic and Enrollment Services.

##### **Information Technology Exam Required for Graduation**

All six South Dakota State Universities have been directed by the Board of Regents to implement an Information Technology exam. The Technology examination will be administered as a part of the CAAP Proficiency Examination each fall and spring semester.

Effective fall 1999 semester, students pursuing a Baccalaureate or Associate Degree will be required to sit for and pass the Technology Examination. Passing this exam will be a requirement for graduation from SDSM&T.

In format, the Technology exam is made up of True/False, Matching and Multiple Choice questions. The exam should take around 25 minutes to complete and will cover areas dealing with e-mail, spread sheets, word processing, data bases, programming, and the like.

For questions regarding the Technology exam, contact the Coordinator of Educational Services, in the Office of Academic and Enrollment Services, in the O'Harra Building, Room 216.



## **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](http://www.hpcnet.org/sdsmt/policies).

### **ACADEMIC AMNESTY POLICY**

#### **Philosophy**

Some students drop out of college after a semester or more of poor academic performance. Some of them wish to resume their education at a later date, but find that their previous poor academic performance hinders admission to programs, application for scholarships, and overall grade point average. Academic amnesty seeks to respond to those students who want an opportunity to begin anew.

#### **Criteria**

The student must:

1. be an undergraduate;
2. have last attended a formal post-secondary institution no less than five years prior to re-enrollment at a formal post-secondary institution; and
3. have completed a minimum of 12 credit hours from SDSM&T since re-enrollment with a minimum of 2.0 grade point average.

#### **Procedure**

1. The student must submit a formal Academic Amnesty Petition through his or her academic advisor to the Office of Academic and Enrollment Services.
2. The Office of Academic and Enrollment Services will verify that the criteria have been met and will notify the student and the advisor of the decision.
3. Upon approval, the Office of Academic and Enrollment Services will ensure that:
  - a. proper notation is made on the student's transcript;
  - b. all transfer credit entered on the student's transcript prior to re-enrollment shall be removed from the

- a. SDSM&T transcript;
- b. all SDSM&T work prior to re-enrollment, including grades
  - i. will remain on the student's permanent record,
  - ii. will not be included in calculation of the student's grade point average, and
  - iii. will not be used toward graduation requirements.

### **COMPUTER AND NETWORK USAGE GUIDELINES AND POLICY**

Students, faculty, staff and others affiliated with SDSM&T 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. 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 SDSM&T 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 [www.hpcnet.org/its/itspolicies](http://www.hpcnet.org/its/itspolicies).

**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 SDSM&T 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 SDSM&T 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, classification (year), program(s) of study (major), term address and phone number, e-mail address, hometown or country, student activities/organizations, date of graduation, degree received, and athlete's height and weight. Students have the right to request that such information concerning them be withheld from the annual University Directory. For a full description of FERPA, information regarding the location of students' educational records, and procedures at SDSM&T for compliance with the law, please contact the Office of Academic and Enrollment Services.

**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.

The deadline for all course work other than final examinations shall be no later than the last day of regular classes.

A student may be excused from a final examination at the discretion of the instructor. The deadline for submission of final grades for any course shall be established by the registration officer provided, however, that it be no earlier than 96 hours after the end of the examination period for fall semester and no earlier than 120 hours after the end of the examination period for spring semester.

#### **GRIEVANCE PROCEDURES FOR STUDENTS**

Students may pursue grievances when there is cause to do so. It is the policy of the Board of Regents that there be no harassment, interference, intimidation, or reprisals against complainants, witnesses or representatives. The following general procedure should be followed by all students who feel there is cause to pursue a grievance. The Vice President for Student Affairs and Dean of Students Office is available to assist students in discussing circumstances that may or may not be grievable, and to advise students on steps under which grievances should be filed.

Grievance forms are available at the Vice President for Student Affairs and Dean of Students Office.

#### **Definitions**

A **grievance** for the purpose of this policy is defined as an alleged incident, circumstance, or situation causing a student to believe he/she has been wrongfully or unjustly treated.

**Working days** means those days when the offices of the institution are open for regular business Monday through Friday, exclusive of legal holidays.

#### **Steps for Processing a Grievance**

**Step 1:** The student should first attempt to resolve the problem with the other person(s) involved in the problem. For example, a

problem between or among students should be discussed first with the other involved party or parties; a problem with an instructor should be addressed first with the instructor involved and then the Department Chair. A problem with a campus service unit should be taken up first with the director of that unit.

**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 Executive Council level who is the supervisor of the administrator receiving the grievance.

The grievance must be filed within 15 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 ten working days.

If the President of SDSM&T represents the lowest level administrator having authority to dispose of the grievance, said grievance must be originally filed at the Step 4 level.

**Step 3:** If the grievance is not resolved at the Step 2 level, 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 Level. 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.

**Step 4:** If the grievance is not resolved at the Step 3 level, the grievant may formally grieve to the President of SDSM&T using grievance Form C.

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 level 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.

**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. This form must be filed with the Executive Director of the Board of Regents within ten 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.

For more information, please contact the Affirmative Action Officer in Human Resources.

### POLICY GOVERNING ACADEMIC INTEGRITY

The Faculty Advisory Council of the South Dakota School of Mines and Technology believe that a high standard of academic honesty and intellectual integrity should apply to all college students. Academic Dishonesty shall be defined to include all forms of cheating, fraud, plagiarism or knowingly furnishing false information.

A student accused of academic dishonesty in the context of the classroom, laboratory, or any other academic endeavor, must be given notification in writing by the instructor of record. This action must be taken within ten class days of the time the incident becomes known to the instructor. The student must then

be given the opportunity for an informal hearing with the instructor of record to speak in his/her defense. The student must make this request within ten class days of the student receiving the notification or within the first ten class days of the following semester if the former is not practical. If a hearing is held, the instructor shall then give the student written notification of the decision within ten class days of the hearing date. Copies of this correspondence shall be sent to the Office of the Vice President for Student Affairs and Dean of Students.

The penalty for any act of academic dishonesty arising from a classroom situation shall be at the discretion of the instructor. Resolution of the incidents may range from requiring a repeat of the examination, quiz, paper, project, or any other course requirement; to a penalty of failure in the course. The authority of the instructor to assign grades shall not be infringed upon.

For complete rules and regulations governing matters of academic integrity, see Board of Regents Policy #3:4.

**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, SDSM&T does not have the right to reproduce such software or to permit its reproduction by others.

SDSM&T 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. SDSM&T 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.

**UNDERGRADUATE ACADEMIC PROBATION POLICY**

Students with cumulative grade point averages (GPAs) below the GPA standard are placed on academic probation. Students on academic probation earning a term GPA below the standard or not raising the cumulative GPA to the level of the minimum progression standard within two additional academic terms would be suspended for two academic terms (including summer semester) contingent upon student appeals process outcomes and administrative action by the university. All undergraduate students are required to obtain a cumulative GPA of at least 2.0 to qualify for graduation.

<b>Minimum Progression Standards</b>		
<b>Class</b>	<b>Credit Hr. Range</b>	<b>GPA Standard</b>
Fr	0-31.99	1.8
So	32-63.99	1.9
Jr	64-95.99	2.0
Sr	96-more	2.0

Any student denied registration on the basis of this policy may apply for readmission to the college following the lapse of at least two terms. No courses, neither regular, evening, nor summer, may be taken during the required suspension period.

A student who has been suspended for academic reasons more than once may not apply for readmission until the student has petitioned the Student Enrollment Appeals Committee to review and act upon their request for readmission.

**POLICIES AND PROCEDURES**



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



Photos Courtesy of SD Department of Tourism

## **SUPPORT SERVICES**

The Office of Academic and Enrollment Services (AES) provides academic support services to SDSM&T 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 SDSM&T.

### **ACADEMIC ORIENTATION**

SDSM&T holds six two-day 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 orientation sessions. Placement testing is scheduled for the first day of academic orientation and mentoring/advising, registering, and completing of the Freshman Goals Survey are scheduled for the second day.

### **ACADEMIC ADVISING**

AES is responsible for assigning advisors/mentors to students based on departmental recommendations. AES also publishes an advisor/mentor handbook and conducts 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. SDSM&T's mentors build bonds with these first-time undergraduate students through summer orientation mentoring sessions;

through an eight-week non-credit, no-fee course called University Mentoring; through social interactions; and through individual meetings during the semester.

### **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 summer registration sessions and the University Mentoring course.

### **STUDENT ASSESSMENT**

AES has responsibility for administering the COMPASS mathematics and English placement tests for new students, the Collegiate Assessment of Academic Proficiency (CAAP) tests for sophomores and the Information Technology Exam. 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 inventors 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 SDSM&T. These newsletters ("FYI: First-Year Information," "The Commuter Connection," and "SDSM&T 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 SDSM&T students through the Tech Learning Center, or TLC.

The TLC also has computers, a television/video cassette recorder (VCR), textbooks, and other study aids available for student use. 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.

A new addition to the Tech Learning Center this year is 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.

For more information regarding the TLC and/or its Assistive Technologies Lab, please call (605) 394-2547 or (605) 394-2400.

SUPPORT SERVICES



*TECHFact: In the summer of 1994, Tech formalized an agreement with the Technische Universität, Bergakademie, Freiberg, Germany to initiate and exchange students and to develop further academic cooperation. Participating undergraduate students pay their tuition and fees at Tech 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.*



## **EDUCATIONAL RESOURCES AND OUTREACH SERVICES**

### **ADVANCED MATERIALS PROCESSING (AMP) CENTER**

The Advanced Materials Processing Center (AMP) provides research and development opportunities in state of the art materials joining and parts fabrication technologies. This facility brings together highly specialized equipment in a laboratory environment to perform research and development projects in Friction Stir Processing and Intelligent Laser Processing. These multidisciplinary projects not only involve the many engineering programs at SDSM&T, but also include other major academic institutions, industrial partners, and government laboratories.

The intelligent laser processing system combines a 3 kW Nd: YAG laser, a Fanuc M16i Robot, and two metal powder-feed systems to allow the direct metal deposition, solid free-form fabrication, and graded alloy development of both metallic and non-metallic materials. Projects in laser cutting, welding, and surface treatment with intelligent feedback controls are also possible.

The three-dimensional friction stir processing equipment provides the capability to join large, curvilinear structures in ferrous and non-ferrous alloys directly from CAD/CAM files. This solid-state material processing technology is being investigated as a fusion weld and riveted joint replacement technology with the joining of previously unweldable materials, such as metal matrix composites, now possible. It is also being investigated as a microstructural modification tool that can induce superplasticity in materials.

The Advanced Materials Processing Center provides a unique opportunity for research ranging from basic solid-state joining and laser fabrication technology development to the creation of new materials, test and evaluation of prototype structures, and the "Design Space" integration into "Processing Space."

### **BLACK HILLS NATURAL SCIENCES FIELD STATION (BHNSFS)**

The Black Hills Natural Sciences Field Station functions in cooperation with colleges and universities from South Dakota, North Dakota, Mississippi, and Wisconsin with the purpose of providing summer field courses in the Black Hills and nearby areas. 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 two bases: the South Dakota School of Mines and Technology campus and a field camp site at Ranch A in Wyoming.

Geology and Geological Engineering Field Camps:

Two sessions are usually consecutive in the first 10 weeks of summer

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

Further information may be obtained by calling (605) 394-5114 or (605) 394-2494. Applications should be received by January 31, and all deposit fees are non-refundable upon acceptance into the course.

### **BOOKSTORE**

The Tech Bookstore is located in the Surbeck Student Center. Tech Bookstore serves the students, staff and faculty of SDSM&T by providing textbooks, office supplies, Hardrocker clothing, computer software, etc. In addition, Tech 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 Tech Bookstore's website at [www.sdsmtbookstore.com](http://www.sdsmtbookstore.com).

### **CENTER OF EXCELLENCE FOR ADVANCED MANUFACTURING AND PRODUCTION (CAMP)**

SDSM&T formally initiated the Center of Excellence for Advanced Manufacturing and

Production (CAMP) in October of 1997. Dr. Richard Gowen reported on the creation of CAMP to the South Dakota Board of Regents who met on the Tech campus during that time. After just three years in operation, CAMP won the prestigious Boeing Company Outstanding Educator Award for year 2000.

In addition to helping provide the best design and manufacturing education to Tech students, CAMP is an exciting new program that will help companies solve design and manufacturing problems through the use of enterprise teams. CAMP integrates students, faculty, and industry partners into a center whose purpose is to develop a unique approach to manufacturing education that simultaneously addresses explicit needs of industry. CAMP also is creating an electronic community using the Internet to facilitate interaction between higher education and industry. In addition, the Center will provide a focus for manufacturing technology assistance to private industry.

Students who are invited to participate in CAMP 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.

#### **CHILDREN'S SCIENCE CENTER**

The Children's Science Center is a partnership between the City of Rapid City and SDSM&T. The Center provides interactive educational programs for children, school groups, and the general public that promote the learning of science and technology. The hands-on exhibits promote learning in earth science, physical science, technology literacy, space science, biology, and other fields. The Children's Science Center also serves as a resource for area teachers.

The long-term goal at the Center is to increase the preparedness of students for university-level study in engineering and sciences.

The Center is located near downtown Rapid City in the Halley Park Museum facility at 515 West Boulevard.

#### **ENGINEERING AND MINING EXPERIMENT STATION**

In 1903 the legislature of South Dakota passed an act (Senate Bill 99) "establishing a Mining Experiment Station as a department of the State School of Mines at Rapid City." The mission of the Engineering and Mining Experiment Station (EMES) is to provide analytical services to both the public and private sectors. Analytical techniques in use include a wide variety of the most advanced instrumental techniques. A variety of classical techniques are also an integral part of the analytical services offered. Analysis available includes gold and silver assays, chemical analysis of minerals, ores, raw materials, manufactured products, fluid inclusions in rocks, and environmental assessments.

EMES currently operates, maintains, and oversees training in electron microscopy (scanning and transmission electron microscopes), X-ray diffraction, atomic absorption, inductively-coupled plasma mass spectrometry, and atomic force and scanning tunneling microscopy. EMES also works closely with the Atmospheric Analytical Chemistry laboratories, which house a gas chromatograph-atomic emission detector, atmospheric-pressure-ionization mass spectrometer, and proton-transfer-reaction mass spectrometer.

#### **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, planetary geology, and remote sensing.

### **HIGH PRIORITY CONNECTIONS**

High Priority Connections (HPC) is an Internet software development department at SDSM&T. HPC created, supports, and develops the High Priority Connection Network (HPCNet). This unique software integrates the access of the Internet with the power of an advanced database to provide a rich toolbox of features that can be used to create and manage secure dynamic web-based activities. HPCNet was developed as part of an extensive research project to link rural businesses and educational activities with needed resources and assistance. The software automates access to the infrastructure services essential for the successful use of the Internet for business and education.

The High Priority Connection Network supports the creation of electronic community networks to link users with common interests through an automated custom classification system. Access to shared services and resources are provided to these communities. A uniform appearance in the retrieval and presentation of information is inherent in the software. Secure connections are maintained between the database and the Internet to provide restricted as well as public access.

Some of the SDSM&T communities created using the HPCNet software are the SDSM&T website ([www.sdsmt.edu](http://www.sdsmt.edu)), the Tech Students website ([www.hpcnet.org/tech/students](http://www.hpcnet.org/tech/students)), and the secure Intranet created for incoming freshmen. For more information about HPCNet solutions, support, and illustrations, please visit [www.hpcnet.org/home](http://www.hpcnet.org/home)

The dedicated staff at High Priority Connections are anxious to assist with Internet software development needs. Contact HPC at (605) 394-6732 or at [www.hpcnet.org/sdsmt/department/hpc](http://www.hpcnet.org/sdsmt/department/hpc).

### **INFORMATION TECHNOLOGY SERVICES (ITS)**

Information Technology Services (ITS) serves the academic technology needs of SDSM&T 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 [www.hpcnet.org/dormnet](http://www.hpcnet.org/dormnet).

ITS also supports academic computing and multimedia facilities, including computing labs, presentation classrooms, distance learning facilities, video services, remote delivery mechanisms, videoconferencing, satellite down-links, the Governor's Electronic Classroom (GEC, CB110), the Digital Dakota Network studio (DDN, CB109), and traditional audiovisual resources to support classroom instruction.

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. Beginning in 2000-2001, participants in the Technology Fellows program began working with faculty in this area as well. ITS is working closely with the Technology Fellows to ensure coordination among services.

In addition, ITS is involved in supporting technology to enhance many SDSM&T outreach efforts, including the on-campus

daycare center (Kids Kastle Little Miner's Clubhouse), Technology for Teaching and Learning-NA (for K-12 Network Administrators), the Children's Science Center, and local service organizations. In partnership with Western Dakota Technical Institute, ITS hosts a Cisco Regional Academy in support of Cisco Local Academies at K-12 schools in western South Dakota. 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 Help Desk ([www.hpcnet.org/its/helpdesk](http://www.hpcnet.org/its/helpdesk)) assists students, faculty, and staff with software and hardware questions and provides scheduling services for many shared resources. The Help Desk is located on the lower level of the Devereaux Library in the Green Room. For assistance, email the Help Desk at [helpdesk@sdsmt.edu](mailto:helpdesk@sdsmt.edu), call (605) 394-1295, drop by, or check the web pages ([www.hpcnet.org/its](http://www.hpcnet.org/its)).

Help Desk hours of operation during the academic year are: Monday - Thursday 7:30 a.m. - 10:00 p.m.; Friday 7:30 a.m. - 5:00 p.m.; Sunday 5:00 p.m. - 10:00 p.m. Hours for holidays, summer, and school breaks vary according to need.

### **Computing and Networking Resources and Services**

Students, faculty, and staff are provided with named, password-protected accounts to access desktop and/or lab computers, dialup connections, file servers, e-mail, and network services. Facilities and services provided by ITS are intended primarily to support and enhance academic and scholarly activity, but incidental personal use is also acceptable. Account holders are responsible for all activity occurring under their accounts, and must keep passwords and access mechanisms secure. An account or access mechanism may be used only by the person identified with that account, not by friends or family members. See [www.hpcnet.org/its/itspolicies](http://www.hpcnet.org/its/itspolicies) for complete acceptable-use policy information.

ITS provides the campus with network connectivity to Internet, Internet2 (Abilene), and other local, state, regional, national, and international networks. Initial print quotas are provided free at the beginning of each semester. Additional printing, plotting services, and network connections to residence hall rooms are provided at nominal cost.

### **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, top floor, room 109
- EE/Physics Building: Room 307
- March-Dake Hall: Room 156
- McLaury Building: Room 304
- Palmerton Hall: Room 11
- Surbeck Student Center: Room 106,
- Miners Shack

In these labs, and through in-room network connections in the residence halls, 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 [www.hpcnet.org/its/pclabs](http://www.hpcnet.org/its/pclabs) 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).

Faculty, staff, and students may also use ITS audiovisual production facilities in preparing reports, presentations, and projects. These facilities include audio and video

recording and editing capability, scanners, digital cameras, slide projectors, computer projectors and projection panels, and TV/VCRs. Many of these items are available for checkout through the ITS Help Desk, located on the lower level of the Devereaux Library in the Green Room. For assistance, e-mail the Help Desk at [helpdesk@sdsmt.edu](mailto:helpdesk@sdsmt.edu), call (605) 394-1295, drop by, or check the web pages ([www.hpcnet.org/its](http://www.hpcnet.org/its)).

### **Interactive Supplemental Materials**

All faculty at SDSM&T have access to Internet and electronic mail facilities. Faculty have the capability to use interactive videoconferencing technologies to meet with students. All faculty post their course syllabi on the Web; many also post handouts and other course materials. Other faculty provide online questions and answers while still others provide links to supplementary information and material related to their courses. 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 (email 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](mailto:helpdesk@sdsmt.edu) or (605) 394-1295 for assistance.

### **Distance Education Course Delivery Systems**

At present, distance education courses are available via videotape, 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 SDSM&T 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 SDSM&T usually

include segments filmed in the classroom as the lecture is being presented to the students on campus during current or recent semesters. 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 videotaping and televising the distance education courses and for distributing or mailing materials to distance learning students and their proctors. To inquire about distance offerings, check the Schedule of Classes or contact Academic and Enrollment Services. To request assistance with distance education delivery or to update proctor information, contact the ITS Help Desk via email at [helpdesk@sdsmt.edu](mailto:helpdesk@sdsmt.edu), or telephone at (605) 394-1295.

### **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 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 EP309. This facility permits videoconferencing via Internet2 (H.323 standard) network connections, as well as with ISDN dialup connections. The room is set up as 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 SDSM&T 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 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.

Since 1970, a T-28 aircraft specially modified to penetrate hailstorms safely has been operated on thunderstorm research programs in the Dakotas, Alabama, Colorado, Florida, Illinois, Kansas, Montana, Oklahoma, Texas, and in Switzerland and Canada. The aircraft carries 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. This thunderstorm penetrating aircraft is currently supported by the National Science Foundation as a national research facility.

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. A complimentary numerical simulation study is underway. 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<sub>2</sub>. 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 chromatographs, 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, Environmental, and Water Resources. 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 95 hours each week.

The library's main level is the location of Archives, Reference Collection, Electronic Resources, Reference Desk, Downtime (the popular reading area), U.S. Patent and Trademark Depository, Circulation Desk, Interlibrary Loan, Technical Services, and Administrative Offices.

The lower level of the library contains an extensive journal collection, an audiovisual listening and viewing room, study areas, and two PC laboratories. The Ivanhoe International Student Center (one of two areas where food and drink are allowed) and the Information Technology Services Help Desk are also located on the lower level.

The second level of the library houses the Government Documents Collection, the majority of the Main Book Collection, and study areas.

The library's top level houses a portion of the Main Book Collection and print versions of Abstracts and Indexes. Also located here are the Minority Student Study Center, the Devereaux Instruction Center, and the new DMZ or Designated Munchie Zone, where students can eat and drink while studying.

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 and DVD's.

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 online catalog (SDLN) 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 the South Dakota School of Mines and Technology. Hundreds of thousands of specimens, especially pertaining to the fields of vertebrate paleontology and mineralogy, are on public display or in the research collections.

The Museum provides an active outreach program to area schools and organizations. Inquiries about specimens and discoveries are welcomed.

Of interest to the public and the general student are skeletons from the Big Badlands and the Upper Cretaceous of Western South Dakota, giving a vivid impression of Dakota life in ancient times. Also of interest are the spectacular Dana-arranged minerals from throughout the world. The South Dakota Hall of Minerals focuses on the diversity of Black Hills minerals. Other special exhibits feature fluorescent minerals, lapidary specimens of local agates, and native gold.

Research collections of mid-Tertiary vertebrates, marine reptiles, dinosaurs, and Black Hills minerals are extensive, and additional specimens are constantly being added. The Museum is closely associated with the Department of Geology and Geological Engineering and the Museum collections form the basis for staff and student research. Graduate students may pursue studies leading to the degree Master of Science in Paleontology. Practical experience is gained by participating in summer field expeditions and classes offered by the Museum of Geology.



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.

### **PUBLICATIONS**

The Publications Manager coordinates the production of all major campus publications including but not limited to the catalog, recruitment publications, the SDSM&T visitors' guide, and the SDSM&T 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 news-worthy 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.

### **SOUTH DAKOTA SPACE GRANT CONSORTIUM**

The Space Grant Consortium was established on 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., Raytheon ITSS, Honeywell, Cynetics Corp., QSS Group, Inc., SAIC, and Raven Industries are industrial affiliates. Educational affiliates include Black Hills State University, University of South Dakota, Dakota State University, Northern State University; all of the Native American Institutions of Higher Education in South Dakota (Si Tanka College, Lower Brule Community College, Oglala Lakota College, Sinte Gleska University, Sisseton Wahpeton Community College, and Sitting Bull College); the South Dakota Discovery Center and Aquarium; Scientific Knowledge for Indian Learning and Leadership (SKILL) at SDSM&T; Teaching SMART, a program of Girls Inc., of Rapid City; SDSM&T Children's Science Center in Rapid City; Kirby Science Discovery Center; Black Hills Astronomical Society; and the Badlands Observatory. The SD Department of Transportation's Office of Aeronautics is a state government affiliate and the National Weather Service is a federal government affiliate.

A primary Consortium objective is to enhance the capability for earth science-related 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 faculty fellowships tenable at the USGS EROS Data Center, 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, including a student research balloon project, 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 Day, teacher workshops, the FIRST Robotics program for high schools, Visiting Scientist programs in schools, Exploring Space Science Day, and Aviation Careers Exploration Academy.

For more information, see the South Dakota Space Grant Consortium website located at [www.sdsmt.edu/space/](http://www.sdsmt.edu/space/).

#### **SPECIAL EVENTS AND EDUCATIONAL PROGRAMS**

SDSM&T 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, SKILL, Computer Programming Contest, West River Math Contest, Concrete Conference, High Plains Regional Science Fair, and the Cultural Exposition.

#### **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.

#### **Conference Coordination**

The Office of University and Public Relations works closely with the City of Rapid

City, the Rapid City Area Chamber of Commerce, and the Convention and Visitors Bureau to assist faculty, staff, and student organizations in hosting regional and national conferences. University and Public Relations staff can assist in identifying sites, facilities, caterers, and other vendors. Event promotion, publication production, and media services are also available. Groups interested in hosting conferences in Rapid City are encouraged to contact University and Public Relations at the beginning of the planning process.

#### **Educational Outreach**

The Office of University and Public Relations assists departments and organizations involved in K-12 outreach through a variety of mechanisms. Mailing lists are available for schools and teachers to on-campus groups interested in working with the K-12 community. In addition, the Office of University and Public Relations oversees the Children's Science Center.

#### **UNIVERSITY SCHEDULING AND CONFERENCES**

The University Scheduling Center (USC) is located in the Surbeck Student Center. The USC serves as a one-stop center assisting with the scheduling of all university resources. The goal is to optimize the effective and efficient use of people, facilities, services, and equipment for the various events and activities of the university.

USC provides for all scheduling of student, community, and professional activities of the university as well as academic classroom changes following the initial AES assignments. The USC also provides scheduling information to the university and public communities.

#### **Summer Conference Services**

From mid-May through mid-August, the campus of SDSM&T provides conferencing services to a variety of guests. The coordination team is available to assist with special event planning and logistical needs to ensure a successful experience for the guests.

Stop by to make reservations or contact USC via telephone at (605) 394-6774 or via e-mail at [usc@sdsmt.edu](mailto:usc@sdsmt.edu).

## STUDENT SERVICES

The Vice President for Student Affairs and Dean of Students Office develops, manages, and directs Student Services programs at the South Dakota School of Mines and Technology. 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 the SDSM&T 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; and produces the campus safety and student code of conduct brochure.

### CAMPUS MINISTRY

Various campus ministries are available for students desiring counsel, fellowship, and activities involving faith and current issues. These organizations can be found in the Campus Ministry Office located in the Surbeck Student Center. United Campus Ministry is a multi-denominational ministry. Contact United Campus Ministry at (605) 394-2811 for additional information and details on specific denominational services.

### CAREER PLANNING, PLACEMENT, AND COOPERATIVE EDUCATION

#### **Career Planning**

The Career Planning Office provides information, guidance, and support to help students with their career development and searches for full-time, summer, and co-op opportunities in their respective career fields. Additional information about the Career Planning Office can be found at [www.hpcnet.org/sdsmt/careerplanning](http://www.hpcnet.org/sdsmt/careerplanning) or by calling (605) 394-2667. Services offered by the Career Planning Office include:

**Job Search and Career Information:** The office assists students with developing their resumes, cover letters, and interviewing skills,

as well as providing information about career opportunities related to the degree programs offered at SDSM&T. Career resources available to students include employer materials, placement and salary data, and other information that can help students make career decisions, search for jobs, and be well prepared for interviews.

**On-Campus Interviews:** Each year more than 100 companies interview SDSM&T students for full-time, summer, or co-op positions. The Career Planning Office coordinates the scheduling of these interviews on campus. Students registered with the office receive periodic Career Planning Bulletins that include company recruiting schedules and eligibility guidelines. In addition, the office posts job announcements from employers that are not interviewing on campus but are interested in recruiting SDSM&T students as employees.

**Career Fair:** Each September the Career Planning Office hosts the SDSM&T Engineering and Science Career Fair. This event is FREE to all SDSM&T undergraduate and graduate students, staff, faculty, and alumni. More than 1,000 individuals attended the 2001 event, in which 82 employers from 25 states were registered. SDSM&T's 2002 Career Fair will be held Tuesday, September 17, in the Surbeck Student Center.

**Summer Internships:** Many companies hire SDSM&T students for summer internships that can help students confirm their career choices. Students should begin their search in the fall for jobs commencing the following May. Summer job opportunities are posted on a specially designated bulletin board.

**Alumni Placement Assistance:** The Career Planning Office provides placement services to SDSM&T graduates at no charge until they have obtained their first job in their career field. Placement services are offered thereafter to alumni for an annual fee.

**Career Counseling:** Individuals interested in information on career development or changing career paths are encouraged to contact the Career Planning Office, or the Director of Counseling Services, located in the Surbeck Student Center, (605) 394-1924.

**Vocational Interest Inventory:** Available upon request. For further information on

Interest Inventories, please contact the Office of Academic Services, in the O’Harra Building, Room 216A, (605) 394-2400.

### **Cooperative Education Program**

The Cooperative Education Program provides students with opportunities to apply their classroom learning to “real world” work experiences in industry. SDSM&T’s Co-op Program is a partnership with business, industry, and government agencies. Students are employed in positions related to their major. Minimum GPA and other eligibility requirements for co-op positions vary among companies. Students interested in participating in the program should contact the Cooperative Education Coordinator in their respective academic departments and also register with the Career Planning Office.

**Academic Credit:** Students may earn academic credit for their co-op experience with the approval of their department Cooperative Education Coordinator. To obtain academic credit, students must register and pay for a Cooperative Education (CP) course (1-3 variable credit hours) at the beginning of the semester they are on co-op assignment. Cooperative education credits may be applied toward graduation in accordance with university and departmental policy.

CP 297/397/497 Cooperative Education 1 to 3 credits. Prerequisite: One full academic year of studies and a minimum 2.0 GPA. Credit is available for each semester or summer work experience upon approval by the departmental Cooperative Education Coordinator. After accepting an offer of a co-op position, students should notify Career Planning of their co-op employer, location, and dates.

Students will be expected to utilize specialized skills 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 will include but not be limited to a written report of the work experience and an employer’s evaluation of work performance. Because the work performed by a student while on co-op is equivalent to the workload of a full-time student, a student on a co-op assignment **who**

**is registered for CP credit** shall be considered to have full-time status.

**Administration:** SDSM&T’s Cooperative Education Steering Committee is comprised of the Cooperative Education Coordinators appointed by each department, the Vice President for Academic Affairs, and the Director of Career Planning, Placement, and Cooperative Education. The committee is responsible for developing qualified 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 about the co-op program, contact the Career Planning Office at (605) 394-2667.

### **CHILD-CARE SERVICES**

The Kids Kastle Little Miner’s Clubhouse provides campus-based, quality licensed child care for SDSM&T 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 SDSM&T students. The office is located in Surbeck Student 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 disabilities who are seeking accommodations should contact the university counselor. The office is open during most daytime and some evening hours. Call (605) 394-1924 for information or (605) 394-2416 for an appointment.

### **DINING SERVICES**

The SDSM&T Dining Services would like to invite students, faculty, and staff to dine on campus in the Miner’s Shack Snack Bar or the

Hardrocker Dining Hall. They are both located in the lower level of the Surbeck Student Center. Dining Services offers a wide variety of meal plans that would fit any student's needs. All students living on campus are required to purchase a meal plan. Dining Services is looking forward to having people dine on campus. For questions, please call (605) 394-1953 or (605) 394-2327.

### **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, and on file in the Student Health Office. Failure to provide the completed Immunization Form will result in denial of registration. 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 SDSM&T 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 Devereaux Library 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: U.S. Immigration and Naturalization Service 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 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 Multicultural Affairs’ commitment is to work with, support efforts, and provide leadership in the quest for a multicultural environment at South Dakota School of Mines and Technology. To this end the Office of 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 of Multicultural Affairs’ long-term mission is to create a learning and working environment where all voices are welcome and all groups count.

### **Minority Student Study Center**

The Minority Student Study Center provides minority students, primarily American Indians, Hispanics, African Americans, and Asian Americans with a study area and peer and academic support programs on the top floor of the Devereaux Library. Services include peer tutoring and mentoring, scholarship, co-op and internship information, AISES (American Indian Science and Engineering Society) chapter meetings, and activities that offer students camaraderie and support.

### **AISES**

AISES is part of a nationwide organization of more than 2,500 American Indian college students. Students do not have to be pursuing a major in engineering or science to belong. AISES helps to pave the way for American Indian students’ success in the pursuit of their educational goals.

### **SKILL**

Founded in 1989, SKILL (Scientific Knowledge for Indian Learning and

Leadership) addresses SDSM&T’s commitment to providing every opportunity for women, minority, and disadvantaged persons to enter science and mathematics-based careers.

SKILL provides prospective students with the following opportunities:

- Experiential summer science and mathematics program for American Indian students in the tenth through twelfth grades.
- Development of culturally relevant science and mathematics curricula to be used in SKILL programs and target schools around the state.
- Networking, outreach, and cooperative community programming linkages designed to increase student, staff, and faculty appreciation for cultural diversity.

### RESIDENCE LIFE

#### **Living Accommodations at Tech**

Living on campus in one of the four SDSM&T 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 and learn in the residence halls at SDSM&T. Most first and second year students are required to live on-campus per South Dakota Board of Regents policy. This policy states the following: “during the first two 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 12 or more credits for four semesters may be exempted from this agreement at the discretion of the institution.”

### Residence Hall Applications

Entering freshmen, transfer students, and returning former students will receive information about living on campus, the residence halls, and a Residence Hall Application form from the Admissions Office. During the spring semester, currently enrolled students will have the opportunity to reserve specific rooms as coordinated by the Residence Life Office. An advance payment (to be applied to rent) of \$100 must accompany each application for a residence hall room. After applications are processed and room assignments made, residents will be required to sign a residence hall contract upon occupancy. Cancellation of an application or room contract without notification to the Residence Life Office by August 1 for the fall semester or December 15 for the spring semester, will result in forfeiture of the advance payment (\$100). The contract will be in force for the full academic year or for the student's period of enrollment, whichever is longer. Signed contracts assure room assignment for these periods and obligate the resident to comply with policies, regulations, and guidelines as stated in the Residence Hall Handbook. Per university policy, all residents are required to purchase a meal plan each semester.

### On-Campus Living

Connolly Hall, completed in 1948, Dake Hall and March Hall, completed in 1959, and Palmerton Hall, completed in 1969, provide comfortable living accommodations for approximately 540 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.

Internet connections are available in all residence hall rooms. Local telephone and expanded basic cable TV plus HBO services are available and included in rent. Rooms are furnished with two beds (frame with mattress), two desks, two study chairs, closet space,

wastebasket, and dressers. Telephones, TVs, and computers are not provided.

### Residence Hall Exemptions

In practice, the South Dakota School of Mines and Technology supports the South Dakota Board of Regents housing policy previously stated and, at its' discretion, will approve exemptions to those students who

- are two or more years past high school graduation as of registration day; or
- will live for the full academic year with parent(s) or legal guardian(s); or
- have a dependent child; or
- are active members of, and living in, a college recognized fraternity or sorority; or
- have completed four semesters of institutional enrollment with 12 or more credits; or
- are 21 years of age or older as of registration day; or
- are married; or
- military veterans with one or more years of active service; or
- are classified as special students (enrolled, but not admitted/non-degree seeking); or
- are taking less than six credit hours.

Exemptions are initiated by completing the Residence Hall Exemption form (on the flip side of the Residence Hall Application form). 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 the lobby of Palmerton Hall. Information on accommodations in the Rapid City area may also be obtained from area realtors, local newspapers, current students, or the Ivanhoe International Center.



*TECHFact: Approximately 21 percent of Tech 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.*



# STUDENT ACTIVITIES

## STUDENT ACTIVITIES AND LEADERSHIP CENTER

The mission of the Student Activities and Leadership Center is to enhance student involvement through enjoyable, educational activities while promoting leadership development and well-rounded students. The center provides organizations who do not have an office a place to make phone calls, design flyers, type memos, and take care of other administrative needs for their organization. The center is responsible for new student orientations, leadership development programs, student organizations and programming, and Greek life. The Student Activities and Leadership Center also provides advisors for a variety of student organizations including student government, student programming board, and student newspaper, among others.

### **Student Organizations**

Involvement in student organizations is encouraged at SDSM&T. Through co-curricular involvement, students develop their leadership skills, learn to manage their time, and gain real-life experience. There are more than 75 organizations at SDSM&T, 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 Director of the Student Activities and Leadership Center or the Student Association Office.

#### **Academic Organizations:**

American Chemical Society  
American Institute of Chemical Engineers  
American Society of Civil Engineers  
American Society of Mechanical Engineers  
Human Powered Vehicle  
Institute of Electrical and Electronic Engineers  
Institute of Industrial Engineers  
Joint TMS/ASM International Student Chapter  
Linux Users Group (LUG) Nuts  
Paleontology Club  
Society of Automotive Engineers  
SAE AeroDesign Team  
Society of Economic Geologists  
Society of Women Engineers  
South Dakota Solar Motion Team  
Tech Geological Association

#### **Athletics:**

Cross Country  
Football  
Golf  
Men's Basketball  
SDSM&T Cycling Club  
SDSM&T Ski and Snowboard Club  
South Dakota Tech Hot Rockers Dance Team  
Tech Soccer Club  
Track  
Women's Basketball  
Women's Volleyball

#### **Greek Organizations:**

Alpha Chi Sigma Co-Ed Fraternity  
Alpha Delta Pi Sorority  
Alpha Omega Epsilon Sorority  
Delta Sigma Phi Fraternity  
Interfraternity Council  
Theta Tau Fraternity  
Triangle Fraternity

#### **Honor Societies:**

Alpha Sigma Lambda - Non-Traditional  
Student Honor Society  
Order of Omega - Greek Honor Society  
Phi Eta Sigma - Freshman Honor Society  
Tau Beta Pi - Engineering Honor Society

#### **Multicultural Organizations:**

American Indian Science and Engineering  
Society (AISES)  
Association of Norwegian Students Abroad  
Cultural Expo Committee  
India Club  
Mongolian Student Association

#### **Music Organizations:**

Concert Choir  
Hardrocker Pep Band  
Instrumental Ensemble  
Jazz Band  
Master Chorale  
Symphonic Band

#### **Religious Organizations:**

Christian Challenge  
International Christian Fellowship  
Inter-Varsity Christian Fellowship  
Lutheran Campus Ministry  
Muslim Students' Association  
Newman Club  
United Campus Ministry

#### **Special Interest Organizations:**

Circle K Club  
College Democrats  
College Republicans  
Drama Club

Habitat for Humanity  
 Hardrocker Climbing Club  
 Hardrocker College Bowl Club  
 Hardrocker Flying Club  
 Leadership Development Team  
 M Week (Homecoming)  
 Non Trad Student Forum  
 Pershing Rifles  
 Pumpkin Sitters Literary Society  
 ROTC Ranger Challenge  
 SDSM&T Salsa Club  
 Student-Alumni Connection  
 Students Against Destructive Decisions  
 TONITE (Tech's Outrageous New Initiative for Total Entertainment)

**Student Government Organizations:**

Connolly Hall Council  
 Dake Hall Council  
 March Hall Council  
 Palmerton Hall Government  
 Residence Hall Association  
 Student Association

**Student Media:**

K-TEQ Radio  
 The Raver (Tech's Student Newspaper)  
 SDSM&T Amateur Radio Club

**Student Association**

All regularly enrolled students at SDSM&T 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 Residence Hall Association and President of the Student Body appoint additional Representatives.

**TONITE**

TONITE (Tech's Outrageous New Initiative for Total Entertainment) is the campus-wide programming board. The mission of TONITE is to provide a

comprehensive program for the cultural, educational, recreational, and social interests of the students, staff, faculty, alumni, and guests of SDSM&T. TONITE also provides an opportunity for students to develop their leadership skills and to interact with faculty outside of the classroom.

TONITE consists of a diversity of programming committees, including Major Events, Special Events, Recreation, Lecture, Public Relations, and Publicity. Membership is open to all SDSM&T 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 outreach, community component.

**Music Program**

The Music Program, a division of the Department of Humanities, is housed in the Physical Education Center. Included are a large ensemble rehearsal area of more than 1,600 square feet with adjoining music office, music library, music storage, and two smaller rehearsal areas of more than 1,000 square feet; one of which is an applied music teaching studio and the other, which houses the electronic music laboratory for computer and electronic music instruction and practice. The Music Program also houses and maintains the combined choral music libraries of former and current Rapid City community choral organizations. Cultural and educational enrichment opportunities include:

- Academic course offerings - a wide variety of course offerings are taught by the music faculty. For complete descriptions, see the courses listed under MUS, MUEN, or MUAP elsewhere in this catalog.
- Ensemble participation - Most university

ensembles are open to both SDSM&T students and the greater Rapid City community: Symphonic Band, Concert Choirs, Jazz Band, Master Chorale, Pep Band, and other smaller ensembles such as Brass Quintet, or The High Energy Machine. In addition, SDSM&T hosts community music ensembles such as the Dakota Choral Union, Kantorei, and Dakota Voices, which include students and community members alike.

- Music performances - Many and varied music concerts and recitals are presented to SDSM&T, the Rapid City community, area schools, professional organizations, and through organized music festivals. A sample of these include:
  1. SDSM&T Concerts are presented by the major ensembles every semester at venues around Rapid City and the Black Hills.
  2. SDSM&T Recitals are presented by faculty and students throughout the academic year in the Rapid City area.
  3. Concert Tours by music ensembles have included:
    - a. 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.
    - b. Appearances at nationally recognized events such as the Music Educators National Conference in California and the Washington (DC) National Cathedral dedication.
    - c. Foreign tours resulting in critical acclaim and invitations to perform in such venues as the New Years Eve Mass in Vienna's Karlskirche (1990), Lindenhofhaus Harmonie-Festival (1993), Florence's Palazzo Vecchio (1996), and Bethlehem College in Israel (1999).

### **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 opportunities for

students to be involved in all aspects of the dramatic art - acting, producing, stage, set, and technical design. Recent productions have run the gamut from Shakespeare to modern drama. 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 the South Dakota School of Mines and Technology. 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 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 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 seventy percent 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 inner tube water polo, wallyball, indoor and outdoor soccer, basketball, softball, volleyball, swimming, racquetball, and flag football. A Director of Intramural Activities is responsible for directing the Intramural Program.



*TECHFact: 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, SDSM&T's 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.*



The College of Earth Systems consists of three departments - Departments of Civil and Environmental Engineering, Geology and Geological Engineering, and Atmospheric Sciences - and the Museum of Geology. Four bachelors of science degrees and four masters of science degrees are currently being offered in the college. The college also offers a Ph.D. program in Geology and Geological Engineering. In addition, the college provides extensive support for the Ph.D. program of Atmospheric, Environmental, and Water Resources, which is a joint program with South Dakota State University. It also participates in the Materials Engineering and Science Ph.D. program and the interdisciplinary undergraduate Environmental Engineering B.S. degree program.

Modern engineering and science disciplines continue to evolve and become more complex every day, requiring advanced technical knowledge and continuous training. The College of Earth Systems offers undergraduate curricula designed to provide knowledge and skills for engineering and science students who plan to practice and also for those students who plan to continue their education. The broad knowledge base and technical experience of the college faculty make it possible to offer a variety of courses that meet these demands. The college has as its major objective to educate men and women to function at their highest possible levels. Emphasis is placed on the development of problem solving techniques associated with the use of technology.

Graduate education within the College of Earth Systems integrates the two essential functions of the college, teaching and research. The three departments within the college have renowned reputations in research and scholarly works. Faculty members strive to excel in their areas of expertise. Though the graduate enrollment has grown in recent years, the graduate program continues to provide personal contact between the faculty and students.

The college provides balanced education and research in traditional areas of Civil and Environmental Engineering, Geology, Geological Engineering, Atmospheric Sciences, Mining Engineering, and Paleontology. Recently, an emphasis has been placed on the study of environment and water resources, resulting in quality interdisciplinary research among the departments within the college. As a result, productive interaction across the disciplines has become increasingly common for both the faculty and students. This makeup of the college provides the students a unique opportunity to participate in an environment that recognizes the interdisciplinary nature of modern engineering and science.

The following describes information about the college you need in selecting the courses for your education. We look forward to welcoming you to the college.

Sincerely,

*Sangchul Bang*

Dr. Sangchul Bang  
Interim Dean, College of Earth Systems

## ATMOSPHERIC SCIENCES



### CONTACT INFORMATION

Dr. Patrick R. Zimmerman  
 Department of Atmospheric Sciences  
 Mineral Industries 201  
 (605) 394-2291  
 e-mail: patrick.zimmerman@sdsmt.edu

### FACULTY

Professor Zimmerman, Chair; Dean Farwell;  
 Professors Detwiler, Helsdon, and Hjelmfelt;  
 Assistant Professors Baker, Capehart, Peng,  
 and L. Vierling.

### MINOR IN ATMOSPHERIC SCIENCES

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.

A minor in atmospheric sciences is offered to any student enrolled in any undergraduate degree program that allows minors at

SDSM&T. For some majors this would require an additional semester or more of study beyond the normal four years. A minimum of eighteen (18) credits must be earned from the list of courses shown below. The three courses in introduction to atmospheric sciences, atmospheric physics, and synoptic meteorology (301, 501, 450) are required for the minor.

### ATMOSPHERIC SCIENCES 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.

A sample program is shown below.

<b>JUNIOR YEAR</b>	
<b>Fall</b>	
ATM 301	Intro to Atmospheric Sciences (could be taken in soph yr) 3
ATM 501	Atmospheric Physics <sup>1</sup> 3
<b>TOTAL</b>	<b>6</b>

**SENIOR YEAR**

<b>Fall</b>		
ATM 450	Synoptic Meteorology I <sup>1</sup>	3
ATM 560	Atmospheric Dynamics <sup>1</sup>	3
<b>TOTAL</b>		<b>6</b>

<b>Spring</b>		
ATM 505	Air Quality	3
ATM 550	Synoptic Meteorology II <sup>1</sup>	3
<b>TOTAL</b>		<b>6</b>

The addition of six (6) hours in physical meteorology (e.g., ATM 540, ATM 530, or ATM 410) plus the necessary physics, chemistry, and computer science courses taken through the Bachelor of Science in Interdisciplinary Sciences (IS) program will give the student the equivalent of a B.S. degree in Atmospheric Sciences.

A sample IS program is shown below.

**FRESHMAN YEAR**

<b>Fall</b>		
MATH 123	Calculus I <sup>1</sup>	4
CHEM 112	General Chemistry I <sup>1</sup>	3
CHEM 112L	General Chemistry I Lab <sup>1</sup>	1
ENGL 101	Composition I	3
GEOL 201	Physical Geology	3
GEOL 201L	Physical Geology Lab	1
PE	Physical Education	1
<b>TOTAL</b>		<b>16</b>

<b>Spring</b>		
MATH 125	Calculus II <sup>1</sup>	4
PHYS 211	University Physics I <sup>1</sup>	3
CHEM 114	General Chemistry II <sup>1</sup>	3
CHEM 114L	General Chemistry II Lab <sup>1</sup>	1
CSC 150	Computer Science I <sup>1</sup>	3
PE	Physical Education	1
Humanities or Social Sciences Elective(s)		3
<b>TOTAL</b>		<b>18</b>

**SOPHOMORE YEAR**

<b>Fall</b>		
MATH 225	Calculus III <sup>1</sup>	4
PHYS 213	University Physics II <sup>1</sup>	3
PHYS 213L	University Physics II Lab	1
ATM 301	Intro to Atmospheric Sci <sup>1</sup>	3
ENGL 279	Technical Communications I	3
Humanities or Social Sciences Elective(s)		3
<b>TOTAL</b>		<b>17</b>

<b>Spring</b>		
MATH 321	Differential Equations <sup>1</sup>	4
CSC 250	Computer Science II	4
ENGL 289	Technical Communications II	3
Humanities or Social Sciences Elective(s)		6
<b>TOTAL</b>		<b>17</b>

**JUNIOR YEAR**

<b>Fall</b>		
MATH 441	Engineering Statistics <sup>1</sup>	2
ATM 501	Atmospheric Physics <sup>1</sup>	3
PHYS 341	Thermodynamics	3
Humanities or Social Sciences Elective(s)		3
Free Elective		3
<b>TOTAL</b>		<b>14</b>

<b>Spring</b>		
ATM 505	Air Quality	3
ATM 540	Atmospheric Electricity	3
ATM 401	Global Environ Change <sup>1</sup>	3
Free Elective		3
Humanities or Social Sciences Elective(s)		3
<b>TOTAL</b>		<b>15</b>

**SENIOR YEAR**

<b>Fall</b>		
ATM 410	Intro to Environ Remote Sens	3
ATM 450	Synoptic Meteorology I <sup>1</sup>	3
ATM 560	Atmospheric Dynamics <sup>1</sup>	3
ATM 530	Radar Meteorology	3
Biology Elective		3
<b>TOTAL</b>		<b>15</b>

<b>Spring</b>		
ATM 550	Synoptic Meteorology II <sup>1</sup>	3
Science Elective		3
Humanities or Social Sciences Elective(s)		6
IS 465	Senior Project	3
<b>TOTAL</b>		<b>15</b>

<sup>1</sup> Required by Atmospheric Sciences Department

Students in the minor or IS program desiring to be qualified for federal employment as Meteorologists (National Weather Service) should contact a Department of Atmospheric Sciences advisor to ensure that their plan of study meets the strictly enforced NWS requirements.

The basic requirements for federal service qualification with the National Weather Service 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<sup>2</sup>
  - 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<sup>2</sup>
- C. Three (3) semester hours of ordinary differential equations<sup>2</sup>
- 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.

<sup>2</sup> 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.

The 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. The graduate should 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 graduate program in atmospheric sciences is offered to students with undergraduate degrees in atmospheric sciences or meteorology, physics, mathematical sciences, 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. A Master of Science degree requires twenty-four (24) credit hours of course work, with an additional six (6) semester hours of credit for completing a thesis.

In addition to the M.S. program in atmospheric sciences, departmental faculty are active participants in the Atmospheric, Environmental, and Water Resources (AEWR) Ph.D. program. The AEWR Program is a doctoral program jointly offered by the South Dakota School of Mines and Technology and South Dakota State University. A number of disciplines at each institution are involved in delivering the program, including engineering specialties such as agricultural, chemical, civil and environmental, and mining; as well as geology; water resources; atmospheric sciences; environmental sciences; biology; chemistry; hydrology; wildlife and fisheries. Degree candidates are expected to complete courses in a broad range of topics selected from these disciplines. For further information on the AEWR program please refer to the AEWR section of this catalog.



# CIVIL ENGINEERING



## CONTACT INFORMATION

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## FACULTY

Associate Professor Kenner, Chair; Professors Sangchul Bang, Hansen, Mott, and Preber; Associate Professors Fontaine and Klasi; Assistant Professor Patnaik; Instructor Arneson-Meyer.

## CIVIL ENGINEERING

Civil engineering is broad in scope and encompasses a number of technical disciplines. It includes the planning, design, construction, and operation of the structures utilized by our modern civilization. These structural systems include buildings of all types, bridges, tunnels, dams, harbors, airports, waterways, railways, highways, and irrigation networks. Civil

engineering further includes environmental and water resource engineering. Environmental engineers are involved in city planning, water and wastewater treatment, stream, lake, and ground water pollution, and engineering aspects of environmental health. Water resource engineers are concerned with the economic, social, and engineering aspects of water resource planning, design, construction, management, and operation.

## CIVIL ENGINEERING PROGRAM GOALS

The Department of Civil and Environmental Engineering at the South Dakota School of Mines and Technology has established the following goals for the Civil Engineering program:

1. Provide a quality undergraduate educational program that prepares the graduate for the practice of Civil Engineering;
2. Provide a progression of course work that prepares the student for entry into any graduate school for advanced training in the discipline of the student's choosing;

3. Develop the student's ability to maintain professional competency through continued self-study and advanced professional training;
4. Develop a professional attitude by encouraging participation in student activities of ASCE and stressing obtaining professional registration by emphasizing the need to take the Fundamentals of Engineering examination; and
5. Develop the student's sensitivity to social and economic aspects of technical problems and of problem solutions that confront Civil Engineers.

#### 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 required courses in that area. The low enrollments in these courses allow for good interaction between students and faculty. Seniors also select two 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
GE 115	Professionalism/Engr and Sci	2
PE	Physical Education	1
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>16</b>

##### 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
<b>TOTAL</b>		<b>17</b>

#### SOPHOMORE YEAR

##### First Semester

MATH 225	Calculus III	4
EM 214	Engr Mechanics (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
<b>TOTAL</b>		<b>18</b>

##### Second Semester

ENGL 279	Technical Communications I	3
MATH 321	Differential Equations	4
EM 223	Fluid Mechanics	3
EM 216	Mechanics of Materials	3
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>16</b>

#### JUNIOR YEAR

##### 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 356	Theory of Structures I	3
<b>TOTAL</b>		<b>18</b>

##### Second Semester

PHYS 213	University Physics II	3
	Science Elective	3
CEE 327	Water & Waste Water Trtmnt	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 <sup>1</sup>	
CEE 358	Applied Structural Design <sup>1</sup>	
<b>TOTAL</b>		<b>18</b>

#### SENIOR YEAR

##### First Semester

IENG 301	Basic Engineering Economics	2
	Department Approved Elective <sup>2</sup>	3
CEE 474	Engr Project Management	3
CEE	Track Elective <sup>2</sup>	3
CEE	Approved Elective <sup>3</sup>	3
EM 215	Engineering Mechanics or	
ME 221	Dynamics of Mechanisms	3
CEE 464	Civil Engr Capstone Design	1
<b>TOTAL</b>		<b>18</b>

##### Second Semester

CEE 463	CEE Profession	1
ME 211	Intro to Thermodynamics	3
CEE 464	Civil Engr Capstone Design	2
CEE	Track Elective <sup>2</sup>	3
CEE	Approved Elective <sup>3</sup>	3
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>15</b>

### 136 credits required for graduation

#### Curriculum Notes

<sup>1</sup> Structural Engineering emphasis students must choose CEE 357 while students of other emphasis areas desiring a terminal structural design course may choose CEE 358.

<sup>2</sup> Must be two or more approved courses in one area selected from either Environmental Engineering, Geotechnical Engineering, Structural Engineering, or Water Resources Engineering.

<sup>3</sup> Must be courses approved by the Department of Civil and Environmental Engineering.

## GEOLOGICAL ENGINEERING



### CONTACT INFORMATION

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### FACULTY

Professor Davis, Chair; Professor Roggenthen;  
 Associate Professor Stetler.

### SUPPORTING FACULTY

Professors Duke, Fox, Lisenbee, and Paterson;  
 Assistant Professor Price.

### 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.

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.

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.

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 Association of Ground Water Scientists and Engineers and the Society for Mining, Metallurgy, and Exploration (SME). 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 contains Pentium III personal computers with GIS capabilities. Computer 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.

<b>FRESHMAN YEAR</b>		
<b>First Semester</b>		
CHEM 112	General Chemistry I	3
MATH 123	Calculus I	4
ENGL 101	Composition I	3
GE 115	Professionalism/Engr and Sci	2
	Humanities or Social Sciences Elective(s)	6
<b>TOTAL</b>		<b>18</b>
<b>Second Semester</b>		
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	GEOE 464	Geol Engr Design Project I	3
GE 117	Professionalism/Engr & Sci II	2	GEOL 416	GIS I: Intro to GIS	3
<b>TOTAL</b>		<b>16</b>	<b>TOTAL</b>		<b>15</b>

**SOPHOMORE YEAR****First Semester**

EM 214	Engr Mechanics (Statics)	3
MATH 225	Calculus III	4
MINE 301	Mine Surveying	3
PE	Physical Education	1
PHYS 213	University Physics II	3
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>17</b>

**Second Semester**

ENGL 279	Technical Communications I	3
EM 216	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
<b>TOTAL</b>		<b>17</b>

**JUNIOR YEAR****First Semester**

ENGL 289	Technical Communications II	3
GEOL 331	Stratigraphy & Sedimentation	3
GEOL 341	Elementary Petrology	3
CEE 346	Geotechnical Engineering I	3
MET 320	Met Thermodynamics	4
<b>TOTAL</b>		<b>16</b>

**Second Semester**

GEOE 322	Structural Geology	3
GEOE 324	Engineering Geophysics I	3
EM 328	Applied Fluid Mechanics	3
	Approved Elective <sup>1</sup>	3
IENG 301	Basic Engr Economics	<b>OR</b>
MINE 441	Economics of Mining	2
	Humanities or Social Sciences Elective(s)	1
<b>TOTAL</b>		<b>15</b>

**Summer**

GEOE 410	Engineering Field Geology	6
<b>TOTAL</b>		<b>6</b>

**SENIOR YEAR****First Semester**

GEOE 466	Engr and Envr Geology	3
GEOE 475	Ground Water	3
GEOE 461	Petroleum Production <sup>2</sup>	3

**Second Semester**

MINE 411	Rock Mechanics I	4
	Professional Electives <sup>3</sup>	6
GEOE 465	Geol Engr Design Project II	3
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>16</b>

**136 credits required for graduation****Curriculum Notes**

<sup>1</sup> Approved Elective. Must be a course approved by the Department of Geology and Geological Engineering.

<sup>2</sup> Students interested in mineral exploration may substitute GEOE 451 for GEOE 461.

<sup>3</sup> 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 and Fundamentals
CEE 337	Engineering Hydrology
CEE 347	Geotechnical Engineering II
CEE 423	Environmental Systems Analysis
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)
MINE 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 332 is recommended for students interested in numerical modeling of partial differential equations.

## GEOLOGY



### CONTACT INFORMATION

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### FACULTY

Professor Davis, Chair; Professors Bishop,  
Duke, Fox, Lisenbee, Martin, and Paterson;  
Assistant Professor Price; Melvin Haslem Post-  
doctoral Fellow in Paleontology and Assistant  
Professor Bloch.

### 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 emphasis in  
Geology 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.

All samples and specimens collected while  
at the South Dakota School of Mines and  
Technology must be curated into the systematic  
collections of the Museum of Geology for  
future students, scientists, and technologies.

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, and microcomputers, and workstations, which form the core of the remote sensing and geographic information system 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.

### **Geology Emphasis**

#### **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
<b>TOTAL</b>		<b>15</b>

#### **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
Gen Ed Humanities Elective <sup>1</sup>		3
PE	Physical Education	1
<b>TOTAL</b>		<b>15</b>

### **SOPHOMORE YEAR**

#### **First Semester**

GEOL 331	Stratig and Sedimentation	3
MATH 225	Calculus III	4
PHYS 213	University Physics II	3
MINE 301	Mine Surveying	3
Gen Ed Social Science Elective <sup>1</sup>		3
<b>TOTAL</b>		<b>16</b>

#### **Second Semester**

ENGL 279	Technical Communications I	3
GEOL 212	Mineral and Crystallography	3
GEOE 211	Earth Systems Engr Analysis	3
Humanities/Social Science Elective <sup>1</sup>		6
PE	Physical Education	1
<b>TOTAL</b>		<b>16</b>

### **JUNIOR YEAR**

#### **First Semester**

ENGL 289	Technical Communications II <sup>1</sup>	3
GEOL 341	Elementary Petrology	3
GEOL 416	GIS I: Intro to GIS	3
GEOL 471	Invertebrate Paleo <sup>4</sup>	3
Free elective		3
Humanities/Social Science Elective		1
<b>TOTAL</b>		<b>16</b>

#### **Second Semester**

GEOE 322	Structural Geology	3
GEOL 403	Regional Field Geology	1
GEOL 321	Historical Geology	3
GEOE 324	Engr Geophysics I	3
GEOL 442	Optical Petrology <sup>4</sup>	3
<b>TOTAL</b>		<b>13</b>

#### **Summer**

GEOE 410	Engr Field Geology	<b>6</b>
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### **SENIOR YEAR**

#### **First Semester**

GEOL 464	Senior Research I <sup>2</sup>	3
GEOE 475	Ground Water	3
Geology electives <sup>3</sup>		3
Free electives		3
Humanities/Social Science elective		3
<b>TOTAL</b>		<b>15</b>

#### **Second Semester**

GEOL 465	Senior Research II <sup>2</sup>	3
GEOE 482	Applied Geomorph <sup>4</sup>	3
GEOE 451	Economic Geology	3
Geology electives <sup>3</sup>		4



Free electives	3
<b>TOTAL</b>	<b>16</b>

**128 credits required for graduation****Paleontology Emphasis****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
PE	Physical Education	1
<b>TOTAL</b>		<b>16</b>

**Second Semester**

CHEM 114	General Chemistry II	3
CHEM 114L	General Chemistry II Lab	1
BIOL 153	General Biology II	3
BIOL 153L	General Biology II Lab	1
PHYS 111	Intro to Physics I	3
PHYS 111L	Intro to Physics Lab	1
GenEd Humanities Elective <sup>1</sup>		3
<b>TOTAL</b>		<b>15</b>

**SOPHOMORE YEAR****First Semester**

GEOL 331	Stratig and Sedimentation	3
BIOL 121	Basic Anatomy	3
BIOL 121L	Basic Anatomy Lab	1
GEOL 271	The Search for our Past	3
Social Science and Humanities Electives <sup>1</sup>		6
<b>TOTAL</b>		<b>16</b>

**Second Semester**

ENGL 279	Technical Communications I <sup>1</sup>	3
GEOL 212	Mineral and Crystallography	3
GEOL 276	Dinosaurs	3
GEOE 211	Earth Systems Engr Analysis	3
Gen Ed Humanities/Social Science Elective		3
PE	Physical Education	1
<b>TOTAL</b>		<b>16</b>

**JUNIOR YEAR****First Semester**

ENGL 289	Technical Communications II <sup>1</sup>	3
GEOL 341	Elementary Petrology	3
GEOL 416	GIS: Intro to GIS	3
GEOL 471	Invertebrate Paleo <sup>4</sup>	3
BIOL 311	Principles of Ecology	3
Humanities/Social Science Elective		1
<b>TOTAL</b>		<b>16</b>

**Second Semester**

GEOE 322	Structural Geology	3
GEOL 403	Regional Field Geology	1
GEOL 321	Historical Geology	3
GEOL 472	Museum Conserv Curation	3
MATH 381	Intro to Probability/Statistics	3
<b>TOTAL</b>		<b>13</b>

**Summer**

GEOE 410	Engr Field Geology	<b>6</b>
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**SENIOR YEAR****First Semester**

GEOL 464	Senior Research I <sup>2</sup>	3
GEOL 372	Vert Paleo Tech Exh Design	3
MATH	Math elective	3
	Free electives	3
	Humanities/Social Science elective	3
<b>TOTAL</b>		<b>15</b>

**Second Semester**

GEOL 465	Senior Research II <sup>2</sup>	3
	Geology Electives <sup>3</sup>	6
	Free electives	6
<b>TOTAL</b>		<b>15</b>

**128 credits required for graduation****Curriculum Notes**

<sup>1</sup> Students must complete 27 credits of the general education core in their first 64 credit hours, including 6 credits of science, 3 credits math, 6 credits English/Technical Communication, 6 credits humanities, and 6 credits social science. ENGL 289 yields an addition 3 general education credits, for a total of 30.

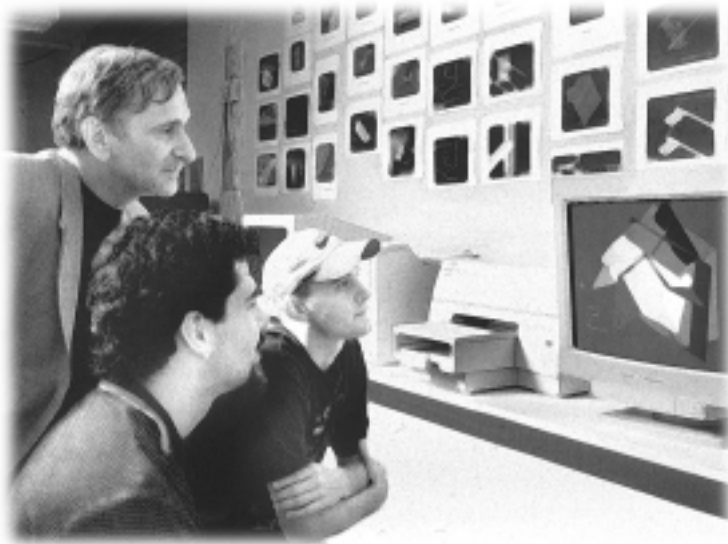
<sup>2</sup> Under exceptional circumstances, a student may petition the department chair to substitute geology electives for senior research.

<sup>3</sup> A Geology elective is any class with a GEOL or GEOE prefix.

<sup>4</sup> Courses offered alternate years.

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 332 is recommended for students interested in numerical modeling of partial differential equations.

## MINING ENGINEERING



### CONTACT INFORMATION

Dr. Charles A. Kliche  
Mining Engineering  
Mineral Industries 212  
(605) 394-1971  
e-mail: charles.kliche@sdsmt.edu

### FACULTY

Professor Kliche, Program Director; Professor Hladysz.

### SUPPORTING FACULTY

Professors Hansen and Preber; Associate Professor Klasi.

### MINING ENGINEERING

**By action of the South Dakota Board of Regents, the Mining Engineering Program at SDSM&T was placed on inactive status effective May 10, 2002. This action suspends enrollment of new students but**

**continues to provide currently enrolled students with the courses needed to graduate no later than May 2005.**

Mining Engineering is the application of engineering and scientific principles to the discovery, appraisal, and extraction of minerals from the Earth and sea. The curriculum provides the student with fundamental training in the basic sciences, engineering sciences, engineering design, geology, and the humanities, as well as training in the student's specialized branch of mining engineering. Principles of mine operation, rock mechanics, economics, computer applications, and mine management receive special emphasis.

Today, the mining world needs problem solvers, proficient in the use of state-of-the-art computer technology. The Mining Engineering program places an important emphasis on acquiring special skills that will help them advance successfully in their professional career. Setting this as the most important goal the engineering design concept is introduced in a number of courses leading to two mine design senior capstone courses. The capstone

design courses are structured as feasibility studies. Each student is given a packet of information that is used to design a mine (underground and surface) starting with drill hole information through to a complete design and description of the planned operation and economic analysis.

Design experience built into the curriculum and enhanced by the use of sophisticated design software emphasizes the development and improvement of the following educational aspects and outcomes:

- Creativity.
- Problem-solving skills with the use of technology.
- Writing skills.
- Communication skills.
- Leadership and team work.

The Bachelor of Science program in Mining Engineering is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

A minor in Mining Engineering is not available.

#### ENVIRONMENTAL AND QUARRYING OPTIONS

The Mining Engineering program offers students the opportunity to specialize in environment and quarrying. This can be accomplished by utilizing electives to take courses in engineering and construction materials, environmental engineering, mine environment and reclamation, environmental biology, and geohydrology.

#### COOPERATIVE PROGRAM

The Mining Engineering 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 years to graduate.

#### MINING ENGINEERING LABORATORIES

Modern research facilities exist in the department for rock mechanics and ventilation, particularly in the following areas: physical and mechanical properties of rocks; stability and support of underground structures; slope stability; theoretical and experimental studies of jointed rock masses; and the study of the flow in ventilation networks. Laboratory equipment available for student use includes: equipment for specimen preparation, rock strength testing machine, triaxial apparatus, direct shear machine, computerized data acquisition system, ventilation network model, surveying equipment, and Global Positioning System.

The computer laboratory consists of personal computers used independently or linked to the campus file servers 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, and Silicon Graphics workstations are used by students in surface and underground mine design.

#### MINING 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.

<b>FRESHMAN YEAR</b>		
<b>First Semester</b>		
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
GE 115	Professionalism/Engr and Sci	2
EG 111	Engineering Graphics	2
PE	Physical Education	1
<b>TOTAL</b>		<b>16</b>
<b>Second Semester</b>		
CHEM 114	General Chemistry II	3
MATH 125	Calculus II	4

PHYS 211	University Physics I	3
ENGL 101	Composition I	3
PE	Physical Education	1
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>17</b>

**SOPHOMORE YEAR**

**First Semester**

MINE 201	Intro to Mining & Exploration	3
GEOL 201	Physical Geology	3
GEOL 201L	Physical Geology Lab	1
MATH 225	Calculus III	4
PHYS 213	University Physics II	3
ECON 201	Principles of Microeconomics	3
<b>TOTAL</b>		<b>17</b>

**Second Semester**

MINE 202	Underground Mining	3
GEOL 212	Mineralogy & Crystallography	3
MATH 321	Differential Equations	4
ENGL 279	Technical Communications I	3
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>16</b>

**JUNIOR YEAR**

**First Semester**

ENGL 289	Technical Communications II	3
MINE 301	Mine Surveying	3
MINE 302	Surface Mining	3
GEOL 341	Elementary Petrology	3
EM 217	Statics and Mechs of Materials	4
ME 211	Intro to Thermodynamics	3
<b>TOTAL</b>		<b>19</b>

**Second Semester**

MINE 441	Economics of Mining	3
MINE 411	Rock Mechanics I	4
GEOE 322	Structural Geology	3
EM 215	Engr Mechanics (Dynamics)	3
EM 327	Applied Fluid Mechanics	4
<b>TOTAL</b>		<b>17</b>

**SENIOR YEAR**

**First Semester**

MINE 464	Underground Mine Design	4
MINE	Mining Elective	3
MINE 461	Mine Ventilation and Air Cond	3
MINE 490	Undergraduate Seminar	1
EE 301	Circuits, Machines, & Systems	4
	Free Elective	2
<b>TOTAL</b>		<b>17</b>

**Second Semester**

MINE 465	Surface Mine Design	4
MINE	Mining Elective	3
MET 220	Mineral Processing	4
	Humanities or Social Sciences Elective(s)	4
	Free Elective	2
<b>TOTAL</b>		<b>17</b>

**136 credits required for graduation**

**Curriculum Notes**

Statics, Strengths (Mechanics of Materials), and Dynamics must be included in a combination of courses: EM 217 and EM 215 or EM 219 and EM 216 or EM 214, EM 215, and EM 216.



Photo Courtesy of SD Department of Tourism

*TECHFact: SDSM&T has the best in cutting edge equipment and facilities. It also has the unusual advantage of being so close to the natural laboratories of the Black Hills and Badlands.*

The College of Interdisciplinary Studies is composed of the Departments of Humanities, Military Science, Physical Education, and Social Sciences. The mission of the College is to provide a broadly-based education that prepares students to function effectively and successfully in their professional and personal lives. The faculties of the departments work closely with each other and with students to provide the highest quality of education for students. Through continual professional growth, excellence in teaching, and consultation with leaders in business and industry, the faculty delivers a curriculum of courses and experiences to help students achieve high levels of competence in their careers and in their individual lives.

The College of IS administers the Bachelor of Science in Interdisciplinary Sciences. This degree, while strongly based in the sciences, is somewhat unique in the university. The IS Degree allows students to enroll in a wide variety of courses selected specifically to prepare a student for the career of his/her choice. The student, working closely with an advisor, supplements the required degree courses with those in which he/she has an interest and/or which prepare the student to achieve the student's career goal.

Students who have received or are pursuing this degree have entered or are preparing to enter such diverse professions as business and technology management, medicine and health technology, military service, personnel, science industries, environmental science, and technical writing. The IS degree provides preparation for the pursuit of advanced degrees in a variety of fields. Among the graduate programs that former students have entered and current students are planning to enter are medicine, law, business, psychology, social work, teaching, and the natural sciences.

A second degree administered through the college is the Associate of Arts in General Studies. One-half of this two-year degree consists of students completing the general education requirements. These requirements provide a broad, general background of education. They also are required if a student decides at a future time to pursue a four-year degree. The second half of this degree consists of courses the student and the advisor select on the basis of interest and/or career development.

The faculty of the College of Interdisciplinary Studies prides itself on involvement with students. Whether it is advising, teaching, research projects, or field experiences, the college faculty takes personal interest in students and is committed to providing excellence in education.

Sincerely,

*Sue Shirley*

Dr. Sue Shirley  
Interim Dean, College of Interdisciplinary Studies

## 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 SDSM&T 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 semester hours is required. This requirement can be met by taking one of two 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 SDSM&T 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 semester hours in two disciplines, i.e. two 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 151	Indian Art History <sup>1,2</sup>	3
ARTH 211	Art History	3
ENGL 221/222	British Literature I and II <sup>1</sup>	3/3
ENGL 241/242	American Lit I and II <sup>1</sup>	3/3
ENGL 250	Science Fiction	3
FREN 101/102	Intro French I and II <sup>1</sup>	4/4
GER 101/102	Intro German I and II <sup>1</sup>	4/4
HIST 121/122	Western Civilization I and II	3/3
HUM 100	Introduction to Humanities	3
HUM 200	Connections: Humanities and Technology <sup>1</sup>	3
JAPN 101/102	Japanese Culture and Language I and II <sup>1</sup>	3/3
LAK 101/102	Lakota Language I and II <sup>1,2</sup>	3/3
MUS 100	Music Appreciation	3
PHIL 100	Introduction to Philosophy	3
PHIL 200	Introduction to Logic	3
PHIL 220	Introduction to Ethics	3
PHIL 233	Philosophy and Literature	3
REL 230	Introduction to the Bible	2
REL 250	World Religions <sup>1</sup>	2
SPAN 101/102	Intro Spanish I and II <sup>1</sup>	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 disciplines, i.e. two different course prefixes, is required.

ANTH 210	Cultural Anthropology <sup>1</sup>	3
ECON 201	Prin of Microeconomics	3
ECON 202	Prin of Macroeconomics	3
GEOG 101	Introduction to Geography <sup>1</sup>	3
HIST 151/152	American History <sup>1</sup>	3/3
POLS 100	American Government	3
POLS 210	State & Local Government	3
PSYC 101	General Psychology	3
PSYC 251	The Psychology of Being	3
SOC 100	Introduction to Sociology	3
SOC 150	Social Problems <sup>1</sup>	3
SOC 250	Marriage and the Family	3

<sup>1</sup> Course meets Cultural Diversity requirement.

<sup>2</sup> Courses are part of the cooperative agreement between SDSM&T and Oglala Lakota College.

**Mathematics**

A minimum of three 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 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 semester hours is required. Courses must be selected from those marked with a (\*) 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 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 112 Personal Computer Programming 2

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 64. The number of elective credits will vary from a minimum of 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 48 credit hours, students may register for up to nine hours of 300 level courses.

If planning to pursue a baccalaureate degree from SDSM&T students should consider taking two credits of approved physical education courses.

This information may be found at [www.hpcnet.org/is](http://www.hpcnet.org/is)

## INTERDISCIPLINARY SCIENCES

The Bachelor of Science in Interdisciplinary Sciences at the South Dakota School of Mines and Technology is an individualized degree program, which seeks to serve the needs of students whose goals cannot be met within other departments. The degree program allows the student to enroll in a wide variety of courses, including carefully chosen electives in the humanities, fine arts, and social sciences. Special plans of study with an emphasis in environmental science, pre-MBA studies, atmospheric sciences, information technology, network administration, and health sciences are available.

The Interdisciplinary Sciences Degree is administered by the College of Interdisciplinary Studies, and students conduct their studies under the supervision of a faculty member in that college.

This degree is especially appropriate for the following individuals:

1. Students with undergraduate courses at SDSM&T or transferable courses from other institutions;
2. Students whose educational and career goals necessitate courses in several departments;
3. Transferring and returning students who desire to incorporate previous college courses into a degree program;
4. Students whose professional and life experiences require that they integrate knowledge from diverse fields; and
5. Students in pre-professional careers: law, medicine, physical therapy, atmospheric sciences, etc.

The benefits of the Interdisciplinary Science Degree include:

1. Flexibility in a wide range of study;
2. Individual design allowing the student to influence the content of the degree; and
3. The opportunity to study natural sciences, social sciences, humanities, and liberal arts from a broad perspective, thus providing a well-rounded program.

### INTERDISCIPLINARY SCIENCES PROGRAM ADMISSION POLICY

After successful completion of at least thirty (30) credit hours, 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 will consist of a Letter of Intent stating the courses taken, the courses proposed to be completed, and the career goals to which this academic course work is to be applied. A copy of the Letter of Intent form is available from the IS College office. The completed form must be submitted to the college office prior to its submission to the IS Steering Committee.

The deadlines for submitting the Letter of Intent form to the IS College office are as follows: May graduates - April 30 of preceding year; August graduates - July 30 of preceding year; December graduates - November 30 of preceding year.

### REQUIREMENTS FOR GRADUATION

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. English Sequence		
(ENGL 101, 279, 289)	9 cr	
II. Sciences <sup>1</sup>		
Math and Computer Science	12 cr min	
Biology	3 cr min	
Chemistry	3 cr min	
These or other sciences	24 add'l cr	
<b>SUBTOTAL</b>	<b>42 cr</b>	
III. Humanities, Social Sciences		
Social Sciences	6 cr min	
(with 3 cr. being upper division)		
Humanities	6 cr min	
(with 3 cr. being upper division)		
Social Sciences or Humanities	12 add'l cr	
<b>SUBTOTAL</b>	<b>24 cr</b>	
IV. Physical Education	2 cr	
V. Electives	45 cr	



VI. IS 464 Research Methods 3 cr

VII. IS 465 Senior Project 3 cr

**TOTAL 128 cr**

Thirty-six (36) of the above credits must be at the junior or senior level (courses numbered 300 and above). Twelve (12) of the thirty-six (36) must be in science or math.

<sup>1</sup> Of the forty-two (42) credits required in sciences, six (6) credits must be sequential in one of these areas: Biology, Chemistry, Physics, or Earth Sciences.

### TRANSFER STUDIES

The transfer studies program is particularly advantageous for those students who are either undecided about an area of major study or who have decided to pursue a degree not offered at SDSM&T. Such 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. Through this program of access and transfer, students can begin their college studies under the best of all conditions. They can enjoy the widest opportunities for the choice of a degree area and still experience the excellent educational environment found on the SDSM&T campus.

Students wishing to pursue this program should request a catalog from the college from which they eventually plan to graduate and/or communicate with that institution regarding degree requirements in specific curricula. Advisors are available to help students develop a program of study from courses offered at SDSM&T, which will transfer to the college chosen for graduation.

### INFORMATION SYSTEMS

The world of business and industry relies heavily on technology and its applications. There is a great demand in the world of work for individuals who have been educated in the creative applications of technology. Within the Interdisciplinary Science Degree students can select courses which will prepare them for the

ever-expanding world of technology related to business and industry.

### **Information Technology/E-Commerce**

This emphasis allows students to develop a working knowledge of the latest technologies necessary to participate in the world of electronic commerce, including creating interactive commercial web sites. Students will learn how the Internet works, the hardware and software necessary to create and host web sites, as well as editing and incorporating sound, graphics, animation, and video into web pages.

### **Network Administration**

This emphasis focuses on the role and functions of a computer network administrator. Included in these are learning how to administer a network for peak efficiency. Students will learn the functions of adding, deleting, and updating software as well as reconfiguring the network as it expands and changes. Students who complete this emphasis will be prepared to pursue certification in the field of network administration.

### PRE-PROFESSIONAL STUDIES

#### **Health Sciences and Human Services and Other Programs of Study**

Because of the flexibility of the Interdisciplinary Sciences Degree it is possible to build the program of study around the interests of the student and career opportunities. Listed below are some of the careers that IS graduates have entered or are pursuing.

#### **Health Science**

**Pre-Med:** The IS Degree allows students to complete a program of courses to prepare students for entrance into a medical school. The faculty, by staying knowledgeable of what schools of medicine require for admission, will help students select the courses these schools require and recommend.

**Pre-Physicians Assistant (PA):** Working with the advisor, students can select the courses, which will fulfill the IS Degree requirements and admission requirements of those universities that offer the PA degrees.

**Medical Technology (MT)/Radiologic Technology (RT):** The South Dakota School of Mines and Technology has an articulation agreement with Rapid City Regional Hospital, which has fully certified MT and RT programs. This agreement allows students to pursue an IS Degree and either MT or RT certification. A number of the courses needed to complete the MT or RT program count towards the IS Degree. Many students then graduate with both a Bachelors Degree and MT or RT certification.

**Nursing:** Many students complete the IS Degree in conjunction with completing their nursing training in the nursing programs directed by SDSU or USD at Rapid City Regional Hospital. A number of the pre-nursing and nursing courses meet the graduation requirements for the Bachelor of Science in Interdisciplinary Sciences.

There are numerous other Health Science professions into which IS graduates have entered or are planning to enter. These include Dentistry, Sports Medicine, Optometry, Chiropractics, Ophthalmology, Pre-Pharmacy, Occupational Therapy, and Physical Therapy. Students planning to enter these professions should consult the programs of study of the schools they plan to attend. Working closely with their advisor the appropriate courses will be selected to fulfill the graduation requirements for the IS Degree and meet the entrance requirements for the professional schools in Health Science.

### **Human Services**

The IS Degree offers educational opportunities for a career in helping people. A number of the IS graduates have entered such careers and many current students are planning entry into these types of careers. Within the IS College there are 15 courses in Psychology and Sociology. In addition, there are opportunities to study special topics of the student's choice and to gain valuable experience working with various agencies and organizations.

### **Social Work Program**

The University of South Dakota (USD) and South Dakota School of Mines and Technology (SDSM&T) have entered into an articulation agreement that allows students in the western part of the state to enroll in an accredited social

work program. The primary mission of the undergraduate program in social work is to equip students with the necessary knowledge, values, and skills for entering the social work profession. The program's faculty places a particular emphasis on the problems and issues related to the service of people in the region. Besides the General Education requirements, students also need to have a strong liberal arts base on which to build their social work knowledge. Students must complete a successful volunteer/paid experience during their first two years. The program can be completed in four years. The first two years are spent at SDSM&T and the final two years at USD. Most of those persons with a baccalaureate degree in Social Work are providing direct service to people. Often times they work in a social agency or center where they provide direct service to disadvantaged families, children, adolescents, and older adults. The role of the Social Worker is to assist in solving problems and linking people with services that address their needs.

The IS Degree provides an excellent opportunity for preparation for students planning to attend graduate schools in Psychology, Sociology, and Social Work.

### **Additional Programs of Study**

**Atmospheric Sciences:** Students interested in this area have the opportunity to concentrate courses in the Department of Atmospheric Sciences. With this emphasis within the IS Degree, students will study and do research with faculty from the world-renowned Institute of Atmospheric Sciences.

**Pre-Law:** A number of IS graduates and current students desire a career in law. IS advisors, by being knowledgeable of what law schools require and recommend of applicants, will work closely with students to develop a program of study within the IS Degree. They will help prepare students with such skills as oral and written communications, critical thinking, and the broad education required by law schools.

**Environmental Science:** If students have an interest in this area, they will have the opportunity within their IS program of studies to take courses in such environmental areas as Biology, Chemistry, Physics, Geology, and Atmospheric Sciences.

**Public Relations/Personnel/Human**

**Resources:** While pursuing an IS Degree, students have the opportunity to prepare for a career in these areas by taking courses in Psychology, Sociology, and oral and written communications.

**INTERDISCIPLINARY SCIENCES**

(Upper level courses are in bold print)

IS 191, 192<sup>1</sup>, 270<sup>1</sup>, 291, 292, **370<sup>1</sup>, 380, 391, 392, 464, 465, 491, 492, 691, 692**

<sup>1</sup> May be used as free elective for the IS Degree.



*TECHFact: Although far from home, Tech's Norwegian students celebrated Norwegian Independence Day on May 17 with a parade and other festivities. Almost eight percent of Tech's enrollment in the fall of 2001 was international students. Students represented more than 25 other countries including the People's Republic of China, Mongolia, Zambia, and India.*

## HUMANITIES



### CONTACT INFORMATION

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### FACULTY

Professor Antonen, Chair; Professors Boysen, Feiszli, and Morgan; Associate Professors Lee, Rice, Shirley, and Sneller; Assistant Professors Hudgens, Mitchell, and Palmer.

### 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 SDSM&T. Interdisciplinary Science 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 464, and IS 465, 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 151, 211, **320, 491, 492**

#### **English:**

ENGL 031<sup>1</sup>, 032<sup>1</sup>, 033<sup>1</sup>, 101<sup>2</sup>, 201<sup>2</sup> 221, 222, 241, 242, 250, 279<sup>2</sup>, 289<sup>2</sup>, **300, 330, 343, 350, 360, 374, 383, 391<sup>3</sup>, 392<sup>3</sup>, 468**

**Foreign Language:**

FREN 101, 102, 201, 202, GER 101, 102,  
JAPN 101, 102, LAK 101, 102, SPAN 101,  
102

**History:**

HIST 121, 122

(For students enrolling in Fall 1999 or later  
these courses are a humanities; prior to Fall  
1999 these courses were a social science.)

**Humanities:**

HUM 100, 200, 291, 292, **300, 350, 375, 410,**  
**491, 492**

**Music:**

MUAP 152, MUEN 100<sup>3</sup>, 122<sup>3</sup>, 250<sup>3</sup>, 260, **330**  
MUS 100, 110, 250, **326**

**Philosophy:**

PHIL 100, 200, 220, 233

**Religion:**

REL 230, 250

**Speech Communications:**

SPCM 101<sup>3</sup>

<sup>1</sup> Does not meet general requirements for  
graduation.

<sup>2</sup> Meets general requirements for  
graduation, but not for humanities credits.

<sup>3</sup> May not be used as humanities credit, but  
may be used for free elective credit. (Consult  
advisor for further details.)



*TECHFact: Tech's 2001 fall enrollment was 2,370, 2,026  
undergraduate and 344 graduate students.*

## MILITARY SCIENCE



### CONTACT INFORMATION

LTC. Kent R. Guthrie  
 Department of Military Science  
 Classroom Building 113  
 (605) 394-2769 or (605) 394-6038  
 e-mail: kent.guthrie@sdsmt.edu

### FACULTY

Professor Guthrie, Chair; Assistant Professors  
 Beegles, Hall, Porter, and VanCuren.

### GENERAL INFORMATION

The South Dakota School of Mines and Technology 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. Military Science courses complement any course of study providing

leadership training unavailable anywhere else on campus. Participation in the ROTC Basic Course incurs no military obligation.

For the second year in a row, Army Reserve Officer Training Corps cadets from the Mount Rushmore Battalion won the Ranger Challenge competition held in Fort Carson, Colorado.

### 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 Military Science. 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 Military Science courses, two (2) credit hours each semester the first two years, and four (4) credit hours each semester the last two 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 after attending a summer ROTC Leadership Training Course at Ft. Knox, Kentucky. Participation at the basic camp 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 courses are tuition free. Books and equipment are provided by the department. Associated fees assessed for all courses do apply. Military Science 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, \$250 Sophomore, \$300 Junior, and \$350 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 Nation Advanced Leadership Camp (NALC) 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 percent reduction in tuition costs.

### **EXTRACURRICULAR ACTIVITIES**

Military-related extracurricular activities and organizations available to the ROTC student include Scabbard and Blade, Pershing Rifles, and the SDSM&T 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



### CONTACT INFORMATION

Mr. Jerald R. Schafer  
Department of Physical Education  
King Center 117  
(605) 394-2603  
e-mail: jerald.schafer@sdsmt.edu

### FACULTY

Associate Professor Schafer, Chair; Professors Felderman and Welsh; Assistant Professor Soucy.

### PHYSICAL EDUCATION

The physical education program is administered as a phase of a student's general education. The primary objective is to assist in providing for a healthy and active life for each individual.

The specific objectives are to create an interest in physical fitness and physical skills and to develop the skills as much as time and facilities permit, while fulfilling the physical education credit requirement.



## SOCIAL SCIENCES



SOCIAL SCIENCES

### CONTACT INFORMATION

Dr. James K. McReynolds  
Department of Social Sciences  
Classroom Building 304  
(605) 394-2542  
e-mail: james.mcreynolds@sdsmt.edu

### FACULTY

Associate Professor McReynolds, Chair;  
Professor Goss; Associate Professor Quinn;  
Assistant Professors Dendinger, Van Nuys, and  
Adamson; Instructor Schrader; Devereaux  
Library Director Andersen; Associate Librarian  
Cataloger Davies; Assistant Librarian Azar.

### 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<sup>1</sup>, 211<sup>1</sup>, BAD 101<sup>1</sup>, 291<sup>1</sup>, **345<sup>1</sup>, 350, 360, 370<sup>1</sup>**

#### **Economics:**

ECON 201, 202

**Geography:**

GEOG 101, 240, 250, 300

**History:**

HIST 151, 152, 360

**Law:**

LAW 457

**Political Science:**

POLS 100, 210, 301, 330, 340, 350, 353, 412

**Psychology:**

PSYC 101, 251, 327, 331, 341, 361, 391, 392, 451

**Sociology:**

SOC 100, 150, 250, 260, 320, 350, 391, 392, 410/510, 420/520, 459

**Social Work:**

SOCW 200, 210

<sup>1</sup> May not be used as social sciences credits, but may be used for free elective credit. (Consult advisor for further details.)



*TECHFact: Tech 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.*

The College of Materials Science and Engineering is composed of the departments of Chemistry and Chemical Engineering, Materials and Metallurgical Engineering, and Physics. Through these departments, the College administers Bachelor of Science degree programs in Chemistry, Chemical Engineering, Metallurgical Engineering, and Physics. The College also administers the Master of Science degree program in Chemical Engineering and the interdisciplinary MS degree program in Materials Engineering and Science. The College also offers Biology courses.

Nearly all students at the university will take some basic science courses within the College. The College's undergraduate students participate actively in many university interdisciplinary teams, including an active participation in the Center for Advanced Manufacturing and Production. Those interdisciplinary activities focus on research and design projects. One of the examples of such projects is the Chemical Engineering Car Competition sponsored by the American Institute of Chemical Engineers. In this competition, both Chemical and Mechanical Engineering undergraduate students are designing and building new types of cars, which are propelled by alternative sources of energy. Those students compete at regional and national levels. Graduates of the College's programs find exciting and rewarding opportunities for careers in industrial or government employment, private practice, or consulting.

Faculty members of the College are active in research. The National Science Foundation, the U.S. Army, the U.S. Navy, the U.S. Air Force, the Department of Energy, and the Environmental Protection Agency sponsor many research projects undertaken by the College's faculty. The research activities vary from developing practical new materials that can withstand extreme conditions, nanomaterials, biotechnology, to design of equipment and industrial installations.

The College's faculty have taken a lead role in the university's Ph.D. program in Materials Engineering and Science. The faculty have also taken a very active role in the newly created Advanced Material Processing Center.

Our disciplines offer challenging and rewarding opportunities in understanding, synthesizing, and producing materials for a highly technological world. We are committed to providing excellence in educational opportunities for students seeking those opportunities.

Sincerely,

*Jan A. Puszynski*

Dr. Jan A. Puszynski  
Dean, College of Materials Science and Engineering

# BIOLOGY



## CONTACT INFORMATION

Dr. Sookie S. Bang  
Biology  
McLaury 102  
(605) 394-2426  
e-mail: sookie.bang@sdsmt.edu

## FACULTY

Professor Winter, Chair; Professor Sookie Bang; Assistant Professor K. Vierling.

## BIOLOGY

The biology courses are offered for students in science, engineering, and general studies; many students need a knowledge of biology as part of their background. 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 371	Genetics	3
BIOL 491	Biological Problems	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 Special 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 371 Genetics	3
BIOL 431 Industrial Microbiology	3
BIOL 431L Industrial Microbiology Lab	1
BIOL 401 Global Environmental Change	3
BIOL 492 Special 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.



*TECHFact: In 2001, SDSM&T awarded 270 bachelor's degrees, 80 master's degrees, and five doctorate degrees. Tech offers commencement in December and May.*

## CHEMICAL ENGINEERING



### CONTACT INFORMATION

Dr. James M. Munro  
 Department of Chemistry and Chemical  
 Engineering  
 Chemistry and Chemical Engineering 227  
 (605) 394-2422  
 e-mail: james.munro@sdsmt.edu

### FACULTY

Professor Winter, Chair; Professor Munro;  
 Robert L. Sandvig Professor Puszyński;  
 Associate Professor Dixon; Assistant Professor  
 Gilcrease.

### CHEMICAL ENGINEERING

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 are expected to have a solid foundation in the science of chemistry, mathematics, and applied technology in order to help solve the problems

besetting the people of the world and to efficiently use the world's resources. These needs or problems might be related to the environment, electronics, biochemical engineering, energy, food, fibers, biotechnology, petroleum, pharmaceuticals, and new engineering materials. 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, graduates are expected to:

- conduct themselves with the highest ethical standards and to understand the safety, environmental, and societal consequences of their work as chemical engineers.
- be able to analyze chemical processes, both as entire processes and as their separate components, through the effective use of critical thinking skills.
- be proficient in the oral and written communication of their work and ideas.
- be proficient in the use of computers, including process simulation software, for solving chemical engineering problems and for communicating their solutions to others.
- have the ability to learn independently, but also be able to participate effectively in groups of their peers.
- be proficient in their chosen field as

reflected in part by their successful entry into the engineering job market or graduate schools, and by their successful performance in these endeavors.

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 removal from gas and liquid streams, absorption, ion exchange, recycling, etc. Chemical changes of interest include polymerization, chlorination, combustion, alkylation, hydrogenation, neutralization, industrial waste destruction or recycling, bioremediation, fermentation, etc.

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. The department is currently operating one of only a handful of summer chemical engineering Research Experiences for Undergraduates (REU) sites in the country. This unique opportunity allows undergraduates to accomplish research first hand in a university setting, while working under the guidance of a faculty member. More information about this exciting experience may be found on the web at: [www.sdsmt.edu/mse/chem-che/chemE/reu/info.html](http://www.sdsmt.edu/mse/chem-che/chemE/reu/info.html). These employment opportunities may be included as an integral part of the student's studies and are discussed in greater detail in the following pages.

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 also have flexibility through directed electives to tailor their education to better meet their personal goals, such as through courses in the environmental,

biochemical, or 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 SDSM&T for one to earn dual degrees in Chemical and Environmental Engineering; thus coupling a focus on the environment with complementary chemical processing and design skills.

The chemical engineering faculty at SDSM&T strive to keep the curriculum current and dynamic. As a part of this evolution, the faculty is in the process of developing an innovative and unique approach to teaching chemical engineering. This multi-year project vertically integrates process design throughout the curriculum. To further enhance the learning environment, sophisticated process design simulators (such as the commercial software, AspenPlus), are being co-integrated with the process design project. Major funding for the development comes from the National Science Foundation and from industrial sponsors.

The Chemical Engineering Program has laboratory facilities that are used to supplement the basic information presented in the classroom. These facilities include the main laboratory that houses miniplant equipment such as a distillation column, evaporators, heat exchangers, a gas absorber, etc. 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, engineering workstations for solving process design problems, and several research laboratories. The department has been awarded substantial grants from industrial foundations and companies to enhance the laboratory facilities as well as the biotechnology curriculum. The Dow Corning Foundation Enhanced Materials, Automation, Processing, and Simulation (M.A.P.S.) Laboratory will begin development of a unique laboratory experience. Students will be exposed to the real-world challenge of effectively applying process skills in a pilot plant environment. This will be coupled to

advanced process simulation using AspenPlus and state-of-the-art Camile process controllers. The Chemical Engineering Program is expanding their emphasis in the growth area of biochemical engineering. Integration of biochemistry, microbiology, and biochemical engineering into an integrated curriculum is being substantially funded by Cargill, Inc. Check out the latest developments at [www.sdsmt.edu/mse/chem-che/chemE/bioche.html](http://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, or 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 co-op credit must complete a departmental co-op application form, available from their advisor. Students pursuing alternating term co-op positions are advised to take their first two co-op work terms as a spring semester followed by a fall semester in order to optimize the scheduling of courses for their degree.

#### 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. At the regional and national AIChE meetings, chemical engineering students from SDSM&T are able to compete against other ChE students in such things as research paper presentations, process designs, and a new Chem-E Car Competition. SDSM&T students do quite well in these competitions. For example, in Fall of 1999 a SDSM&T student won first in the nation for her research presentation at the National AIChE Annual Meeting. At this same meeting, the process design team tied for second in the nation. These four students were competing against all of the other 161 Chemical Engineering schools in the U.S. In addition to this, for three of the past four years the SDSM&T ChE students have won the student chapters competition at the Rocky Mountain Regional Student Chapter AIChE conference. During Spring 2000, the chemical reaction powered car they designed beat teams from Colorado, Utah, New Mexico, and Montana. Highlights of student activities may be found at [aiche.sdsmt.edu/](http://aiche.sdsmt.edu/). The ChE program strongly encourages students to broaden their education through co-ops, internships, and research experiences. For the fifth year the Chemical Engineering program hosted eight students from SDSM&T and other universities throughout the U.S. at SDSM&T's REU (Research Experience for Undergraduates) site. Additionally, students are encouraged to apply at other REU sites. For example, in summer 2002, student research included working on fuel cells at the University of Houston, bioprocessing at Colorado State University, and biomedical engineering at University of Minnesota. Through these competitions and the other opportunities to meet with other ChE students across the U.S., SDSM&T students are able to demonstrate the quality of their education as well as learn more about the profession of Chemical Engineering.

#### 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
GE 115	Professionalism in Engr & Sci	2
ENGL 101	Composition I	3
	Humanities or Social Sciences Elective(s)	5
<b>TOTAL</b>		<b>18</b>

**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 117	Professional Pract in ChemE	3
	Humanities or Social Sciences Elective(s)	4
<b>TOTAL</b>		<b>18</b>

**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	Exper Organic Chem IA	1
PHYS 213	University Physics II	3
<b>TOTAL</b>		<b>17</b>

**Second Semester**

CHE 218	Chemical Engineering II	3
CHE 222	Chem Engr Thermodynamic I	3
CHEM 328	Organic Chemistry II	3
	Humanities or Social Sciences Elective(s)	3
CHE 350	Computer Appl in Chem Engr	2
MATH 321	Differential Equations	4
<b>TOTAL</b>		<b>18</b>

**JUNIOR YEAR****First Semester**

CHE 317	Chemical Engr III	3
CHE 321	Chemical Engr Thermo II	3
CHE 233	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
<b>TOTAL</b>		<b>17</b>

**Second Semester**

CHE 318	Chemical Engineering IV	3
CHE 362	Chemical Engineering Lab III	1

CHE 443	Chem Kinetics/Reactor Dsgn	3
CHEM 345	Physical Chem I and II Lab	1
CHEM 343	Physical Chem for Engr II	2
	Engineering Elective	3
	Department Approved Elective	3
<b>TOTAL</b>		<b>16</b>

**SENIOR YEAR****First Semester**

CHE 417	Chemical Engineering V	2
CHE 461	Chemical Engineering Lab IV	1
CHE 464	Chemical Engr Design I	4
CHE 433	Process Control	3
	Chemical Engineering Elective	3
	Biology Elective	3
<b>TOTAL</b>		<b>16</b>

**Second Semester**

CHE 465	Chem Engineering Design II	3
	Chemical Engineering Elective	2
	Chemical Engineering Lab Elective	1
	Department Approved Elective	4
	Humanities or Social Sciences Elective(s)	4
PE	Physical Education/MUEN	2
<b>TOTAL</b>		<b>16</b>

**136 credits required for graduation****Curriculum Notes**

The following optional areas for emphasis are available. The advisor recommends and approves courses to take if students are interested in emphasis in one of these areas: Biochemical engineering, Environmental engineering, or Materials (polymers, ceramics, materials processing, corrosion, or solid state/semi-conductors).

BIOL elective: BIOL 231, 431, or other approved by advisor.

CHE elective: 5 credits from CHE 400, 434, 444, 450, 455, 474, 474L, 484, or others approved by advisor.

CHE lab elective: 1 credit from CHE 400, 474L, 484L, or other approved by advisor.

Engineering Elective: 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 3 credits of advanced Military Science and up to 6 credits of cooperative education.

# CHEMISTRY



## CONTACT INFORMATION

Dr. Dale E. Arrington  
Department of Chemistry and Chemical  
Engineering  
Chemistry and Chemical Engineering 313  
(605) 394-1236  
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## FACULTY

Professor Winter, Chair; Professors Arrington  
and Boyles; Associate Professor McDowell;  
Assistant Professors Heglund and Williams.

## CHEMISTRY

The Department of Chemistry and  
Chemical Engineering offers undergraduate  
chemistry courses, which meet the  
requirements for the degree Bachelor of  
Science and for other programs on campus.  
The Chemistry program offers two 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.

A minor in chemistry is not available.

## **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	Chemistry Seminar	0.5
<b>TOTAL</b>		<b>17.5</b>

##### **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
PE	Physical Education	1
Humanities or Social Sciences Elective(s)		3
CHEM 290	Chemistry Seminar	0.5
<b>TOTAL</b>		<b>15.5</b>

#### **SOPHOMORE YEAR**

##### **First Semester**

CHEM 332	Analytical Chemistry	3
CHEM 332L	Analytical Chemistry Lab	1
CHEM 292	Chemistry Outreach	1
CHEM 326	Organic Chemistry I	3
CHEM 326L	Exper Organic Chem I	2
MATH 225	Calculus III	4

PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
CHEM 290	Chemistry Seminar	0.5
<b>TOTAL</b>		<b>18.5</b>

**Second Semester**

CHEM 182	Chemical Computations	2
CHEM 252	Systematic Inorganic Chem	3
CHEM 328	Organic Chemistry II	3
CHEM 328L	Exper Organic Chem II	2
ENGL 279	Technical Comm I	3
PE	Physical Education	1
Humanities or Social Sciences Elective(s)		3
CHEM 290	Chemistry Seminar	0.5
<b>TOTAL</b>		<b>17.5</b>

**JUNIOR YEAR****First Semester**

ENGL 289	Technical Comm II	3
CHEM 292	Chemistry Outreach	1
CHEM 342	Physical Chemistry I	3
Humanities or Social Sciences Elective(s) <sup>1</sup>		5
Elective		3
CHEM 490	Senior Seminar	0.5
<b>TOTAL</b>		<b>15.5</b>

**Second Semester**

CHEM 345	Physical Chem I and II Lab	2
CHEM 344	Physical Chemistry II	3
CHEM 370	Chemical Literature	1
Elective		4
Adv Chemistry Requirement <sup>2</sup>		5
CHEM 490	Senior Seminar	0.5
<b>TOTAL</b>		<b>15.5</b>

**SENIOR YEAR****First Semester**

Electives		4
Adv Chemistry Requirement <sup>2</sup>		10
CHEM 490	Senior Seminar	0.5
<b>TOTAL</b>		<b>14.5</b>

**Second Semester**

Electives		7
Adv Chemistry Requirement <sup>2</sup>		6
CHEM 490	Senior Seminar	0.5
<b>TOTAL</b>		<b>13.5</b>

**128 credits required for graduation****Curriculum Notes**

<sup>1</sup> 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.

<sup>2</sup> Twenty-one (21) advanced chemistry credits must be taken from the following chemistry (CHEM) courses: either 480 or 482; either 420 or 426; and 421, 434, 434L, 452, 452L, and 460.

**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	Chemistry Seminar	0.5
<b>TOTAL</b>		<b>17.5</b>

**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) <sup>1</sup>		6
CHEM 290	Chemistry Seminar	0.5
<b>TOTAL</b>		<b>14.5</b>

**SOPHOMORE YEAR****First Semester**

CHEM 332	Analytical Chemistry	3
CHEM 332L	Analytical Chem Lab	1
CHEM 292	Chemistry Outreach	1
CHEM 326	Organic Chemistry I	3
CHEM 326L	Exper Organic Chem I	2
ENGL 279	Technical Comm I	3
PHYS 111	Introduction to Physics I	3

PHYS 111L	Intro to Physics I Lab	1
CHEM 290	Chemistry Seminar	0.5
<b>TOTAL</b>		<b>17.5</b>

### Second Semester

CHEM 182	Chemical Computations	2
CHEM 252	Systematic Inorganic Chem	3
CHEM 328	Organic Chemistry II	3
CHEM 328L	Exper Organic Chem II	2
PHYS 113	Introduction to Physics II	4
Elective		4
CHEM 290	Chemistry Seminar	0.5
<b>TOTAL</b>		<b>18.5</b>

## JUNIOR YEAR

### First Semester

ENGL 289	Technical Comm II	3
CHEM 292	Chemistry Outreach	1
	Advanced Chemistry Requirement <sup>2</sup>	3
	Advanced Elective <sup>3</sup>	3
	Humanities or Social Sciences Elective(s)	5
CHEM 490	Senior Seminar	0.5
<b>TOTAL</b>		<b>15.5</b>

### Second Semester

CHEM 340	Fundamentals of Physical Chemistry	3
CHEM 370	Chemical Literature	1
	Advanced Elective <sup>3</sup>	3
	Electives	8
CHEM 490	Senior Seminar	0.5
<b>TOTAL</b>		<b>15.5</b>

## SENIOR YEAR

### First Semester

	Advanced Chemistry Requirement <sup>2</sup>	3
	Advanced Electives <sup>3</sup>	6
	Electives	5
CHEM 490	Senior Seminar	0.5
<b>TOTAL</b>		<b>14.5</b>

### Second Semester

	Advanced Chemistry Requirement <sup>2</sup>	3
	Advanced Elective <sup>3</sup>	3
	Electives	8
CHEM 490	Senior Seminar	0.5
<b>TOTAL</b>		<b>14.5</b>

**128 credits required for graduation**

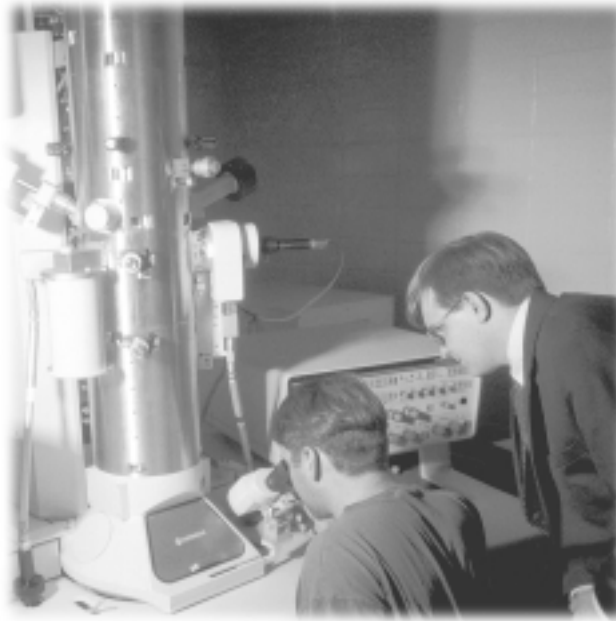
### Curriculum Notes

<sup>1</sup> 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.

<sup>2</sup> Chem 460, 480, and 330 or 482 must all be taken to fulfill this requirement.

<sup>3</sup> 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.

## METALLURGICAL ENGINEERING



### CONTACT INFORMATION

Dr. Jon J. Kellar  
 Department of Materials and Metallurgical  
 Engineering  
 Mineral Industries 106  
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 e-mail: jon.kellar@sdsmt.edu

### FACULTY

Professor Kellar, Chair; Distinguished and  
 Douglas W. Fuerstenau Professor Han;  
 Professors Howard, Marquis, and Stone;  
 Instructors Arbegast and Cross.

### 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, and superconductors.

There are three 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.

Advances made by Metallurgical and Material Engineers usually 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 not only responsible for the production of materials but 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. Metallurgical Engineering is similar to Chemical Engineering when it comes to the chemical processes for the production of large quantities of pure materials. However, Metallurgical Engineers generally are not involved in the production of organic materials whereas Chemical Engineers are less likely to be involved in primary inorganic material production processes.

Materials and Metallurgical Engineers are employed throughout the nation and the world.

#### **GOALS FOR THE DEGREE PROGRAM BACHELOR OF SCIENCE IN MATERIALS AND METALLURGICAL ENGINEERING**

Materials and Metallurgical Engineering graduates shall be prepared in four areas that will assure professional competence, life-long development skills, ethical practice, and community involvement.

1. Professional Competence: Graduates must complete a curriculum that includes course work in technical subjects related to materials science, metallurgical engineering, humanities, social sciences, and communications. Students will be required to participate in design activities throughout their program of study with a

capstone design required during their last two years of study. Students are expected to participate in extra-curricular activities including, but not limited to, participation in student professional societies.

2. Prepared for Life-long Learning: Students are to be endowed with independent learning skills that will foster their continued self-development beyond graduation.
3. Knowledgeable of Ethical Practice: Every student will be knowledgeable of the Code of Ethical Practice for Professional Engineers and will have participated in classroom discussions on ethical issues.
4. Recognition of Community Responsibilities: Because of the educational opportunities afforded them by the citizens of the state of South Dakota, graduates have a responsibility to become valued participants in their communities.

#### **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.

**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 <sup>5</sup>	4
CHEM 112	General Chemistry I <sup>6</sup>	3
ENGL 101	Composition I <sup>1</sup>	3
GE 115	Professionalism/Engr and Sci	2
PE	Physical Education	1
Humanities or Social Sciences Elective(s) <sup>3,4</sup>		3
<b>TOTAL</b>		<b>16</b>

**Second Semester**

MATH 125	Calculus II	4
BIOL 153	General Biology II <sup>6</sup> or	3
CHEM 114	General Chemistry II <sup>6</sup>	3
PHYS 211	University Physics I	3
CHEM 112L	General Chem Lab	1
GE 117	Professionalism/Engr & Sci II	2
PE	Physical Education	1
Humanities or Social Sciences Elective(s) <sup>3,4</sup>		3
<b>TOTAL</b>		<b>17</b>

**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	1
ENGL 279	Technical Communications I <sup>1</sup>	3
Humanities or Social Sciences Elective(s)		3
<b>TOTAL</b>		<b>18</b>

**Second Semester**

MATH 225	Calculus III	4
EM 217	Statics/Mechanics Materials	4
PHYS 213L	University Physics II Lab	1
MET 220	Min Proc and Resource Recov	4
Humanities or Social Sciences Elective(s) <sup>3,4</sup>		4
<b>TOTAL</b>		<b>17</b>

**JUNIOR YEAR**

**First Semester**

ENGL 289	Technical Communications II <sup>2</sup>	3
MET 320	Metallurg Thermodynamics	4

MET 351	Engineering Design I	2
Set A or C		7
<b>TOTAL</b>		<b>16</b>

**Second Semester**

MET 352	Engineering Design II	1
MATH 373	Intro to Numerical Analysis	3
Free Elective		2
Set B or D		11
<b>TOTAL</b>		<b>17</b>

**SENIOR YEAR**

**First Semester**

MET 433	Process Control	3
MET 464	Engineering Design III	2
IENG 301	Basic Engineering Economics	2
Science Elective		3
Set A or C		7
<b>TOTAL</b>		<b>17</b>

**Second Semester**

MET 465	Engineering Design IV	1
Science Elective		3
Humanities or Social Sciences Elective(s)		3
Set B or D		11
<b>TOTAL</b>		<b>18</b>

**136 credits required for graduation**

**Curriculum Notes**

- <sup>1</sup> Satisfies General Education Goal #1
- <sup>2</sup> Satisfies General Education Goal #2
- <sup>3</sup> Satisfies General Education Goal #3
- <sup>4</sup> Satisfies General Education Goal #4
- <sup>5</sup> Satisfies General Education Goal #5
- <sup>6</sup> 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



# PHYSICS



## CONTACT INFORMATION

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## FACULTY

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 his 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 are offered. Research is primarily in applied 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 program, which gives graduate students in the Department the opportunity to earn the degree of Doctor of Philosophy. 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 majors may elect a materials track. This is a sequence of courses specializing in solid-state materials. Students should see their advisor for further details.

#### 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
GE 115	Professionalism/Engr and Sci	2
PE	Physical Education	1
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>17</b>

###### 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
<b>TOTAL</b>		<b>15</b>

##### SOPHOMORE YEAR

###### First Semester

MATH 225	Calculus III	4
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
ENGL 279	Technical Communications I	3
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>14</b>

###### Second Semester

MATH 321	Differential Equations	4
EE 211	Intro to Electrical Engr I	4
ENGL 289	Technical Communications II	3
	Humanities or Social Sciences Elective(s)	6
<b>TOTAL</b>		<b>17</b>

##### 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
<b>TOTAL</b>		<b>15</b>

**Second Semester**

MATH 315	Linear Algebra	4
PHYS 451	Classical Mechanics	4
PHYS 471	Quantum Mechanics	4
PHYS 343	Statistical Physics <sup>1</sup>	4
PHYS 314	Exper Physics Design II	2
<b>TOTAL</b>		<b>18</b>

**SENIOR YEAR****First Semester**

PHYS 421	Electromagnetism	4
PHYS 361	Optics <sup>1</sup>	3
PHYS 412	Advanced Design Projects I	2
PHYS 481	Mathematical Physics <sup>1</sup>	4
Humanities or Social Sciences Elective(s)		4
<b>TOTAL</b>		<b>17</b>

**Second Semester**

PHYS 433	Nuclear and Particle Physics <sup>1</sup>	3
PHYS 439	Solid State Physics <sup>1</sup>	4
PHYS 414	Advanced Design Projects II	2
Humanities or Social Sciences Elective(s)		6
<b>TOTAL</b>		<b>15</b>

**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 disciplines or in a sequence of foreign language courses) and six (6) hours in social sciences (in two 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.

<sup>1</sup> Courses offered alternate years.

## Welcome to the College of Systems Engineering!

The College of Systems Engineering is composed of the Department of Electrical and Computer Engineering, the Department of Mathematics and Computer Science, and the Department of Mechanical Engineering. We offer the Bachelor of Science degree in Computer Engineering, Computer Science, Electrical Engineering, Industrial Engineering, Mathematics, and Mechanical Engineering as well as the Master of Science degree in Computer Science, Electrical Engineering, and Mechanical Engineering.

As our world becomes more complex, we see more and more solutions to problems requiring efforts, which cross the boundaries of traditional disciplines. Systems Engineering implies such an approach, where persons from a variety of technical backgrounds work together. Computer engineers and scientists focus on the design of computer hardware and software systems. Electrical and mechanical engineers focus on the design of electrical and mechanical systems. Industrial engineers focus on integrated systems of people, material, and equipment. Mathematicians provide expertise in the underlying mathematical principles on which these disciplines are based.

If you are interested in a career in any one of these disciplines, your future may well involve working with people from other disciplines. Our goal is to provide you with a good technical education along with opportunities to work with your peers in other disciplines in preparation for a successful and productive career. Real life projects are explored in many classes. Team projects such as the Solar Motion team, the Mini-Indy and Mini-Baja (Formula SAE) teams, and the Human Powered Vehicle team give you a chance to learn outside the classroom. The Center of Excellence for Advanced Manufacturing and Production (CAMP) is creating teams of students, faculty, and industry advisors to work on exciting projects in this area.

Our faculty share a commitment to quality education both in and outside the classroom. We enjoy working with students to accomplish our goals of giving you a solid background in the foundations of your major, enabling you to continue learning in rapidly changing fields, and helping you develop the ability to communicate and the other skills necessary to realize your professional objectives. We have active student professional societies in all six programs and encourage you to participate in these. Student groups give you a chance to practice organizational and interpersonal skills that will be important in the workplace. In addition, the co-op education program provides an excellent opportunity to experience working in your chosen field before graduation.

Faculty within the college cooperate and collaborate in curriculum development and research. We have research projects underway in areas such as computer-aided manufacturing, wind power feasibility, computer graphics, advanced material processing, and robotics and neural network applications. These efforts enable faculty to increase our knowledge in these areas and to bring experience at the leading edge of their fields to their upper level and graduate courses. We encourage advanced undergraduates as well as graduate students to participate in research activities.

In short, we believe our disciplines are exciting, dynamic, and challenging ones. We invite you to join us for a very stimulating and rewarding educational experience.

Sincerely,

*Wayne Krause*

Dr. Wayne Krause, P.E.  
Dean, College of Systems Engineering

# COMPUTER ENGINEERING



## CONTACT INFORMATION

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## FACULTY

William J. Hoffert Professor Simonson, Chair through fall 2002; Professor Hasan, Chair beginning spring 2003; Professor Batchelder; Associate Professor Premkumar; Assistant Professor Hemmelman.

## SUPPORTING FACULTY

Professors Carda, Chamberlain, Corwin, Logar, Meiners, and Opp; Associate Professor Penaloza; Assistant Professor Montoya; Instructor Linde.

## COMPUTER ENGINEERING

The Computer 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, digital systems, assembly language, data structures, operating systems, and software engineering. Computer Engineering students are required to select three 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.

The undergraduate curriculum is designed to provide Computer 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 lifetime learning.

### **MISSION**

The mission of the Computer Engineering Program, in support of the mission of the South Dakota School of Mines and Technology, 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 lifetime learning.

### **OBJECTIVES**

The educational objectives of the Computer Engineering program are to provide each graduate with:

1. Foundation of Fundamentals. Students will obtain a strong foundation in the mathematical and basic sciences.
2. Problem Analysis. Students will develop skills for analyzing problems important to Computer Engineering.
3. Problem Design. Students will develop skills to solve closed-ended and open-ended problems important to Computer Engineering.
4. Communication Skills. Students will obtain an ability to communicate effectively, both in writing and in speaking.
5. Multidiscipline Teams. Students will obtain an ability to function effectively within multidisciplinary teams.
6. Professional Responsibility. Students will obtain a solid understanding of professional ethics, integrity, and professional etiquette.
7. Leadership. Students will be involved in a variety of leadership experiences.
8. Diversity. Students will be required to work with students and faculty who have different backgrounds and different opinions.
9. Breadth of Knowledge. Students will obtain an appreciation for disciplines other than Computer Engineering.
10. Social Responsibility. Students will be

exposed to non-technical issues that impact technological choices in a global and societal context.

11. Life-Long Learning. Students will experience an academic environment that encourages and facilitates continuous learning.
12. Local Community. Students will be exposed to engineering decisions that have affected and will affect the Rapid City community.

### **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 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 Electronic 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; and
- Senior capstone experience.

### 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. A graduating senior with high scholarship can finish a master's degree in electrical engineering or computer engineering with about one additional full year of work at 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 supervised until 10 p.m. on 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 and 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 444 and CENG 448.

Classes that are typically offered every spring semester include CENG 342, CENG 442, and CENG 446.

Classes that are typically offered in the spring semester of odd numbered years, for example spring 2003, include CENG 447.

Classes that are typically offered in the spring semester of even numbered years, for example spring 2002, include CENG 420.

### 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

MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
ENGL 101	Composition I	3
CHEM 112L	General Chemistry I Lab	1
GE 115	Professionalism/Engr & Sci	2
PE	Physical Education <sup>1</sup>	1
Humanities or Social Sciences Elective(s)		3
<b>TOTAL</b>		<b>17</b>

##### 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 <sup>1</sup>	1
Humanities or Social Sciences Elective(s)		3
<b>TOTAL</b>		<b>18</b>

## SOPHOMORE YEAR

## First Semester

EE 211	Intro to Electrical Engr I	4
MATH 321	Differential Equations	4
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
CSC 250	Computer Science II	4
<b>TOTAL</b>		<b>16</b>

## Second Semester

ENGL 279	Tech Communications I	3
EE 212	Intro to Electrical Engr II	4
CENG 314	Assembly Language	3
	Humanities or Social Sciences Elective(s)	6
<b>TOTAL</b>		<b>16</b>

## JUNIOR YEAR

## First Semester

ENGL 289	Tech Communications II	3
EE 321	Electronics I	4
EE 351	Mechatronics and Measurement Systems	4
CSC 251	Finite Structures	4
MATH 225	Calculus III	4
<b>TOTAL</b>		<b>19</b>

## Second Semester

EE 312	Signals	3.5
CSC 371	Data Structures	4
CENG 342	Digital Systems	4
MATH 381	Intro to Prob Theory/Stats	3
EM 219	Engineering Mechanics	4
<b>TOTAL</b>		<b>18.5</b>

## SENIOR YEAR

## First Semester

EE 311	Systems	3.5
CSC 477	Software Engineering	3
CENG 464	Computer Engr Design I	2
CENG	Elective <sup>2</sup>	4
IENG 301	Basic Engr Economics	2
<b>TOTAL</b>		<b>14.5</b>

## Second Semester

CENG 465	Computer Engr Design II	2
CSC 472	Operating Systems	4
CENG	Elective <sup>2</sup>	3
CENG	Elective <sup>2</sup>	4
	Humanities or Social Sciences Elective(s)	4
<b>TOTAL</b>		<b>17</b>

**136 credits required for graduation**

## Curriculum Notes

<sup>1</sup> Music Ensemble courses may be substituted for Physical Education courses for qualified students. Any other substitution must be approved in advance by the Physical Education Department Chair.

<sup>2</sup> 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 442	Microprocessor Design	4
CENG 444	Computer Networks	4
	(credit for only one of CENG 444 or CSC 441 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
CENG 448	VLSI Design	4
CSC 431	Theory Computer Graphics	3
CSC 440	Advanced Digital Systems	4
CSC 441	Data Communications	4
CSC 451	Intro to Artificial Intellig	3
CSC 464	Intro to Digital Image Processing and Computer Vision	3
CSC 471	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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### FACULTY

Professor Logar, Chair; Professors Carda,  
Corwin, Opp, and Penaloza; Associate  
Professor Weiss; Assistant Professors  
McGough and Stubbendieck; Instructor  
Schrader.

### 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). At this time, this program is the only CSAB-

accredited program in the state of South Dakota.

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

The South Dakota School of Mines and Technology 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 so as 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 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.

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 371, 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.

<b>FRESHMAN YEAR</b>		
<b>First Semester</b>		
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) <sup>1</sup>	3
<b>TOTAL</b>		<b>17</b>
<b>Second Semester</b>		
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
<b>TOTAL</b>		<b>16</b>
<b>SOPHOMORE YEAR</b>		
<b>First Semester</b>		
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) <sup>1</sup>	3
<b>TOTAL</b>		<b>16</b>

### Second Semester

ENGL 279	Technical Communications I	3
CSC 341	Computer Organization and Design	4
CSC 371	Data Structures	4
	Humanities or Social Sciences Elective(s) <sup>1</sup>	6
<b>TOTAL</b>		<b>17</b>

## 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 <sup>1</sup>	3
<b>TOTAL</b>		<b>16</b>

### Second Semester

MATH 315	Linear Algebra	4
MATH 441	Engineering Statistics I	2
MATH 442	Engineering Statistics II	2
CSC 370	Programming Language Concepts	3
PHYS 213	University Physics II	3
PHYS 213L	University Physics II Lab	1
<b>TOTAL</b>		<b>15</b>

## SENIOR YEAR

### First Semester

CSC 477	Software Engineering	3
CSC 440	Advanced Digital Systems	4
CSC 484	Database Mgmt Systems	3
	Electives or CSC Electives <sup>1</sup>	6
<b>TOTAL</b>		<b>16</b>

### Second Semester

CSC 472	Operating Systems	4
CSC 465	Senior Design Project	3
HUM 375	Computers in Society <sup>1</sup>	3
	Electives or CSC Electives <sup>1</sup>	5
<b>TOTAL</b>		<b>15</b>

**128 credits required for graduation**

### Curriculum Notes

- It is intended that CSC 477 and CSC 465 be viewed as a two-course sequence. If at all possible, they should 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.

<sup>1</sup> 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 HUM 375, which is required.
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 credits of Physical Education, and those courses used to meet requirement (1) above.
4. A minimum of three Computer Science elective courses numbered 300 or above must be taken. MATH 471 also counts as a Computer Science elective. Co-op credit 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 371, and CSC 472.

Classes that are typically offered every fall semester include CSC 372, CSC 440, CSC 484, and CSC 477.

Classes that are typically offered every spring semester include CSC 341, CSC 370, and CSC 465.

Classes that are typically offered in the fall semester of even numbered years, for example fall 2002, include CSC 422/522, CSC 451, CSC 661, and CSC 772.

Classes that are typically offered in the spring semester of odd numbered years, for example spring 2003, include CSC 445/545, CSC 473, CSC 673, CSC 762, CSC 784, and MATH 471.

Classes that are typically offered in the fall semester of odd numbered years, for example fall 2003, include CSC 421/521, CSC 464, CSC 713, and CSC 751.

Classes that are typically offered in the spring semester of even numbered years, for example spring 2004, include CSC 431, CSC 441, CSC 631, CSC 752, and CSC 761.

# ELECTRICAL ENGINEERING



## CONTACT INFORMATION

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## FACULTY

William J. Hoffert Professor Simonson, Chair through fall 2002; Professor Hasan, Chair beginning spring 2003; Steven P. Miller Endowed Chair and Professor Whites; Professors Batchelder, Chamberlain, and Meiners; Associate Professor Premkumar; Assistant Professors Hemmelman and Montoya; Instructor 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 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 lifetime learning.

**MISSION**

The mission of the Electrical Engineering Program, in support of the mission of the South Dakota School of Mines and Technology, 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 lifetime learning.

**OBJECTIVES**

The educational objectives of the Electrical Engineering program are to provide each graduate with:

1. Foundation of Fundamentals. Students will obtain a strong foundation in the mathematical and basic sciences.
2. Problem Analysis. Students will develop skills for analyzing problems important to Electrical Engineering.
3. Problem Design. Students will develop skills to solve closed-ended and open-ended problems important to Electrical Engineering.
4. Communication Skills. Students will obtain an ability to communicate effectively, both in writing and in speaking.
5. Multidiscipline Teams. Students will obtain an ability to function effectively within multidisciplinary teams.
6. Professional Responsibility. Students will obtain a solid understanding of professional ethics, integrity, and professional etiquette.
7. Leadership. Students will be involved in a variety of leadership experiences.
8. Diversity. Students will be required to work with students and faculty who have different backgrounds and different opinions.
9. Breadth of Knowledge. Students will obtain an appreciation for disciplines other than Electrical Engineering.
10. Social Responsibility. Students will be exposed to non-technical issues that impact technological choices in a global and

societal context.

11. Life-Long Learning. Students will experience an academic environment that encourages and facilitates continuous learning.
12. Local Community. Students will be exposed to engineering decisions that have affected and will affect the Rapid City community.

**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 Electronic 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; and
- Senior capstone experience.

### 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. A graduating senior with high scholarship can finish a master's degree in electrical engineering with about one additional full year of work at 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 supervised until 10 p.m. on 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 and 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 211, EE 212, EE 464, and EE 465.

Classes that are typically offered every fall semester include EE 311, EE 321, EE 381, EE 421, EE 431, and EE 461.

Classes that are typically offered every spring semester include EE 301, EE 312, EE 322, EE 330, EE 362, EE 451, EE 382, and EE 481.

Classes that are typically offered in the fall semester of even numbered years, for example fall 2002, include EE 482.

Classes that are typically offered in the fall semester of odd numbered years, for example fall 2003, 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
GE 115	Professionalism/Engr & Sci	2
Humanities or Social Sciences Elective(s)		3
PE	Physical Education <sup>1</sup>	1
<b>TOTAL</b>		<b>17</b>

##### **Second Semester**

MATH 125	Calculus II	4
PHYS 211	University Physics I	3
PE	Physical Education <sup>1</sup>	1
CSC 150	Computer Science I	3
CENG 244	Intro to Digital Systems	4
Humanities or Social Sciences Elective(s)		3
<b>TOTAL</b>		<b>18</b>

## SOPHOMORE YEAR

## First Semester

EE 211	Intro to Electrical Engr 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
<b>TOTAL</b>		<b>15</b>

## Second Semester

ENGL 279	Technical Communications I	3
EE 212	Intro to Electrical Engr II	4
EM 219	Statics and Dynamics	4
EE 351	Mechatronics and Measurement Systems	4
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>18</b>

## JUNIOR YEAR

## First Semester

ENGL 289	Tech Communications II	3
EE 311	Systems	3.5
EE 321	Electronics I	4
EE 381	Electric and Magnetic Fields	3
MATH 225	Calculus III	4
<b>TOTAL</b>		<b>17.5</b>

## 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 <sup>2</sup>	3
<b>TOTAL</b>		<b>17.5</b>

## SENIOR YEAR

## First Semester

IENG 301	Basic Engr Economics	2
PHYS 341	Thermodynamics	3
EE 464	Electrical Engr Design I	2
EE	Electrical Engr Elective <sup>3</sup>	4
EE	Electrical Engr Elective <sup>3</sup>	4
	Free Elective <sup>4</sup>	3
<b>TOTAL</b>		<b>18</b>

## Second Semester

EE 382	Applied Electromagnetics	3
EE 465	Electrical Engr Design II	2
EE	Electrical Engr Elective <sup>3</sup>	3
	Technical Elective <sup>5</sup>	3
	Humanities or Social Sciences Elective(s)	4
<b>TOTAL</b>		<b>15</b>

## 136 credits required for graduation

## Curriculum Notes

<sup>1</sup> 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.

<sup>2</sup> MATH 315, 373, and 441/442 are approved electives.

<sup>3</sup> Total design content of electrical engineering electives must be a minimum of six (6) hours. CENG 342, 420, 442, 444, 446, 447, and 448 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. (A maximum of six (6) co-op credits may be used for the EE degree.)

<sup>4</sup> 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.

<sup>5</sup> 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.



# INDUSTRIAL ENGINEERING



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## FACULTY

Ervin Pietz Professor Kellogg, Program Director; Associate Professors Kerk and Matejeik.

## 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.

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.

The expectations of graduating engineers in industrial engineering are encompassed in program objectives. Students graduating in Industrial Engineering will be able to:

- solve problems using math, science, optimization methods, probability and statistics, and simulation.
- design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and environments.
- understand and apply current management techniques by integrating the various business and engineering functions.
- work effectively on teams including multi-disciplinary teams.
- communicate effectively with a broad spectrum of technical and non-technical audiences.
- continue to develop the personal and professional skills necessary to adapt to our changing societal, technological, and global environments.

Students may participate in the Cooperative Education Internship Program. The Coop 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. 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 <sup>1</sup>	1
ENGL 101	Composition I	3
CHEM 112L	General Chemistry I Lab	1
GE 115	Professionalism/Engr and Sci	2
<b>TOTAL</b>		<b>17</b>

#### Second Semester

MATH 125	Calculus II	4
PHYS 211	University Physics I	3
PE	Physical Education <sup>1</sup>	1
GE 117	Professionalism/Engr & Sci II	2
PYSC 101	General Psychology	3
	Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>		<b>16</b>

### SOPHOMORE YEAR

#### First Semester

EM 219	Engineering Mechanics	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
<b>TOTAL</b>		<b>18</b>

#### 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
<b>TOTAL</b>		<b>19</b>

### JUNIOR YEAR

#### First Semester

ENGL 289	Technical Communications II	3
IENG 311	Work Methods and Measurement	3
IENG 485	Statistical Quality and Process Control	3
IENG 345	Entrepreneurship	4
IENG 362	Stochastic Models	3
	Humanities or Social Sciences Elective(s)	2
<b>TOTAL</b>		<b>18</b>

**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
<b>TOTAL</b>		<b>16</b>

**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
ME 262	Product Development	4
Department Elective		2
<b>TOTAL</b>		<b>18</b>

**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
<b>TOTAL</b>		<b>14</b>

**136 credits required for graduation****Curriculum Notes**

<sup>1</sup> 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. Three (3) hours of Humanities and three (3) hours of Social Science must be completed within the first thirty-two (32) hours of study. At least six (6) hours of Humanities and six (6) hours of Social Science must be completed within the first sixty-four (64) hours of study. Humanities

and Social Science electives must satisfy the general education requirements.

4. At least three (3) hours of Humanities or Social Science must be at the 300 or 400 level.
5. Thirty-two (32) semester hours in Mathematics or Science. At least three (3) hours of each must be completed in the first thirty-two (32) hours of study. At least six (6) hours of each must be completed within the first sixty-four (64) hours of study.
6. ENGL 101 must be completed within the first thirty-two (32) hours of study. ENGL 279 must be completed within the first sixty-four (64) hours of study.

# MATHEMATICS



## CONTACT INFORMATION

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## FACULTY

Professor Logar, Chair; Professors Carda, Corwin, Opp, and Teets; Associate Professors Burgoyne and Johnson; Assistant Professors Dahl, McGough, and Riley; Instructors Geary, Johnson, and Trimble.

## 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 is a new degree program that 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, enrolled in all corequisites, passed the appropriate placement examinations, or have obtained permission from the Chair of the Mathematics and Computer Science Department. The

prerequisite for MATH 120 is a grade of “C-” or better in MATH 102 or MATH 115, or an acceptable ACT score and Algebra Placement Examination score, or equivalent transfer credit from an accredited college or university. The prerequisite for MATH 123 is a grade of “C-” or better in MATH 102 or in Math 115, or an acceptable ACT score and Algebra Placement Examination score, or equivalent transfer credit from an accredited college or university. Additionally, students enrolling in MATH 123 must have passed MATH 120 with a grade of “C-” or better, or have an acceptable score on the Trigonometry portion of the COMPASS exam and 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. Placement examinations are given immediately prior to registration.

Students transferring from other institutions or returning to the South Dakota School of Mines and Technology 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 degree at SDSM&T. 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 policy 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 on demand and staff. Summer offerings are highly dependent on

staffing. An attempt will be made to offer MATH 021, MATH 102, MATH 120, MATH 123, MATH 125, MATH 225, MATH 321, and MATH 381 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 485.

Classes that are typically offered every spring semester include MATH 315, MATH 382, MATH 441, and MATH 442.

Classes that are typically offered in the fall semester of even numbered years, for example fall 2002, include MATH 413 and MATH 431.

Classes that are typically offered in the spring semester of odd numbered years, for example spring 2003, include MATH 241, MATH 421, and MATH 471.

Classes that are typically offered in the fall semester of odd numbered years, for example fall 2003, include MATH 432 and MATH 423.

Classes that are typically offered in the spring semester of even numbered years, for example spring 2004, include MATH 424, MATH 451, and MATH 687.

#### **MATHEMATICS MAJOR**

Students majoring in Mathematics will use the accompanying Applied Mathematics curriculum. The curriculum includes 57 credits of mathematics courses, 11 credits of computer science, ten credits of sciences, and at least nine credits of additional science/engineering courses that fall in a specific field (see emphasis below). Any Mathematics 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. 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 241, MATH 353, MATH 381, MATH 382, MATH 471, MATH

687, and IENG 362. 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 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. The emphasis area is designed to accomplish this goal. The student will take three courses in an external discipline that will provide exposure and depth in an application area of mathematics. Emphasis areas and the associated courses are available from the department or advisor. Our graduates must be prepared to continue learning throughout their careers. In the two-course sequence of MATH 400 and MATH 402, students will have the opportunity to work with individual faculty members on research and develop their communication skills. The fruits of their labor 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.

A 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.

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 twelve (12) credit hours of mathematics electives at the 200 level or higher (excluding MATH 281), for a total of at least twenty-eight (28) semester credit hours. 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. Academic and Enrollment Services has forms that should 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 Mathematics Curriculum;
2. take three emphasis area courses (emphasis areas and supporting courses 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.)

## 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.

### 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 <sup>1</sup>		3
<b>TOTAL</b>		<b>17</b>

#### 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 <sup>1</sup>		5
<b>TOTAL</b>		<b>17</b>

### 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 <sup>1</sup>		3
<b>TOTAL</b>		<b>17</b>

#### 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 <sup>1</sup>		3
<b>TOTAL</b>		<b>17</b>

### JUNIOR YEAR

#### First Semester

MATH 413	Abstract Algebra	3
MATH 381	Probability and Statistics	3
MATH 431	Dynamical Systems	3
Elective <sup>1</sup> /Emphasis <sup>2</sup>		6
<b>TOTAL</b>		<b>15</b>

### Second Semester

MATH 382	Probability and Statistics II	3
MATH 471	Numerical Analysis	3
MATH 421	Complex Analysis	3
Elective <sup>1</sup> /Emphasis <sup>2</sup>		6
<b>TOTAL</b>		<b>15</b>

### SENIOR YEAR

#### First Semester

MATH 423	Advanced Calculus I	4
MATH 432	Partial Differential Equations	3
MATH 400	Undergraduate Research I	1
Elective <sup>1</sup> /Emphasis <sup>2</sup>		7
<b>TOTAL</b>		<b>15</b>

#### Second Semester

MATH 424	Advanced Calculus II	4
MATH 451	Math Modeling	3
MATH 402	Undergraduate Research II	1
Elective <sup>1</sup> /Emphasis <sup>2</sup>		7
<b>TOTAL</b>		<b>15</b>

### 128 credits required for graduation

#### Curriculum Notes

<sup>1</sup> 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.

<sup>2</sup> The student must complete three courses from a science or engineering emphasis area. Emphasis areas and the associated courses will be available from the department.

# MECHANICAL ENGINEERING



## CONTACT INFORMATION

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## FACULTY

Professor Kjerengtroen, Chair; Professors Dolan, Jenkins, Krause, and Langerman; Associate Professors Buck, Kalanovic, and Muci-Kuchler.

## 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 and controls, mechanical systems and design, and thermal science and energy. Beyond this basic foundation, the curriculum also develops:

1. The various aspects of engineering design including all aspects of 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/Controls, e.g., design, development, and manufacture of diverse equipment and processes;
2. Mechanical Systems/Design, e.g., structures, vibrations, and machine design; 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 to build 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

**Objective (4)** Assume leadership roles by:

#### **Outcomes**

- Appreciating the importance of the business environment

- Understanding and applying issues in planning and time management.
- Understanding and applying the elements of engineering design
- Recognizing the relationship between research, design, development, and manufacturing

**Objective (5)** Practice life long learning

by:

#### **Outcomes**

- Recognizing the importance of remaining current within your profession
- Recognizing the relationship between the individual and his/her professional organizations
- Understanding citizenship and the need to be involved in community outreach activities

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 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 (see details in the graduate section of this catalog). A fast-track Master of Science degree is available, wherein undergraduates may take graduate courses for eventual graduate school credit.

The Mechanical Engineering Department does not offer a minor.

### **MECHANICAL ENGINEERING LABORATORIES**

There are five undergraduate laboratories in the Department. These laboratories are: materials testing, mechanical systems and instrumentation, thermal and fluid systems, integrated manufacturing/controls and 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<sup>1</sup>**

<b>First Semester</b>		
MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
CHEM 112L	General Chemistry I Lab	1
GE 115	Professionalism/Engr and Sci	2
ENGL 101	Composition I	3
PE	Physical Education <sup>2</sup>	1
Humanities or Social Sciences Elective(s)		3
<b>TOTAL</b>		<b>17</b>

**Second Semester**

MATH 125	Calculus II	4
PHYS 211	University Physics I	3
GE 117	Professionalism/Engr & Sci II	2
PE	Physical Education <sup>2</sup>	1
Humanities or Social Sciences Elective(s)		6
<b>TOTAL</b>		<b>16</b>

**SOPHOMORE YEAR**

<b>First Semester</b>		
EM 214	Engr Mechanics (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
<b>TOTAL</b>		<b>17</b>

**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 216	Mechanics of Materials	3
<b>TOTAL</b>		<b>17</b>

**JUNIOR YEAR**

**First Semester**

MATH 225	Calculus III	4
ENGL 289	Technical Communications II	3
ME 316	Solid Mechanics	3
EE 211	Intro to Electrical Engr I	4
CSC 150	Computer Science I	3
<b>TOTAL</b>		<b>17</b>

**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
<b>TOTAL</b>		<b>19</b>

**SENIOR YEAR<sup>3</sup>**

**First Semester**

ME 331	Thermo Fluid Dynamics	3
ME 464	Mechanical Engr Design I	2
IENG 302	Engineering Economics	3
MATH 381	Probability/Statistics	3
ME 4XX	Mechanical Engr Elective #1	3
ME 4XX	Mechanical Engr Elective #2	3
<b>TOTAL</b>		<b>17</b>

**Second Semester**

ME 311	Engr Thermodynamics	3
ME 465	Mechanical Engr Design II	2
ME 4XX	Mech Engr Elective #3 (+lab)	4
ME 4XX	Mechanical Engr Elective #4	3
Humanities or Social Sciences Elective(s)		4
<b>TOTAL</b>		<b>16</b>

**136 credits required for graduation**

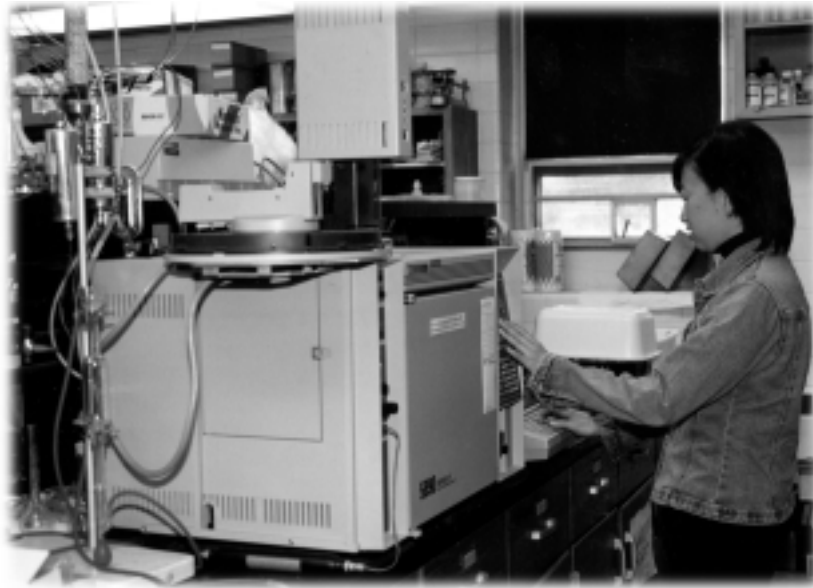
**Curriculum Notes**

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> Total design content of senior year mechanical engineering electives must be a minimum of four (4) hours.

# ENVIRONMENTAL ENGINEERING



## CONTACT INFORMATION

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## STEERING COMMITTEE

Professor Mott, Program Coordinator and  
Steering Committee Chair; Professors Davis,  
Kellar, Kliche, and Winter.

## 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. ENVE 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 opt for an emphasis consisting of five to six required and elective courses and 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. 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.

Graduates of this program are expected to be able to:

1. Apply mathematical, scientific, and engineering principles in conjunction with humanities and social sciences in definition and solution of existing or potential environmental problems.
2. Think critically in the iterative decision-making processes associated with engineering design.
3. Work and learn, on a lifelong basis, both independently and cooperatively with peers.
4. Communicate their work and ideas effectively, both orally and in written form, to their peers and at all societal levels.

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 specialty, 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 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
GE 115	Professionalism/Engr and Sci Humanities or Social Sciences Elective(s)	3
PE	Physical Education <sup>8</sup>	1
<b>TOTAL</b>		<b>17</b>

##### Second Semester

CHEM 114	General Chemistry II	3
CHEM 114L	General Chemistry II Lab	1
GE 117	Professionalism/Engr & Sci II	2
MATH 125	Calculus II	4
PHYS 211	University Physics I	3

Humanities or Social Sciences Elective(s)	3
PE Physical Education <sup>8</sup>	1
<b>TOTAL</b>	<b>17</b>

**SOPHOMORE YEAR****First Semester**

ENVE 217 Chemical Engineering I	3
MATH 225 Calculus III	4
CHEM 230 Analytical Chem for Engrs	2
ENGL 279 Technical Communications I	3
Engineering Mechanics <sup>1</sup>	4
Humanities or Social Sciences Elective(s)	3
<b>TOTAL</b>	<b>19</b>

**Second Semester**

PHYS 213 University Physics II	3
GEOE 221 Geology for Engineers	3
BIOL 231 General Microbiology	3
MATH 321 Differential Equations	4
Humanities or Social Sciences Elective(s)	3
Laboratory elective <sup>7</sup>	1
<b>TOTAL</b>	<b>17</b>

**JUNIOR YEAR****First Semester**

ENGL 289 Technical Communications II	3
CHEM 316 Fund of Organic Chem	3
ENVE 317 Chemical Engineering III <sup>2</sup>	3
ENVE 320 Metallurg Thermodynamics <sup>3</sup>	4
ENVE 326 Envr Engr Process Fundament <sup>3</sup>	3
EM 328 Applied Fluid Mechanics <sup>4</sup>	3
<b>TOTAL</b>	<b>19</b>

**Second Semester**

IENG 301 Basic Engineering Economics	2
ENVE 318 Chemical Engineering IV <sup>2</sup>	3
ENVE 337 Engineering Hydrology	3
MATH 373 Intro to Numerical Analysis <sup>6</sup>	3
MATH 441 Engineering Statistics I	2
Specialty elective <sup>5</sup>	3
<b>TOTAL</b>	<b>16</b>

**SENIOR YEAR****First Semester**

ATM 301 Intro to Atmospheric Sciences	3
ENVE 423 Environ Systems Analysis	3
ENVE 475 Ground Water	3
ENVE 464 Envr Engr Design I	2
Specialty electives <sup>5</sup>	6
<b>TOTAL</b>	<b>17</b>

**Second Semester**

ENVE 465 Envr Engr Design II	2
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Specialty Electives <sup>5</sup>	8
Humanities or Social Sciences Elective(s)	4
<b>TOTAL</b>	<b>14</b>

**136 credits are required for graduation****Curriculum Notes**

<sup>1</sup> EM 217 or EM 219, or a combination of EM 214/216, EM 214/215, or EM 214/ME 221 will satisfy the engineering mechanics requirements.

<sup>2</sup> MET 422 will satisfy the requirements for transport phenomena.

<sup>3</sup> CHE 222 and CHE 321 will satisfy the thermodynamics requirement.

<sup>4</sup> CHE 218, EM 223, or ME 331 will also satisfy fluid mechanics requirements.

<sup>5</sup> Each student must select preparatory and upper division specialty course work totaling seventeen (17) credits.

<sup>6</sup> CHE 350 and CEE 284 also meet the requirement for a numerical analysis course. Students electing CHE 350 must also select the combination of GE 115 and CHE 117 rather than GE 115/117 to satisfy information technology requirements and the prerequisite for CHE 350.

<sup>7</sup> PHYS 213L, BIOL 231L, or CHEM 332L will satisfy this requirement.

<sup>8</sup> 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.

**ENVIRONMENTAL ENGINEERING EMPHASIS AREAS****Chemical Engineering****Required course work**

Sub CHE 222 & ChE 321 for ENVE 320	2
BIOL 232 General Microbiology Lab <i>and</i>	
CHEM 332L Analytical Chemistry I Lab <sup>1</sup>	1
ENVE 455 Pollution/Phenomena/Process Design	3
CHEM 480 Toxicology	3
CHEM 482 Environmental Chemistry	3
CHE 492 Special Topics in Chem Engr	1
<b><u>A minimum of three (3) credits from the following:</u></b>	
BIOL 311 Principles of Ecology	3
BIOL 401 Global Envr Change	3
BIOL 431 Industrial Microbiology	3

BIOL 431L	Industrial Microbiology Lab	1	ENVE 310	Aqueous Extrac/Conc/Recy	3
BIOL 491	Biological Problems	1-4	ENVE 310L	Aq Extrac/Conc/Recy Lab	1
BIOL 492	Special Topics	1-3	ENVE 433	Comp App in Geosci Mod	4
ENVE 427	Env Engr Remed Process	3	ENVE 440	Env/Recl Prac in Min Ind	3
CHE 400	Undergraduate Research	1-6			
CHE 417	Chemical Engineering V	2			
CHE 434	Des of Separation Processes	2			
CHE 443	Chem Kinetics/Reactor Dsgn	3			
CHE 492	Special Topics in Chem Engr	1-3			
CHE 491	Indep Studies in Chem Engr	1-3			
CHEM 330	Environmental Science	3			
CHEM 340	Fund of Physical Chem	3			
CHEM 400	Undergraduate Research	1-3			
CHEM 434	Instrumental Analysis	3			
CHEM 434L	Instrumental Analysis Lab	2			
CHEM 492	Special Topics in Chemistry	1-3			
CHEM 491	Indep Study in Chemistry	1-3			
GEOE 466	Engr and Env Geology	3			
ENVE 220	Mineral Processing and Resource Recovery	4			
ENVE 440	Environmental and Reclamation Practices in Mining Industry	3			

<sup>1</sup> The combination of these two courses also satisfies the laboratory elective requirement.

### Civil Engineering

#### Required course work

ENVE 327	Water and Waste Water Treatment	3
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 three (3) 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 400	Undergraduate Research	var.
ENVE 455	Pollution Phenom/Process	3
ENVE 491	Indep Studies in Envr Engr	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

### Geological Engineering

Seventeen (17) credits from the following:

GEOE 322	Structural Geology	3
GEOE 324	Engineering Geophysics	3
GEOE 410	Engineering Field Geology	6
GEOE 466	Engr and Env Geology	3
GEOE 482	Applied Geomorphology	3
CEE 437	Watershed/Floodplain Mod	3

### Materials and Metallurgical Engineering

Required course work

sub. MET 422 for ENVE 317 & ENVE 318 <sup>1</sup>	2	
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

A minimum of four (4) credits from the following:

MET 232	Properties of Materials	3
MET 231	Properties of Materials Lab	1
MET 454	Aqueous Mat Processing	3
ENVE 427	Env Engr Biol Process Design	3
ENVE 455	Pollution/Phenomena/Process Design	3
CHEM 480	Toxicology	3
CHEM 482	Envr Chemistry	3
ENVE 440	Environmental and Reclamation Practices in the Mining Ind	3
GEOE 466	Engr and Env Geology	3

<sup>1</sup> CHE 317 and CHE 318 (six (6) credits total) are the typical required courses. For the Materials and Metallurgical Engr. Specialty substitute MET 422 (four (4) credits) for these two courses which increases the required number of specialty credits to nineteen (19).

### Mining Engineering

ENVE 201	Intro to Mining and Expl	3
ENVE 302	Surface Mining	3
ENVE 441	Economics of Mining	3
ENVE 433	Comp App in Geosc Mod	4
ENVE 440	Environmental and Reclamation Practices in the Mining Ind	3
Electives		1

This section of the catalog contains information that you, as a new, continuing, or prospective graduate student will use to make important decisions about your ongoing education and future. A quick perusal of this section will introduce you to the breadth of our graduate programs in engineering, science, and technology. A more in-depth examination will help you select the area or areas of interest that will best meet your personal, professional, and educational needs. Please do not hesitate to ask for additional information at the Graduate Office or at the appropriate college or department.

Distinguishing between graduate schools is not an easy task because many U.S. universities have the facilities and faculties for quality graduate education and state-of-the-art research. So what do we believe sets the South Dakota School of Mines and Technology apart? First, our emphasis is on the individual graduate student, beginning with the proper match among interests, programs, and faculty advisors and continuing with a sustained commitment for the student's development as a scholar, researcher, and practitioner. Second, our smaller size guarantees access to distinguished faculty, classes, equipment, and resources. Here, you will study and work side-by-side with respected teachers and researchers as new questions are generated and novel solutions are produced. Graduate students at SDSM&T are more than spectators of this overall education and research process, they participate in it! Third, our graduate programs provide options that allow graduate students to gain a wider variety of experiences and skills. For example, students are encouraged to participate in interdisciplinary research that can improve their ability to work effectively in team-based projects, to pursue off-campus internship programs with industry and government, to take additional courses to enhance their communication and computer skills, etc. This educational breadth, which is possible to obtain in all of our graduate programs, can contribute to superior employment and career opportunities upon graduation. Fourth, the amount of financial support, which is available for graduate student stipends, continues on an upward trend due to significant increases both in the numbers and awarded amounts of externally-funded grants and contracts obtained by SDSM&T faculty. Thus, a combination of GRA's, GTA's, fellowships, and scholarships provide abundant funding for SDSM&T graduate students. Fifth, recent acquisitions of modern equipment and major research instrumentation throughout the campus have further improved our infrastructure and our competitiveness. The availability of these new tools contributes to our ability to pursue advanced investigations in emergent areas such as biocomplexity, nano science and technology, advanced materials development and processing, etc. Sixth, our tradition of training future engineers and scientists for employment by the private sector, in addition to academe, the government, and entrepreneurship, is congruent with employment trends. That is, most of the long-term growth in future employment demand for M.S. and Ph.D. graduate engineers and scientists will probably occur in industry, business, and new technology-based companies. A graduate degree from SDSM&T will allow you to benefit from this global trend.

Our strengths at SDSM&T lie not only in the opportunities and graduate programs described in this catalog, but also in our underlying commitment to excellence in education, research, and service. Whereas we strive to readily adapt to the demands associated with the increasing rate of changes in technology, society, and the world; our tradition of excellence will remain intact as SDSM&T continues to grow and evolve.

Your decision to pursue graduate education is commendable and we look forward to helping you meet your educational goals.

Sincerely,

*Sherry O. Farwell*

Dr. Sherry O. Farwell  
Dean, Graduate Education and Research

## 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 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 on January 19, 1967, to the Departments of Electrical Engineering and Geology and Geological Engineering. In June 1983, the Board of Regents authorized the doctorate in Materials Engineering and Science and terminated the Electrical Engineering doctoral program. 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.

The Graduate Office was organized formally in 1950-51. The policies of the Graduate Office are formulated with the assistance of the Graduate Education and Research Council, 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 Graduate Dean. The Graduate Education and Research Council consists of one faculty representative from each college, the dean of each college, two members appointed by the Faculty Advisory Council, and the Graduate Dean 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, Environmental, and Water Resources<sup>1</sup>
- Materials Engineering and Science (multi-disciplinary)
- Geology/Geological Engineering

<sup>1</sup> Cooperative program with South Dakota State University

## 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 request an application form from the Graduate Office. 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 Education Office. Application materials of domestic applicants should be received at least two months before the beginning of the semester for which the student desires admission. International applicants must submit all of their materials at least four months before the beginning of the semester (see application form for target dates). Applicant files will not be reviewed for possible admission until the \$35 application fee has been paid.

Three letters of recommendation are required. These should be submitted, upon request of the applicant, by three persons



familiar with the scholastic ability and interests of the applicant. However, applications from students at or graduated from the South Dakota School of Mines and Technology need only to include the names of two faculty members familiar with the applicant's academic performance.

If the applicant has not completed an undergraduate program, a list of the remaining requirements should accompany the application; evidence of graduation should be submitted as soon as available. Students who fail to complete all Bachelor's degree requirements by the end of their first semester as a graduate student will be suspended from their graduate program until these requirements are complete.

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 weak 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 Graduate Dean 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). 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 may 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 Graduate Dean 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 \$106.50 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 SDSM&T. 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 SDSM&T.

#### **FULL-TIME/HALF-TIME DEFINED**

##### **Full-time Graduate Student is Defined as:**

A student registered for nine or more credit hours per semester during the academic year, or six or more credit hours during the summer session, or a student having completed 75 percent or more of the minimum course work applicable to the degree and carrying a minimum of two credits during any semester or summer session. This definition should not be confused with eligibility for reduced tuition.

##### **Half-time Graduate Student is Defined as:**

A student registered for five to eight credit hours per semester during the academic year, or three to five 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. Students in the Technology Management program (MS-TM) may count credit hours attempted in University of South Dakota courses toward the determination of full-time status at any time; however, tuition remission is not applicable for courses attempted at the University of South Dakota.

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**

The 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 usually the availability of funds.

The Graduate Dean 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. Any student with a cumulative GPA less than 3.0 is usually not eligible for such financial assistance.

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 Graduate Dean. They must also be registered for nine credit hours (six in summer) in order to be eligible for reduced tuition. Refer to the preceding section on “Tuition and Fees” for additional information on reduced tuition.

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 \$13.23 per hour for Master's degree candidates and \$14.16 per hour for Ph.D. students. A conventional full-time GRA/GTA (20 hours per week) for an M.S. degree pays \$8,732 per academic year and \$2,293 per month in the summer (40 hours per week) for a total of approximately \$16,758 per calendar year. A conventional full-time GRA/GTA (20 hours per week) for a Ph.D. degree pays \$9,346 per academic year and \$2,454 per month in the summer (40 hours per week) for a total of approximately \$17,936 per calendar year.

If funds are available, extra support can also be provided during the Christmas break. A full-time GTA or GRA is expected to devote a minimum of 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. A student who is awarded an assistantship for the summer period is required to enroll for a minimum of two credits during the summer period; up to eight 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 industry 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 and a "Graduate Admissions Application" form (no supporting documents or application fee required).
2. Complete the forms and obtain appropriate signatures at his/her current department/program.
3. Return both forms to the Graduate Office.

Upon favorable recommendation from the relevant departments/programs, the Graduate Dean will 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 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 graduate advisor 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 Graduate Dean 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 Graduate Dean, then the major advisor 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 semesters of the dual program will be considered probationary. The second program of study can be terminated based on recommendations of the Ph.D. advisor and/or M.S. advisor to the Graduate Dean.

#### 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 12 semester credits may be accumulated, after which the student must apply for admission as a degree-seeking student or must petition the Graduate Dean for a variance from this policy.

#### REGISTRATION

A graduate student will report to the person or office specified in the admission letter and thereafter will follow the registration procedure for all SDSM&T students. The graduate 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 Graduate Dean 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 credits. Registration for two 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

subsequent semester or summer in order to graduate.

#### **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 their program of study by completing and submitting a "Request for Leave of Absence" form that is available in the Graduate Office. The form must be completed and signed by the student, the student's faculty advisor, department chair, or program coordinator, and then submitted to the Graduate Office. The Graduate Dean 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 calendar year.

#### **ACADEMIC LOADS**

Fifteen credit hours per semester is considered to be the normal maximum graduate load. Higher loads must be approved by the Graduate Dean and may be permitted if the student is taking a combination of courses at the graduate and undergraduate level.

A student holding a full assistantship may not average more than 11 hours of course work per semester but may take up to 12 credit hours during any one semester to facilitate scheduling. A student holding a research assistantship may register, in addition, for up to four hours of research credit at the discretion of his/her major professor. A student with a half-time assistantship is limited to a maximum of 13 credit hours of course work and an additional two hours of research credit per semester. The academic load of a student holding an appointment for less than half time, or those with outside jobs, is at the discretion of the student's graduate advisor or major professor.

An appeal by a student for any variance from the above policies on credit-hour limits must be submitted, through the student's graduate advisor or advisory committee, to the

Graduate Dean. The Graduate Dean will rule upon the request for variance after consultation with the chair/coordinator of the student's major department/program.

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 taken as an undergraduate student. A graduate student may apply up to 12 semester hours of graduate credits earned as an undergraduate at SDSM&T toward the fulfillment of advanced-degree requirements under the following conditions:
  - a. The courses for which the credits were earned must have been petitioned and approved for graduate credit when the student was an undergraduate or as provided below. The petition must be filed with the Graduate Education Office.
  - b. The courses must be approved both by the student's advisory committee and the Graduate Dean to be credited toward the advanced degree as reflected in the student's program of study.
2. Credits petitioned for a graduate program. The Graduate Dean may approve a petition for graduate credit from an SDSM&T graduate student under the following conditions:
  - a. The student must have filed a petition for graduate credit in accordance with the provisions set forth in another section entitled "Graduate Credit," number "5" under "General."
  - b. The courses for which graduate credit is petitioned must be approved by the student's advisory committee to be credited toward the advanced degree as reflected in the student's program of study.
  - c. The petition must be filed with and signed by the Graduate Dean and signed by the head of the student's B.S. degree granting department certifying that the credit is not applied to an undergraduate

degree.

- d. Any 300 or 400 level course petitioned by a graduate student for graduate credit must be in conformance with the Graduate School restrictions on the use of undergraduate courses for advanced degrees at SDSM&T.

Upon written justification by the chair/coordinator of the graduate student's major department/program, the Graduate Dean may approve a minor variance from the 12 credit hour limit.

Petition forms for graduate credits earned as an undergraduate are available at the Graduate Office in MI-235.

#### **WORK TAKEN AT ANOTHER INSTITUTION**

Credit for up to 12 semester hours of graduate-caliber course work taken at another institution may be transferred toward the requirements for the Master's degree at SDSM&T. Such credit must be reviewed and approved by the student's committee and by the Graduate Dean. Up to one-half of the minimum course work requirements for a Ph.D. degree may be transferred under the same procedure and restrictions.

The Graduate Dean 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 another institution may be used to reduce graduation requirements but will not affect the cumulative GPA earned at SDSM&T.

#### **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

SDSM&T 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 an "S" grade.
5. The student who fails any course must repeat the course with a passing grade. The student may petition, through his/her graduate advisor or advisory committee, the Graduate Dean 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 graduate advisor or advisory committee, progress in these courses is unsatisfactory, additional work may be required.
7. Of credits counted for an advanced degree, not more than 50 percent 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. Only courses listed in the graduate student's Program of Study will be included in the grade-point average that is calculated by the Graduate Office. Hence, this latter GPA calculation may not agree with the cumulative grade-point average on the official 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, or converted to, either “U” for Unsatisfactory or “S” for Satisfactory. See Section entitled “Grading System” under General Information (in another section of this catalog) for interim grade options. These grades will not be used in the computation of 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.

#### **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.

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 Graduate Dean. 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 and/or canceling the student’s eligibility for assistantships and fellowships. 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 (items 1-3 below) will continue each semester until (a) the course(s) has been retaken and an acceptable grade(s) has been received or (b) the course(s) has been replaced with another course(s) of equivalent credit and acceptable grade as approved by the student’s graduate advisory committee, and documented in a revised program of study submitted to the Graduate

Office.

A student will be placed on probation for a “U” or “UP” grade received for research credit(s). Probation will be maintained until a “UP” is changed to “SP” or “S.” Since a “U” is a final grade, probation will be maintained until at least one subsequent “S” or “SP” 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” or “UP” 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 for reconsideration of a termination decision. (Refer to section on “Appeal Procedure.”)

Removal from probation is contingent upon meeting the following academic requirements:

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 SDSM&T. Thesis and dissertation research credit hours and grades will not be counted in the determination of this grade-point ratio.
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-”

- (2.66) 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 "SP."
  5. A student must earn no less than a "B-" (2.66) in any 100 and 200 level courses taken for grade credit.
  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 advisory committee; and filing of a satisfactory program of work 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, which 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 graduate advisor or advisory 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 for the thesis option and nine 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 advisory committee, but must still be approved by the Graduate Dean.

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.

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 advisory committee. If the student is not satisfied with the decision on the appeal, the student may petition the Graduate Education and Research Council for reconsideration. Such petition must be filed with the Graduate Dean.

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 Graduate Dean 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 Graduate Dean must certify that the candidate has fulfilled all degree requirements including the submission of a "check-out" form with appropriate signatures. 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. 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 30 credit hours including six to nine 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 32 credit hours. Candidates for the non-thesis option may not use thesis research credits for the fulfillment of credit-hour requirements for the Master's degree.

### **M.S. DEGREE REQUIREMENTS**

The M.S. degree minimum requirements for the thesis option are:

1. A program of at least 30 credit hours of course work and research.
2. At least 15 credit hours of graduate course work (500 level courses and above).
3. At least six credit hours of thesis research. (No more than nine credit hours of thesis research will count toward degree.)
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 32 credit hours of course work (refer to specific program requirements for exact number of minimum course work credit hours).
2. At least 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<sup>1</sup>:

1. For the thesis option, the number of undergraduate credits that may be used for the degree is limited to six 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 Graduate Dean upon written justification 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 Technology Management for limitations in that program.
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 Graduate Dean for his or her review and potential approval.

<sup>1</sup> 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, Environmental, and Water Resources.

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 for the Master's degree. 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. 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 student's advisory committee.

#### **DUAL MAJORS**

The 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 Graduate Education and Research Council through his/her advisory committee for a variance from this policy.

#### **SUPERVISION OF THE MASTER'S PROGRAM**

The supervision of the study program of each master's student is initially the responsibility of the graduate advisor, also

known as the major professor. A graduate committee consists of a major professor, a Graduate Office representative, and at least one additional department member. In addition, the department chair or program coordinator is an ex-officio member of the committee unless serving in another capacity.

The major professor is assigned by the chair/coordinator of the student's major department/program with the concurrence of the student and the prospective major professor. The major professor's primary responsibility is the supervision of a student's research and thesis preparation. It remains the graduate advisor's responsibility to ensure that academic standards and credit-hour requirements are satisfied. The major professor in consultation with the student selects the members of the student's committee. The Graduate Office representative must be chosen from outside the major department/program. The major professor is the chairperson of the committee and is responsible for obtaining approval from each prospective member for that person's service on the committee.

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 majority of the student's committee. A written appeal by a student for a change in major professor may be filed with the Graduate Education and Research Council through the Graduate Dean in contested cases. The decision by the Graduate Education and Research Council is final.

#### **PROGRAM OF STUDY**

The student's advisory 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 advisory 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 advisory committee. Before starting to write the thesis, the student is urged to obtain a copy of "Instructions for the Preparation of Theses and Dissertations" from the major department/program or the Graduate Office 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 advisory committee no later than one full week before the time and date of the student's scheduled examination.

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 Graduate Dean before final reproduction. The Dean requires that the final draft of the thesis be left in the Graduate Office for a minimum of 72 hours to allow adequate time for review and potential approval.

The institution requires five copies of the thesis in final form: the original (unbound) manuscript and one bound copy for the Devereaux Library; two 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. The thesis may be required in digital format. Contact the Graduate Office for instructions. In case of a proprietary thesis, the original will be retained without reproduction in secured Graduate Office files throughout the 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.

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 policy shall determine whether non-faculty persons may attend the examination.

The student shall obtain and complete the 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 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 three 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 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 or an approved departmental/program form. Two copies of the form will be filed; one with the department/program and the other with the Graduate Office.

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 advisory committee, normally eight to 12 weeks after the date of the first examination.

Upon successful completion of the examination, the candidate will receive from the Graduate Office representative a "check-out" form. (Refer to a preceding section entitled "Certification for the Degree" for further information regarding the completion and submission of this form.)

#### **TIME LIMITATION**

A Master of Science degree program must be completed within five 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 years prior to the date of anticipated graduation must be reviewed by the student's major department/program and the Graduate Dean for acceptance. Following this review, the student's major department/program and the Graduate Dean 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 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 80 semester credits (90 for the AEWB program) beyond the bachelor's degree.
3. A minimum of 50 semester credit hours of course work (45-60 for the AEWB program<sup>1</sup>) beyond the bachelor's degree. A maximum of 24 semester credits are allowed from appropriate M.S. course work to apply to the Ph.D. credit requirement.
4. A minimum of 20 semester credit hours

(30 for the AEWB program) of appropriate research credits. A maximum of six 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 Graduate Dean.

5. Satisfaction of academic standards as prescribed elsewhere in this catalog.
6. At least two 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.

<sup>1</sup> See AEWB program description for details of course work and research credits in the 90-credit program.

Between three and four 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 12 credits of upper-division undergraduate 400 level courses toward the 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 26-36 credit course work requirement. The chair of the student's major department must petition the Graduate Education and Research Council through the Graduate Dean for use of 300 level credits for Ph.D. programs.

The dissertation will normally represent at least the equivalent of one full academic year of research. The dissertation committee approves the total number of research credits that the candidate may carry, consistent with departmental, continuing registration, and other requirements.

The student's advisory committee can recommend to the Graduate Dean 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 consecutive semesters of residence as a full-time student are required at the 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 months following the successful completion of the comprehensive examination.

#### LANGUAGE REQUIREMENTS

Atmospheric, Environmental, and Water Resources (AEWR): 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 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 dissertation committee, and submitted to the Graduate Office.
  4. Competence in at least two 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.
- A foreign national may satisfy the language requirement by demonstrating competence in

reading, writing, and speaking English provided that, in the opinion of the dissertation 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 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 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 dissertation 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, 12-18 of the 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 12 of the 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 intended major.

#### **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, advisory committee, and course of study.

The study program of each doctoral student is under the supervision of a committee consisting of a major professor, Graduate

Office representative, and at least three 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 majority of the student's committee. The Graduate Office shall be notified promptly of such a change. A written appeal by a student for a change in major professor may be filed with the Graduate Education and Research Council through the Graduate Dean in contested cases. The decision by the Graduate Education and Research Council is final.

The policies that govern membership on, selection of, and the formalization of the dissertation 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 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 advisory committee, shall expand the student's committee to a total of five members by the addition of one or two 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 dissertation committee, that person shall represent the field selected as the candidate's minor. The Graduate Office representative is appointed by the Graduate Dean, upon the recommendation of the major professor and with the concurrence of the department chair/program coordinator.

#### **PROGRAM OF STUDY**

The dissertation 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 dissertation 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. When the program has been approved by the Graduate Dean, a copy will be returned to the student, the major professor, and the major department/program. The student's dissertation 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 dissertation 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 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 36 hours of credit beyond the B.S. degree, 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 dissertation committee, with suggestions from any faculty member from whom the student has taken a graduate course.

The student's dissertation committee schedules and arranges the written and oral examinations and notifies the Graduate Dean. 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 Graduate Dean on the appropriate form supplied by the Graduate Office.

Satisfactory completion of the comprehensive examination requires that no more than one member of the dissertation committee votes against passing. If the student passes with conditions, such as failure to pass a part of the examination, the dissertation committee shall inform him/her promptly as to how and when the conditions may be removed. If, in the opinion of two or more members of the dissertation 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 dissertation committee, the Graduate Dean, and the Graduate Education and Research Council.

The comprehensive examination should be passed at least five 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 dissertation 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 Graduate Dean 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 dissertation 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 Graduate Dean before final reproduction. The Graduate Dean requires that the final draft of the dissertation must be left in the Graduate Office for a maximum of 72 hours to allow adequate time for review and potential approval.

The institution requires four copies of the dissertation in final form: the original, unbound manuscript and one bound copy for the Devereaux Library; and two bound copies for the student's major department/program, one of which will be forwarded to the major professor.

A final draft of the dissertation must be submitted by the candidate to each member of his/her dissertation committee no later than two full weeks before the scheduled dissertation defense.

**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 dissertation 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 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 dissertation committee. If the student fails, another examination can be scheduled only with the approval of the student's dissertation committee and the Graduate Dean.

Upon successful completion of the examination, the candidate will receive from the Graduate Office representative a "check-out" form which must be completed and returned to the Graduate Office before the



candidate will be certified for the degree.  
(Refer to a preceding section entitled  
“Certification for the Degree.”)

### **TIME LIMITATION**

If the requirements for the Doctor of Philosophy degree are not completed within a 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 and the Graduate Dean 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.



*TECHFact: The women’s basketball team reached the NAIA Final Four in the 1998 and 1999 tournaments.*

## ATMOSPHERIC SCIENCES



### CONTACT INFORMATION

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### FACULTY

Professor Zimmerman, Chair; Dean Farwell;  
 Professors Detwiler, Helsdon, and Hjelmfelt;  
 Assistant Professors Baker, Capehart, Peng,  
 and L. Vierling.

### ATMOSPHERIC SCIENCES

The Department of Atmospheric Sciences offers advanced undergraduate and graduate courses leading to the Master of Science degree in Atmospheric Sciences with a Specialization in Meteorology or Earth Systems Science, and Doctor of Philosophy degree in Atmospheric, Environmental, and Water Resources (AEWR).

The primary objective of the atmospheric sciences 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, radar data, observations collected by specially instrumented aircraft, trace gas flux towers located above various terrestrial ecosystems, and tethered balloon systems, and various types of data-processing equipment. The student is expected to carry out original research in the atmospheric sciences.

A student applying for admission to the Atmospheric Sciences Department should have a baccalaureate degree in one of the physical sciences, earth system sciences, mathematics, or engineering. It is desirable for applicants to have received credit for mathematics through Calculus 2 (for Earth Systems Science Specialization) or Differential Equations (for Meteorology Specialization); physics and chemistry are also desirable. Experience with computer programming is recommended. Graduate Record Examination (GRE) scores from the General Test are required of all applicants. TOEFL scores are required of all applicants from colleges outside the U.S.

**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, atmospheric sciences electives at the 600 level or above; (300 level non-atmospheric sciences courses can be accepted if approved by the Graduate Education and Research Council).
3. Of the twenty-four (24) hours specified in Items 1 and 2, eighteen (18) must be at the 500 level or above, and at least half of the thirty (30) credit hours required for an M.S. degree must be at the 600 level or above.
4. Thesis - six (6) credit hours. The thesis must adhere to the format and content guidelines as set forth by the Graduate School.

Please note undergraduate credit limitations given under "M.S. Degree Requirements" for Master of Science degrees.

**COURSE REQUIREMENTS**

The following course requirements apply to all students in Atmospheric Sciences:

- At least one course module at the 500/600 level must be taken in each of the following core areas: Meteorology, Earth System Science, and Techniques.
- Satisfactory performance on coursework exam covering each of the core course modules as well as selected elective course work.
- Must register for ATM 700 Graduate Research (Thesis) each semester and ATM 693 Graduate Seminar each spring semester.

In addition, requirements specific to the two ATM MS options are listed below:

**Meteorology Specialization**

Students entering the program with a bachelor's degree in physics, mathematics, computer science, chemistry, or engineering must take the following courses: Synoptic Meteorology I (not for graduate credit), Atmospheric Physics, Atmospheric Dynamics I, and Synoptic Meteorology II.

Students entering the program with a bachelor's degree in Atmospheric Sciences or Meteorology from another institution are required to take the Atmospheric Physics course.

**Earth System Science Specialization**

All students will be required to take the following courses: The Global Metabolism, Biogeochemistry, Earth System Modeling, and at least one Remote Sensing course. Exceptions may be granted in the case of course duplication from a student's previous course work.

Students may also pursue an M.S. degree in Atmospheric Sciences without National Weather Service Certification. Examples of subdisciplines include remote sensing and biogeochemistry. For these specialties, math through calculus will normally be required. Specific course work requirements will be determined on an individual basis with concurrence from the student's advisor, graduate committee members, and the department chair.

NOTE: Elective courses offered by other departments are encouraged as long as the fifteen (15) hours of course work in Atmospheric Sciences at the 600 level or above are as outlined in "Requirements for M.S. degree."

Graduate students may take electives in the fields of physics, mathematics, computer science, chemistry, engineering, or the humanities to further integrate their undergraduate education into the discipline of atmospheric sciences.

Undergraduate students at SDSM&T may decrease the time required to obtain a Master of Science degree in Atmospheric Sciences by taking as electives the preparatory undergraduate 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**

Facilities and resources of the Institute of Atmospheric Sciences are available for the

research efforts of students in atmospheric sciences. These facilities include an aircraft instrumented for cloud physics and atmospheric electrical observations, various other meteorological instruments, tethered-balloon sampling system, an instrumented flux measurement tower in the Black Hills National Forest ,a computer-based synoptic laboratory, and an atmospheric analytical chemistry laboratory. Computer facilities are available in the department with access to the larger computer complex at the National Center for Atmospheric Research for approved studies. Several graduate research assistantships are available that provide part-time employment of students during the academic months and possible full-time employment during the summer.

### **RESEARCH**

Current research includes aircraft investigations of thunderstorms; applications of weather radar data to rainfall measurements and severe storms; 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 experimental data; analysis of field observations and numerical simulations of lake effect snow storms; satellite remote sensing; carbon sequestration; and land-surface/atmosphere exchange processes; wind climatology; fire chronosequence analysis between the Black Hills and Siberia, Russia using leaf area index (LAI) and remote sensing; trace gas flux measurements; and carbon and ecological modeling. In addition, IAS scientists are currently working on a project to develop a new earth system science curriculum for K-5 students.

# CIVIL ENGINEERING



## CONTACT INFORMATION

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## FACULTY

Associate Professor Kenner, Chair; Professors Sangchul Bang, Hansen, Mott, and Preber; Associate Professors Fontaine and Klasi; Assistant Professor Patnaik; 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 six (6) hours of Graduate Research (CEE 798) must be taken to complete the thesis option. Modeling and Computation in Civil Engineering (CEE 784) is a required course for all students. Other specific course requirements may be applicable depending upon the student's area of specialization. For example, students who elect to major in Environmental Engineering or Water Resources Engineering must complete CEE 733. Students who select Geotechnical Engineering must complete CEE 643. A minimum of thirty (30) hours is required for completion of degree requirements for the thesis option; for the non-thesis option the minimum is thirty-two (32) hours. 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.



*TECHFact: Does concrete float? Tech's Concrete Canoe Team proved that concrete can indeed float by winning the 1995 National Concrete Canoe Competition in Washington D.C. Tech's student chapter of the American Society of Civil Engineers (ASCE) has competed in ten of the twelve national concrete canoe competitions. Tech 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.*

# GEOLOGY AND GEOLOGICAL ENGINEERING



## CONTACT INFORMATION

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## GEOLOGY FACULTY

Professors Fox, Bishop, Duke, Lisenbee,  
Martin, and Paterson; Assistant 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 specializations:

### **Geology Specialization**

1. Petroleum Geology;
2. Environmental/Exploration Geophysics;
3. Ground Water Geology;
4. Mineral Deposits/Mineralogy/Petrology;
5. Sedimentation/Stratigraphy/Paleontology;  
and
6. Structural Geology.

### **Geological Engineering Specialization**

Three options are offered:

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. 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 five to eight (5-8) credits of thesis research and one (1) credit of graduate seminar in fulfilling requirements of the Graduate Office, as well as 23-26 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 SDSM&T 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 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 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 80 credit hours are required beyond the B.S. degree. At least fifty of these credits must be for course work. Up to 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 to 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 cr
GEOL 604	Advanced Field Geology	3 cr
GEOL 790	Graduate Seminar	1 cr
GEOL 808	Fundamental Problems in GEOL/GEOE	3 cr

**One course from:**

GEOL 516	GIS I: Intro to GIS	3 cr
GEOE 766	Digital Modeling of Ground-Water Flow Systems	3 cr
MINE 533	Computer Applications in Geoscience Modeling	4 cr

**One course from:**

GEOL 621	Advanced Structural Geology	3 cr
GEOL 622	Geotectonics	3 cr

**One course from:**

GEOE 626	Environmental Geophysics	3 cr
GEOE 641	Geochemistry	3 cr
GEOE 664	Advanced Ground Water	3 cr
GEOL 652	Problems in Ore Deposits	3 cr

**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 <sup>1</sup>
CEE 628	Environmental Engineering Measurements <sup>2</sup>

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
MINE 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 Modeling and Comp in Civil Engr
CEE 784	

**Energy and Mineral Resources Option:**

Required:

GEOE 525	Engineering Geophysics II
GEOE 531	Principles of Well Logging <sup>3</sup> or
GEOE 552	Geochemical Exploration <sup>4</sup>
GEOE 661	Petroleum Geology <sup>3</sup> or
GEOL 652	Problems in Ore Deposits <sup>4</sup>

Electives:

GEOL 513	Ore Microscopy
GEOE 626	Environmental Geophysics
GEOE 641	Geochemistry
MINE 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

<sup>1</sup> Suitable hydrology courses can be substituted with the approval of the student's graduate committee.

<sup>2</sup> Suitable environmental engineering courses can be substituted with the approval of the student's graduate committee.

<sup>3</sup> Energy Emphasis

<sup>4</sup> 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 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 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 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 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 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.

## PALEONTOLOGY



### CONTACT INFORMATION

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### FACULTY

Professor Davis, Chair; Professors Bishop, Fox, and 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 each in chemistry, physics, and calculus. No graduate credit will be granted for making up deficiencies. A course in statistics is required. Available courses in those areas of zoology most pertinent to paleontology, such as comparative anatomy or equivalent, are required for the degree.

The Graduate Record Examination (GRE) is required of all applicants. 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 Graduate Research  
(a minimum of six (6) credits)

- PALE 770 Seminar in Vertebrate Paleontology  
PALE 790 Graduate Seminar

The following courses are recommended:

GEOL 517 GIS I: Spatial 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. Because the candidate's thesis is apt to involve research in Cretaceous or Oligocene-Miocene faunas, it is better to be prepared in French or German, followed by the others in the order given.

All samples and specimens collected while at the South Dakota School of Mines and Technology must be curated into the systematic collections of the Museum of Geology for future students, scientists, and technologies.



*TECHFact: The SDSM&T 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.*

## CHEMICAL ENGINEERING



### CONTACT INFORMATION

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### FACULTY

Professor Winter, Chair; Professor Munro;  
Robert L. Sandvig Professor Puszynski;  
Associate Professor Dixon; Assistant Professor  
Gilcrease.

### CHEMICAL ENGINEERING

The Department of Chemistry and Chemical Engineering offers programs of study leading to the Master of Science degree in Chemical Engineering. Students normally are expected to follow a thesis option, but may be allowed to pursue a non-thesis option with the approval of the department chair. 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 option a student must earn thirty-two (32) credits in an approved program of study.

### EXECUTIVE PROGRAM

Students pursuing the non-thesis option may elect to take some course work via distance learning in the Executive Program. In this program, students take courses through a combination of videotaped lectures and one-on-one contact with instructors through Internet, videophone, or other communication technologies. The department expects to schedule at least one course each semester to be offered under this program, so that students can earn their M.S. degree while also employed at a distant off-campus location.

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: catalysis, combustion, biotechnology, electronics, high-performance materials, environmental issues, and chemical technology. A student who does not have a bachelors degree in Chemical Engineering will be expected to make up 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](http://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 examination for the non-thesis degree, is also 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 Elective <sup>1</sup>	3
	Applied Computation Elective <sup>2</sup>	3

<sup>1</sup> Kinetics Elective: CHE 544 or MES 728

<sup>2</sup> 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 one three (3) credit course in technology management.



*TECHFact: The Kids Kastle Little Miner's Clubhouse provides child-care services on the SDSM&T campus for the children of students, faculty, and staff.*

## CHEMISTRY



### CONTACT INFORMATION

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### FACULTY

Professor Winter, Chair; Professors Arrington  
and Boyles; Associate Professor McDowell;  
Assistant Professor Heglund.

### 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.



# MATERIALS AND METALLURGICAL ENGINEERING



## CONTACT INFORMATION

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## FACULTY

Professor Kellar, Chair; Distinguished and  
Douglas W. Ferstenau Professor Han;  
Professors Howard, Marquis, and Stone;  
Instructors Arbegast and Cross.

## MATERIALS AND METALLURGICAL ENGINEERING

Students interested in pursuing graduate studies focusing on materials science of alloys, ceramics, and composites, corrosion, and extractive metallurgy, please see Master of Science in Materials Engineering and Science.

## MATERIALS ENGINEERING AND SCIENCE



### CONTACT INFORMATION

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### STEERING COMMITTEE

Assistant Professor Heglund, Program  
 Coordinator and Steering Committee Chair;  
 Professors Foygel and Stone.

### FACULTY

Distinguished and Douglas W. Furstenau  
 Professor Han; Robert L. Sandvig Professor  
 Puszynski; Professors Arrington, Bang, Boyles,  
 Foygel, Kellar, and Marquis; Associate  
 Professors Corey and McDowell; Assistant  
 Professors Heglund and Williams; Instructor  
 Cross.

### 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 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 should be capable of formulating  
 solutions to materials problems through the use  
 of multi-disciplinary approaches with their  
 broad background in basic materials science  
 and engineering.

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 strongly recommended to undertake a project under the supervision of a faculty member. The program is administered by the Dean of the College and Chairs of the three 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 at least twelve (12) credit hours from the following five core courses:

MES 601	Thermochemical Processing Fundamentals
MES 603	Atomic/Molecular Structure of Materials
MES 604	Structure-Property Relationships of Materials
MES 708	Advanced Instrumental Analysis
MES 708L	Experimental Advanced Instrumental Analysis

These courses are modularized and are variable credit so that students can take their twelve (12) credit hours of core course work utilizing the modules that will most benefit their plan of study.

Students showing sufficient knowledge in one or more of these areas before they enter the program, may be exempted from some portions of core courses. A student's proficiency on the knowledge of these core courses will be evaluated by a graduate advisor during the registration period of the student's first semester in the program.

Areas of research currently carried out include inorganic, organic, and biological behavior/synthesis/treatments of materials, 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.

## 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 in Materials Engineering  
and Science.

# COMPUTER SCIENCE



## CONTACT INFORMATION

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## FACULTY

Professor Logar, Chair; Professors Carda,  
Corwin, Opp, and Penaloza; Associate  
Professor Weiss; Assistant Professors  
McGough and Stubbendieck.

## 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 SDSM&T Bachelor of Science degree in Computer Science (CS) and must 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 371)
- an assembly language or computer organization course (e.g., CSC 314)
- an operating systems course (e.g., CSC 472)

All students who do not have a CS 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 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. The student must complete at least thirty (30) semester credit hours, twenty-four (24) course work credits and six (6) semester credit hours of thesis research (CSC 798).
3. No more than a total of three (3) credits of independent study (CSC 691, CSC 791) or co-op (CP 697) may be counted toward the degree.
4. No more than two (2) courses taken from outside of the department may be counted toward the degree.
5. The remaining hours must be Computer Science courses numbered 500 or higher.
6. The student must pass an oral comprehensive course work examination and make an oral presentation of his or her research prior to graduation. A student who fails the oral examination will be allowed one, and only one, attempt to pass a written comprehensive examination.
7. The student must submit an acceptable thesis. The student should refer to the graduate school guidelines on thesis preparation for further information.

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 at least thirty-two (32) semester credit hours, twenty-nine (29) course work credits, and three (3) semester credit hours of non-thesis research (CSC 788).
3. No more than a total of six (6) credits of independent study (CSC 691, CSC 791) or co-op (CP 697) may be counted toward the degree.

4. No more than two (2) courses taken from outside of the department may be counted toward the degree.
5. The remaining hours must be Computer Science courses that are 500 level or higher.
6. The student must pass an oral comprehensive course work examination and make an oral presentation of his or her research prior to graduation. A student who fails the oral examination will be allowed one, and only one, attempt to pass a written comprehensive examination.

The candidate who chooses the course work only option must satisfy the following requirements:

1. The student must complete a minimum of thirty-two credits (32) of coursework.
2. No more than a total of six (6) credits of independent study (CSC 691, CSC 791) or co-op (CP 697) may be counted toward the degree.
3. No more than two (2) courses taken from outside of the department may be counted toward the degree.
4. The remaining hours must be Computer Science courses numbered 500 or higher.
5. The student must pass a written comprehensive examination prior to graduation. A student who fails this examination will be allowed one, and only one, additional attempt to pass the written comprehensive examination.

The South Dakota School of Mines and Technology 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



## CONTACT INFORMATION

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## FACULTY

William J. Hoffert Professor Simonson, Chair  
through fall 2002; Professor Hasan, Chair  
beginning spring 2003; Steven P. Miller  
Endowed Chair and Professor Whites;  
Professors Batchelder, Chamberlain, and  
Meiners; Associate Professor Premkumar;  
Assistant Professors Hemmelman and  
Montoya.

## ELECTRICAL ENGINEERING

The mission of the ECE 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 (MSEE) 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 MSEE degree is available with Thesis  
and Non-Thesis tracks. The course  
requirements for these tracks are as follows:

**Thesis option**

The Thesis MSEE degree consists of a program of graduate course work and thesis research. Candidature for the MSEE degree with Thesis is contingent on an aptitude to do research. A limited number of students are accepted into the MSEE Thesis option, on the recommendation of a major professor. The requirements for the MSEE Thesis degree are as follows:

1. Minimum of 30 credit hours comprising:
  - a. a minimum of six (6) hours and a maximum of nine (9) hours of thesis research.
  - b. a minimum of 21 hours of course work: the sum of research credits and course credits must be 30 or more.
  - c. a minimum of 15 hours of EE courses at the 600 level.
  - d. a maximum of nine (9) hours of graduate-eligible credit outside of EE graduate courses, comprising:
    - i. a maximum of six (6) hours of 400 level ECE courses.
    - ii. a maximum of three (3) hours of courses outside of CSC, ECE, MATH, ME, or PHYS.
  - e. a maximum of three (3) hours of Independent Study credit.
  - f. a maximum of three (3) hours of COOP credit. The number of COOP credits plus Independent Study credits may not exceed three (3) hours.
2. Pass an oral examination on course work.
3. Write a thesis and successfully defend the thesis in an oral examination. At the discretion of the committee, the course work and thesis examinations may be given at the same time.

**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 MSEE Non-Thesis option.

1. Minimum of 33 credit hours comprising:
  - a. a minimum of 21 hours of EE courses at the 600 level.
  - b. a maximum of 12 hours of graduate-eligible credit outside of EE graduate courses, comprising:
    - i. a maximum of six (6) hours of 400 level ECE courses.

- ii. a maximum of three (3) hours of courses outside of CSC, ECE, MATH, ME, or PHY.
  - c. a maximum of six (6) hours of Independent Study.
  - d. a maximum of three (3) hours of COOP credit. The number of COOP credits plus Independent Study credits may not exceed six (6) hours.
2. Pass an oral examination on course work.
  3. In special circumstances a graduate student may undertake a project as Independent Study, with the approval of both the student's graduate advisor and a faculty mentor. If a project is approved for Independent study, it is limited to a maximum of three (3) credit hours and it counts as part of the six (6) credit hour maximum of Independent Study. COOP and Independent Study credit may only be applied to the MSEE program of study with the approval of the student's committee.

**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 MSEE 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 MSEE Non-Thesis degree students, with the Graduate Coordinator serving as the advisor. MSEE 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 MSEE degree offers emphases in three areas: Communications and Signal Processing, 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, and logic analyzers, and a printed circuit board prototyping machine 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, ultra-wideband 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, 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 SDSM&T Center of Excellence in Advanced Manufacturing and Production (CAMP).

### **MSEE Course Offerings**

Each area of emphasis is supported by the following courses:

#### **Communication Systems and Signal**

##### **Processing:**

EE 612	High Speed Digital Design
EE 618	Instrumentation Systems
EE 621	Information and Coding Theory
EE 622	Stats 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 633	Power System Analysis I
EE 634	Power System Analysis II
EE 651	Digital Control Systems
EE 652	Nonlinear and Optimal Control Systems

# MECHANICAL ENGINEERING



## CONTACT INFORMATION

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## FACULTY

Professor Kjerengtroen, Chair; Professors Dolan, Jenkins, Krause, and Langerman; Associate Professors Buck, Kalanovic, and Muci-Kuchler.

## 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, optical techniques for materials characterization, residual stress measurement, 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, experimental methods of engineering, 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, advanced instrumental analysis, transport phenomena, computational methods in transport phenomena, and interfacial phenomena.

The Mechanical Engineering Department is one of the largest programs on campus and has several 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. 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 equal options. They are:

1. **Non-Thesis:**

Total credit hours required	32
Seminar ME 790	1
Project ME 791	6
Remaining 25 hours are taken	
at the 400 <sup>1</sup> /500 level	9
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	
at the 400 <sup>1</sup> /500 level	9
at the 600/700 level	14

<sup>1</sup> 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 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 will 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 must select one course from each of the three 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 SDSM&T 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 weeks prior to the examination that 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.

## ATMOSPHERIC, ENVIRONMENTAL, AND WATER RESOURCES



### CONTACT INFORMATION

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### FACULTY

Professor Detwiler, Program Coordinator;  
Dean Farwell; Professors Bang, Davis, Duke,  
Helsdon, Hjelmfelt, Mott, and Zimmerman;  
Associate Professors Fontaine, Kenner, and  
Stetler; Assistant Professors Baker, Capehart,  
Heglund, Price, K. Vierling, L. Vierling, and  
Williams.

### AEWR PH.D. PROGRAM

In October 1993 the South Dakota Board of Regents approved a joint doctoral program in Atmospheric, Environmental, and Water Resources (AEWR) for the South Dakota School of Mines and Technology and the South Dakota State University. This program is

designed with a strong interdisciplinary theme and a number of disciplines at both institutions are involved in its cooperative delivery. At SDSM&T, the following disciplines participate in the AEWR program: atmospheric sciences, chemistry, chemical engineering, civil and environmental engineering, geology and geological engineering, mathematics and computer science, and mining engineering. Degree candidates in AEWR are expected to complete an approved multidisciplinary program of course work and also perform original research in a focused area. Based on the selected research topic, AEWR students choose a concentration area from the three fields; that is, either atmospheric sciences (including meteorology, atmospheric chemistry, biogeochemistry, and global change), environmental science or engineering, or water resources (i.e., surface and/or subsurface hydrology).

Since the program's inception at SDSM&T, it has experienced significant growth both in terms of graduate student enrollment and faculty involvement. In 1999, the Board of Regents approved various modifications in the

AEWR program that have strengthened its multidisciplinary nature while simultaneously enhancing its programmatic flexibility. These changes incorporate a broader range of AEWB study programs and thereby satisfy a more diverse spectrum of student career goals within the three areas.

A minimum total of ninety (90) semester credit hours, beyond the Bachelor's degree, are required in each AEWB student's program of study. Course credits will range from forty-five to sixty (45 to 60) credit hours and the dissertation research credits will range from thirty to forty-five (30 to 45) credit hours. This distribution of credits between formal course work and dissertation research is consistent with the fact that the AEWB Ph.D. degree is a research-based program in science and engineering. The use of ranges is designed to allow the graduate student to work with his/her advisory committee to formulate a study plan that is based on the individual student's combined knowledge level and professional career goals, and the required thorough educational background in the focus area. Students entering the AEWB program with a previous M.S. degree in a relevant discipline are allowed to apply a maximum of twenty-four (24) semester credit hours toward the course credit requirement and six (6) thesis research credits toward the research-credit requirement. There is no language requirement in the AEWB program. However, all AEWB students are expected to be proficient in speaking, understanding, and writing the English language.

Graduate students who are enrolled full time in the AEWB program should be able to complete their degree requirements and graduate within three to four years. 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. Many SDSM&T faculty members who are actively involved in the AEWB program have externally funded research projects. These projects provide research assistantship opportunities for AEWB students. In addition to graduate research assistantships, support is also possible through graduate teaching

assistantships and various fellowships and scholarships.

Each graduate student's advisory committee recommends the specific primary core courses a student must take to achieve the fundamental AEWB goal of comprehensiveness. The primary core shall consist of four graduate-level three (3) credit courses and a minimum of three semester registrations in AEWB 793, a seminar course. The selection of the four primary core courses will be determined on a case-by-case basis to fulfill the inherent multidisciplinary breadth of the AEWB program and to furnish the educational background required by each specific student's research direction. This core should include at least one course representing each of the three principal fields within the AEWB program. Course work beyond the core will be selected to build competence in the student's specialization area. Again, the graduate student's advisory committee will guide each student in the number and distribution of this additional course work. Each SDSM&T student in the AEWB program is required to take a minimum of one three (3) credit course from South Dakota State University. This requirement is in addition to the three semester registrations in AEWB 793. SDSM&T students will be apprised of opportunities to take additional courses offered by SDSU and will be encouraged by their advisory committees to include more than the minimum in their programs of study.

A wide variety of courses are offered at SDSM&T that can form the basis for study in the area of atmospheric, environmental, and water resources. 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 in the course work core of an AEWB program of study. A second list includes examples of additional courses that might be included in an AEWB 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.

**Suggested Primary Core Courses in AEWB:**

ATM 501	Atmospheric Physics
ATM 505	Air Quality
ATM 510	Introduction to Environmental Remote Sensing
ATM 520	Remote Sensing for Research I
ATM 603	Biosphere-Atmosphere Interactions
ATM 612	Atmospheric Chemistry
CEE 535	Water Resources Engineering (SDSU)
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

**Other Potential Courses for AEWB students:**

ATM 515	Earth Systems Modeling
ATM 530	Radar Meteorology
ATM 540	Atmospheric Electricity
ATM 560	Atmospheric Dynamics
ATM 620	Remote Sensing for Research II
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 526	Environmental Engineering Physical/Chemical Process Design
CEE 527	Environmental Engineering Biological Process Design
CEE 528	Advanced Treatment Plant Design
CEE 533	Open Channel Flow
CEE 628	Environmental Engineering Measurements
CEE 723	Environmental Contaminant Fate and Transport
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

**MANAGEMENT OF THE AEWB PROGRAM**

The joint AEWB program is managed by a Steering Committee, which includes representatives from SDSM&T and South Dakota State University (SDSU). The current AEWB Steering Committee consists of: the Graduate Deans from SDSM&T and SDSU, the two campus AEWB Program Coordinators from SDSM&T and SDSU, two appointed faculty members from SDSM&T, two appointed faculty members from SDSU, and the Executive Director, or his/her designee, of the South Dakota Board of Regents. The primary functions of this AEWB Steering Committee are to a) coordinate the overall program plan between the two universities, b) approve curricular changes, c) promote the use of modern technology in the delivery of AEWB courses between the two universities, and d) facilitate collaborations in research, conferences, and other activities of benefit to the AEWB program.

In addition to the Steering Committee, there is a Campus AEWB Coordinating Committee. This committee at SDSM&T contains representatives from each of the three AEWB areas and deals with campus issues that relate to the implementation and operation of the program.

The preceding committees are distinct from the graduate student advisory committees that provide guidance to individual AEWB students during the course of their academic studies. The graduate student's major advisor serves as the chair of this advisory committee. At least one faculty member from SDSU will be invited to participate on each AEWB graduate student advisory committee at SDSM&T.

## MATERIALS ENGINEERING AND SCIENCE



### CONTACT INFORMATION

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### ADVISORY COUNCIL

Professor Petukhov, Program Coordinator;  
Distinguished and Douglas. W. Ferstenu  
Professor Han; Professors Jenkins and Winter;  
Associate Professor Sobolev; Assistant  
Professor Heglund.

### 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 Research, 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, and Metallurgical and Materials Engineering, and the Departments of Physics, Chemistry, and Chemical Engineering.

The Graduate Record Examination (GRE), three 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: 80 credits)

#### **M.S. Degree** (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** (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** (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

#### **Program Emphasis** (30 credits)

Two program emphasis areas are available: Materials Science and Materials Engineering. See sections below.

#### **Research** (20 credits)

MES 898 (19) Dissertation Research

MES 890 (1-0) Graduate 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: 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 (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  
(3 credits)**

- CHEM 455/ (3-0) Advanced Inorganic  
555 Chemistry
- MES 603 (1-7) Atomic/Molecular  
Structure of Materials
- MES 604 (1 to 5  
-0.5) Structure-Property  
Relationships 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 (3 credits)**

- GEOL 643 (2-1) Intro to Microbeam  
Instruments
- MES 708 (1 to 5  
-0) Advanced Instrumental  
Analysis
- MES 708L (0-1 Experimental Advanced  
to 2) Instrumental Analysis

**Fundamental Engineering Mechanics  
(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/ (3-0) Mechanical Metallurgy  
540
- ME/MET (3-0) Composite Materials  
443
- MET 625 (3-0) Strengthening Mechanisms  
in Materials
- PHYS 751 (3-0) Advanced Dynamics I

**Dissertation Related Topics (12 credits)**

**ENGINEERING EMPHASIS REQUIREMENTS**

(minimum program requirements: 30 credits)

**Analytical Mechanics**

- EM 680 (3-0) Advanced Strength of  
Materials
- ME 623 (3-0) Advanced Mechanical  
Vibrations
- 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/ (3-0) Rock Mechanics III  
512
- MINE 450/ (3-0) Rock Slope Engineering  
550

**Failure Analysis Fracture Mechanics**

- CEE 616 (3-0) Advanced Engineering  
Materials Technology
- CEE 653 (3-0) Reinforced Concrete  
Design
- CEE 655 (2-1) Advanced Composites
- ME 715 (3-0) Advanced Composite  
Materials

**Fundamental Materials Science (6 credits)**

Courses from the Science Emphasis section can also be used to fulfill this requirement.

- CHEM 420 (3-0) Organic Chemistry III
- CHE 621 (3-0) Advanced Chemical  
Engineering  
Thermodynamics I
- CHEM 452/ (3-0) Inorganic Chemistry  
552
- CHEM 426 (3-0) Polymer Chemistry
- MES 603 (1 to 7) Atomic/Molecular  
Structure of Materials
- MES 601 (1 to 5-0) Thermochemical Processing  
Fundamentals
- MES 604 (1 to 5-0.5) Structure-Property  
Relationships of Materials

CHE 474/ (2 to 3) Polymer Technology  
574  
PHYS 439 (4-0) Solid State Physics  
MET 445/ (3-0) Oxidation and Corrosion of  
545 Metals  
MET 421/ (3-0) Refractories and Ceramics  
521

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 SDSM&T 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 SDSM&T Materials Engineering and Science Ph.D. Handbook.



*TECHFact: Tech and their solar-powered vehicle, Dakota Heat, qualified to compete in Sunrayce 99 - a 1,300-mile solar-powered race from Washington, D.C. to Orlando, Florida. The team placed 25th overall. The students design, build, and race the solar car.*

# TECHNOLOGY MANAGEMENT



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## SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY FACULTY

Ervin Pietz Professor Kellogg, Program  
Coordinator; Associate Professors Kerk and  
Matejcek.

## 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 SDSM&T. Alternatively, students may apply for the program online by visiting the SDSM&T website at [www.sdsmt.edu/syseng/tm](http://www.sdsmt.edu/syseng/tm). 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 SDSM&T 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 SDSM&T.

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 SDSM&T 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 SDSM&T. 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 SDSM&T 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

TM 742	Engineering Management and Labor Relations	3
TM 661	Engineering Economics for Managers	3
TM 665	Project Planning and Control	3
TM 631	Optimization Techniques <sup>1</sup>	3

TM 663	Operations Planning <sup>2</sup>	3
ECON 782	Managerial Economics	3

<sup>1</sup> May be satisfied through BAD 720 Quantitative Analysis (USD)

<sup>2</sup> May be satisfied through BAD 760 Production and Operations Management (USD)

#### RECOMMENDED ELECTIVE COURSES

The following constitutes recommended electives which provide some form of management emphasis or approach. The list does not include courses already listed as core courses. Additional elective courses may be selected from other available programs as directed by the student's guidance committee. TM courses are available in distance learning mode.

#### **SDSM&T Courses**

TM 631	Optimization Techniques	3
TM 650	Safety Management	3
TM 663	Operations Planning	3
TM 720	Quality Management	3
TM 732	Stochastic Models in Operations Research	3
TM 745	Forecasting for Business and Technology	3
MATH 485	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 Studies in TM	2
<b>TOTAL</b>		<b>32</b>

**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 485	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 Studies in TM	1
<b>TOTAL</b>		<b>33</b>



*TECHFact: The Mini-Baja is one of many opportunities for Tech students to apply their academic abilities outside the classroom. SDSM&T's Mini-Baja team had two vehicles compete in the Mini-Baja Western Competition in 2002. 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

<b>Abbreviation</b>	<b>Definition</b>
ACCT	Accounting (listed under Business Administration)
AEWR	Atmospheric, Environmental, and Water Resources
ANTH	Anthropology
ART	Art
ARTH	Art History
ATM	Atmospheric Sciences
BAD	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
ENVE	Environmental Engineering
FREN	French
GE	General Engineering
GEOE	Geological Engineering
GEOG	Geography
GEOL	Geology
GER	German
HIST	History
HUM	Humanities
IENG	Industrial Engineering
IS	Interdisciplinary Sciences
JAPN	Japanese
LAK	Lakota
LAW	Law
MATH	Mathematics
ME	Mechanical Engineering
MES	Materials Engineering and Science
MET	Metallurgical Engineering
MINE	Mining Engineering
MSC	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**  
**ACCT 211 PRINCIPLES OF ACCOUNTING II**  
 (3-0) 3 credits each. Prerequisite for ACCT 211: ACCT 210. The focus of these courses is on the preparation and analysis of financial statements applicable to single proprietorships, partnerships, and corporations. Problems and practice sets are an important part of the course work. Prerequisite to all advanced accounting courses. These courses cannot count as social science/humanities credit.

**AEWR 790 GRADUATE 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.

**AEWR 791 INDEPENDENT STUDIES IN  
ATMOSPHERIC, ENVIRONMENTAL, AND  
WATER RESOURCES**  
 1 to 3 credits. Prerequisite: Permission of department chair. 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.

**AEWR 792 SPECIAL TOPICS IN  
ATMOSPHERIC, ENVIRONMENTAL, AND  
WATER RESOURCES**  
 1 to 3 credits. Prerequisite: Permission of department chair. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**AEWR 898 DISSERTATION RESEARCH**  
 Credit to be arranged; not to exceed 12 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.

**ANTH 210 CULTURAL ANTHROPOLOGY**  
(3-0) 3 credits. This course is an introduction to the basic concepts, principles, and problems of cultural anthropology with special emphasis on the ecological and evolutionary adaptations of societies. Draws data from both traditional and industrial cultures and covers such topics as war, status of men and women, religion, kinship, economic, and political order.

**ART 111/111A DRAWING AND PERCEPTION I**  
(3-0) 3 credits. Studio drawing and visual perception with emphasis on references to American and European masters of art.

**ART 112/112A DRAWING AND PERCEPTION II**  
(3-0) 3 credits. Prerequisite: ART 111. A continuation of ART 111 with emphasis on creative expression rather than technical proficiency. Exercises and problems to encourage personal interpretations of a visual image.

**ART 280/280L COMPUTER AIDED GRAPHIC DESIGN**  
(2-1) 3 credits. Prerequisite: ART 111 recommended. Introduction to and applications of computer generated and controlled imaging including informational/statistical graphs, drawing, and animation.

**ARTH 151 INDIAN ART HISTORY**  
(3-0) 3 credits. The course will introduce the student to representative works ranging from traditional/tribal art to contemporary Indian art thus enhancing aesthetic appreciation and deepening understanding. (Taught in collaboration with Oglala Lakota College.)

**ARTH 211 ART HISTORY**  
(3-0) 3 credits. An historical survey of art from 25,000 BCE to the early 1900s CE, with special emphasis on painting, sculpture, and architecture.

**ARTH 320 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 STUDIES IN ART**  
1 to 3 credits. Prerequisite: Three semester hours of art or art history credit 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 advanced, by student and instructor.

**ARTH 492 SPECIAL TOPICS IN ART**  
1 to 3 credits. Prerequisite: Junior or senior standing or permission of instructor. Lecture course or seminar on a topic or field of special interest, as

determined by the instructor. 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 STUDIES IN ATMOSPHERIC SCIENCES**  
1 to 3 credits. Prerequisite: Permission of department chair. 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 three credit hours.

**ATM 392 SPECIAL TOPICS IN ATMOSPHERIC SCIENCES**  
1 to 3 credits. Prerequisite: Permission of department chair. 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.

**ATM 401 GLOBAL ENVIRONMENTAL CHANGE**  
(3-0) 3 credits. Prerequisite: CHEM 112 or equivalent, PHYS 111 or PHYS 113, BIOL 211, 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 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 MS program. Students enrolled in ATM 502 will be held to a higher standard than those enrolling 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 MS program. Students enrolled in ATM 503 will be held to a higher standard than those enrolled in ATM 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 enrolling in ATM 410. ATM 510/510L satisfies the Techniques distribution requirement for the ATM MS 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 491 INDEPENDENT STUDIES IN ATMOSPHERIC SCIENCES**

1-3 credits. Prerequisite: Permission of department chair. 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 three credit hours.

#### **ATM 492 SPECIAL TOPICS IN ATMOSPHERIC SCIENCES**

1 to 3 credits. Prerequisite: Permission of department chair. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. May be repeated to a total of five credit hours.

#### **ATM 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 MS program.

#### **ATM 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 air pollutants is included. Satisfies the Earth Systems distribution requirement for the ATM MS program.

#### **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 MS program.

#### **ATM 520/520L REMOTE SENSING FOR RESEARCH I**

(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 MS 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 MS 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 MS 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 MS program.

**ATM 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 MS program.

**ATM 591 INDEPENDENT STUDIES IN ATMOSPHERIC SCIENCES**

1 to 3 credits. Prerequisite: Permission of department chair. 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 in advance, by student and instructor.

**ATM 592 ADVANCED TOPICS IN ATMOSPHERIC SCIENCES**

1 to 3 credits. Prerequisite: Permission of department chair. 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 MS program.

**ATM 603 BIOSPHERE-ATMOSPHERE INTERACTIONS**

(3-0) 3 credits. Prerequisite: ATM 503 or 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 MS 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 MS 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 MS program.

**ATM 620/620L REMOTE SENSING FOR RESEARCH II**

(2-1) 3 credits. Prerequisite: Permission of instructor. A research based course with a semester-long research project, student seminars on remote sensing, roundtable discussions and a detailed paper. Lecture topics include scale issues in remote sensing, Fourier and fractal analysis, passive and active microwave remote sensing, remote sensing-GIS integration, and remote sensing-model integration. Satisfies the Techniques distribution requirement for the ATM MS 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.

**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 MS 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 MS 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 MS 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 MS 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 MS program.

**ATM 662 GENERAL (GLOBAL) CIRCULATION**

(3-0) 3 credits. A study of the general circulation of the atmosphere including quasi-geostrophic equations; planetary waves; geostrophic adjustment; barotropic, baroclinic instability; frontogenesis; and tropical cyclones.

**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 MS 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 MS program.

**ATM 690 GRADUATE 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 STUDIES IN ATMOSPHERIC SCIENCES**

1 to 3 credits. 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 ADVANCED TOPICS IN ATMOSPHERIC SCIENCES**

1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**ATM 798 GRADUATE RESEARCH (THESIS)**

Credit to be arranged. Not to exceed four credits per semester and not to exceed six credits towards 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. Graduate research assistants and students receiving faculty supervision of their research are required to enroll in this course each semester.

**BAD 101 SURVEY OF BUSINESS AND TECHNOLOGY**

(3-0) 3 credits. The study of multinational business and its relationship to technology is analyzed relative to contemporary ethical and societal issues. This course cannot count as social science/humanities credit.

**BAD 291 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.

**BAD 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.

**BAD 350 LEGAL ENVIRONMENT OF BUSINESS**

(3-0) 3 credits. A study of the legal demands placed by government on business, including the origins of the American Constitutional system and the organization, operation, and termination of business within the framework of this legal system, with emphasis on laws affecting business policy.

**BAD 360 ORGANIZATION AND MANAGEMENT**

(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. Analysis of techniques to improve organizational structure, design, and leadership; applications of behavioral sciences to organizational structure, group dynamics, individual motivation, and organizational processes and changes; and exploration of the decision-making process through case studies.

**BAD 370 MARKETING**

(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. The study of business activities and systems influencing the flow of goods and services from producers to consumers. This course cannot count as social science/humanities credit.

**BIOL 121 BASIC ANATOMY**

(3-0) 3 credits. Anatomy of the human body. Basic biological principles and medical nomenclature.

**BIOL 121L BASIC ANATOMY LAB**

(0-1) 1 credit. Prerequisite or corequisite: 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.

**BIOL 123L BASIC PHYSIOLOGY LAB**

(0-1) 1 credit. Prerequisite or corequisite: BIOL 123. Laboratory exercises will examine the function of the human body.

**BIOL 151 GENERAL BIOLOGY I**

(3-0) 3 credits. A detailed account emphasizing the unity of biology. Cellular biology, biochemistry, genetics, and animal biology are emphasized.

**BIOL 151L GENERAL BIOLOGY I LAB**

(0-1) 1 credit. Prerequisite or corequisite: BIOL 151. Laboratory exercises designed to reinforce subject material covered in BIOL 151 lectures.

**BIOL 153 GENERAL BIOLOGY II**

(3-0) 3 credits. Subject matter a continuation of BIOL 151 with plant biology, human biology, and environmental biology the major topics. However, BIOL 151 is not a prerequisite.

**BIOL 153L GENERAL BIOLOGY II LAB**

(0-1) 1 credit. Prerequisite or corequisite: BIOL 153. Laboratory exercises designed to reinforce subject material covered in BIOL 153 lectures.

**BIOL 200 UNDERGRADUATE RESEARCH**

1 to 3 credits. Prerequisite: Permission of instructor and freshman or sophomore standing. Direct research or study of a selected problem culminating in an acceptable written report.

**BIOL 231 GENERAL MICROBIOLOGY**

(3-0) 3 credits. Prerequisites: CHEM 106 or equivalent, concurrent registration in CHEM 108 recommended. Basic principles of microbiology introducing the physiological and biochemical concepts in microbial interaction with the environment. Topics covered are bacteriology, virology, microbial genetics, immunology, and disinfection.

**BIOL 231L GENERAL MICROBIOLOGY LAB**

(0-1) 1 credit. Prerequisites: CHEM 106/106L or equivalent, concurrent registration in CHEM 108 and CHEM 108L recommended. Prerequisite or corequisite: 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 311 PRINCIPLES OF ECOLOGY**

(3-0) 3 credits. Prerequisite: A prior course in biology is recommended. This course examines the relationship between organisms and the environment. Plant and animal ecology will be emphasized, and human influence on ecological processes will be discussed.

**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 332.

**BIOL 331 MICROBIOLOGY**

(3-0) 3 credits. Prerequisite: CHEM 112. The course is to introduce the general principles of the

structure, metabolic activities, and molecular genetics of microorganisms. The diversity and uniqueness of microbial processes are examined to understand the basic and applied aspects of microbiology. The course is designed for all science and engineering majors. (Experimental)

**BIOL 371 GENETICS**

(3-0) 3 credits. How and what plants, animals, and people inherit from their parents and why. A prior course in biology is recommended.

**BIOL 401 GLOBAL ENVIRONMENTAL CHANGE**

(3-0) 3 credits. Prerequisite: CHEM 112 or equivalent, PHYS 111 or PHYS 113, BIOL 211, 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 401.

**BIOL 423 PATHOGENESIS**

(3-0) 3 credits. Prerequisites: BIOL 231, CHEM 112 or 106. Pathogenic microbiology deals with nutrition, cultural characteristics, and morphology of organisms that affect man and some animals; also with the host-parasite relationships that include both normal flora and pathogens.

**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 BIOLOGICAL PROBLEMS**

1 to 4 credits. 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 492 SPECIAL TOPICS**

1 to 5 credits. Prerequisite: Upper-class standing. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**BIOL 691 INDEPENDENT STUDIES IN BIOLOGY**

1 to 3 credits. 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 ADVANCED TOPICS IN BIOLOGY**

1 to 3 credits. Prerequisite: Permission of instructor and major professor. 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 how to read and interpret construction design documents, the use of engineering and architectural scales, and introduction to computer aided drawing and design, and three dimensional visualization using autocad. (Experimental)

**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 (Q-basic/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 216, 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 223, 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 WATER AND WASTE WATER TREATMENT**

(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 of the design and analysis of municipal water and waste water treatment systems. 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 223 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 I**

(2-1) 3 credits. Prerequisites: EM 216 and CEE 284

or permission of instructor. GEOL 201 is recommended. 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 are required for lab reports. This course is cross-listed with MINE 346/346L.

**CEE 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. This course is cross-listed with MINE 347.

**CEE 356 THEORY OF STRUCTURES I**  
(3-0) 3 credits. Prerequisites: EM 216 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 matrix methods and computer applications to structural analysis. Introduction to indeterminate structures and the moment-distribution method.

**CEE 357/357L THEORY AND DESIGN OF METAL STRUCTURES I**  
(2-1) 3 credits. Prerequisite: CEE 356. 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 356 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 400 UNDERGRADUATE RESEARCH**  
1 to 6 credits. Prerequisite: Junior or senior standing. Credits toward fulfillment of B.S. degree requirements. Directed research investigation of a selected problem culminating in an acceptable written report. Oral defense of the report and research findings are required.

**CEE 423/523 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 enrolling in CEE 523 will be held to a higher standard than those enrolling in CEE 423. This course is cross-listed with ENVE 423/523.

**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 enrolling in CEE 526 will be held to a higher standard than those enrolling 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 enrolling 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 enrolling in CEE 527 will be held to a higher standard than those enrolling in CEE 427. This course is cross-listed with ENVE 427/527.

**CEE427L/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 enrolling in CEE 528 will be held to a higher standard than those enrolling 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 enrolling in CEE 533 will be held to a higher standard than those enrolling 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 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 than those enrolling 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 enrolling in CEE 547 will be held to a higher standard than those enrolling 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 enrolling in CEE 548 will be held to a higher standard than those enrolling in CEE 448.

**CEE 456/456L THEORY AND DESIGN OF STRUCTURES II**

(2-1) 3 credits. Prerequisite: CEE 356. Fundamental behavior of statically indeterminate structural systems. Extension of basic concepts to classical and matrix computer techniques for analyzing continuous beams, trusses, and frames.

**CEE 457/457L 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 458/458L THEORY AND DESIGN OF REINFORCED CONCRETE**

(2-1) 3 credits. Prerequisite: CEE 356. Properties and behavior of concrete. Analysis and design of structural slabs, beams, girders, columns, and footings, with use of elastic and ultimate strength methods. Design of a structural frame-building system.

**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**

1 to 3 credits. Total of 3 credits is required. Prerequisites: The first track elective concurrent with the first 1 credit segment and concurrent registration in the second track course with the second 2 credit segment. 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 enrolling in CEE 574 will be held to a higher standard than those enrolling in CEE 474. This course is cross-listed with MINE 474/574.

**CEE475/475L/575/575L 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. Students enrolling in CEE 575 will be held to a higher standard than those enrolling in CEE 475.

**CEE 491 INDEPENDENT STUDIES IN CIVIL ENGINEERING**

1 to 3 credits. Prerequisite: Senior 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 492 SPECIAL TOPICS IN CIVIL ENGINEERING**

1 to 3 credits. Prerequisite: Senior standing and permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**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.

**CEE 628/628L ENVIRONMENTAL ENGINEERING MEASUREMENTS**

(2-1) 3 credits. Prerequisite: Senior or graduate standing. It is highly recommended that the student have completed CEE 423 or CEE 523 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 458 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 458. 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 356 or permission of instructor. Basic properties and principles of advanced composite materials such as fiberglass and graphite, and aramid 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 STUDIES IN CIVIL ENGINEERING**

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 in advance, by student and instructor. A description of the work to be performed must be filed in the department office.

**CEE 692 ADVANCED TOPICS IN CIVIL ENGINEERING**

1 to 3 credits. Prerequisite: Senior or graduate standing and permission of instructor. 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 423 or CEE 523 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 GRADUATE RESEARCH (NON-THESIS)**

Credit to be arranged; not to exceed three 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 GRADUATE 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 STUDIES IN CIVIL ENGINEERING**

1 to 3 credits; not to exceed three 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 ADVANCED TOPICS IN CIVIL ENGINEERING**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**CEE 798 GRADUATE RESEARCH (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. Prerequisite: Completion of college algebra or equivalent. 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 STUDIES IN COMPUTER ENGINEERING**

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 maximum of six credits of independent studies is allowed for degree credits.

**CENG 292 SPECIAL TOPICS IN COMPUTER ENGINEERING**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. 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 or permission of instructor. Assembly language including addressing techniques, index registers, concepts of machine organization, program linkage and other topics. Does not include the math coprocessor. This course is cross-listed with CSC314/314L. 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 credits)

**CENG 391 INDEPENDENT STUDIES IN COMPUTER ENGINEERING**

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 preparations of papers, as agreed to in advance, by student and instructor. A maximum of six credits of special topics is allowed for degree credits.

**CENG 392 SPECIAL TOPICS IN COMPUTER ENGINEERING**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. A maximum of six credits of special topics is allowed for degree credits.

**CENG 400 UNDERGRADUATE RESEARCH**

Credits to be arranged; not to exceed four credits towards fulfillment of B.S. degree requirements. Prerequisite: Permission of department chair, junior or senior standing. Directed research investigation of a selected problem culminating in an acceptable written report. Taught as required.

**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 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 credits)

**CENG 444/444L COMPUTER NETWORKS**

(3-1) 4 credits. Prerequisite: CENG 244, MATH 381 or 481. 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 441. (Design content - two 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 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 - 2 credits)

**CENG 448/448L VLSI DESIGN**

(3-1) 4 credits. Prerequisite: EE 321. 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 credits)

**CENG 464 COMPUTER ENGINEERING DESIGN I**

(2-0) 2 credit. Prerequisites: CENG 342, EE 321. Prerequisite or corequisite: EE 311, EE 312, CSC477, 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 492. 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 credits)

**CENG 465 COMPUTER ENGINEERING DESIGN II**

(2-0) 2 credits. Prerequisite: CENG 491. 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 credits)

**CENG 472 OPERATING SYSTEMS**

(3-0) 3 credits. Prerequisites: CSC 371, 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 472.

**CENG 491 INDEPENDENT STUDIES IN COMPUTER ENGINEERING**

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 maximum of six credits of special topics is allowed for degree credits.

**CENG 492 SPECIAL TOPICS IN COMPUTER ENGINEERING**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. A maximum of six credits of special topics is allowed for degree credits.

**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 117/117L PROFESSIONAL PRACTICES IN CHEMICAL ENGINEERING**

(2-1) 3 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, credits to be arranged. 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: concurrent registration in CHEM 114 and PHYS 211. The first course on the theory and practice of Chemical Engineering. A study of engineering measurements, real and ideal gas calculations, material balances, 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 233 PROCESS MEASUREMENTS AND CONTROL**

(1-0) 1 credit. Prerequisite or corequisite: CHE 217. A study of the equipment and techniques used in monitoring process measurements and the design of feedback control systems.

**CHE 262 PROCESS MEASUREMENTS LAB**

(0-1) 1 credit. Prerequisite or corequisite: CHE 233. Laboratory experiments in process measurements and feedback control loops.

**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 350 COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING**

(2-0) 2 credits. Prerequisites: CHE 217, CHE 117, concurrent with MATH 321 or permission of instructor. The application of digital computer techniques to the solution of chemical engineering problems.

**CHE 361 CHEMICAL ENGINEERING LABORATORY II**

(0-2) 2 credits. Prerequisite or corequisite: CHE 218 and CHE 233. 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 400 UNDERGRADUATE RESEARCH**

Credit to be arranged. Prerequisite: Junior or senior standing. Directed research investigation of a selected problem culminating in an acceptable written report. A maximum of six (6) credits of undergraduate research will be allowed for degree credit.

**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 443 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 444/544 REACTOR DESIGN**

(3-0) 3 credits. Prerequisites: CHE 443, CHE 350. 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 enrolling in CHE 544 will be held to a higher standard than those enrolling 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 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 enrolling in CHE 545 will be held to a higher standard than those enrolling 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 enrolling in CHE 550 will be held to a higher standard than those enrolling 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 enrolling in CHE 555 will be held to a higher standard than those enrolling 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

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 431. A continuation of CHE 431.

**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 or three credits, depending upon the particular level of course matter that matches their interest. Students taking 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 enrolling in CHE 574 will be held to a higher standard than students enrolling 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 enrolling in CHE 575 will be held to a higher standard than students enrolling in CHE 475.

**CHE 484/584 FUNDAMENTALS OF BIOCHEMICAL ENGINEERING**

(3-0) 3 credits. Prerequisite: Senior standing, or permission of instructor. 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 enrolling in CHE 584 will be held to a higher standard than those enrolling 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 enrolling in CHE 585 will be held to a higher standard than those enrolling in CHE 485.

**CHE 491 INDEPENDENT STUDIES IN CHEMICAL ENGINEERING**

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 492 SPECIAL TOPICS IN CHEMICAL ENGINEERING**

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 special topics 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 STUDIES IN CHEMICAL ENGINEERING**

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 ADVANCED TOPICS IN CHEMICAL ENGINEERING**

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 GRADUATE RESEARCH (NON-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. 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 GRADUATE RESEARCH (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 095 INTRODUCTORY CHEMISTRY**

(3-0) 3 credits. Prerequisite: One year of high school algebra or concurrent registration in MATH 021. Designed primarily for the student with no high school chemistry or for the student who wishes a review prior to enrolling in CHEM 112. Provides a brief but comprehensive survey of important chemical principles such as stoichiometry, atomic structure, chemical bonding, states of matter, solutions, acids and bases, and an introduction to chemical equilibria. May not be used for credit toward any baccalaureate or associate degree. Not recommended for nursing majors.

**CHEM 106 CHEMISTRY SURVEY**

(3-0) 3 credits. Corequisite: MATH 102. A one-semester survey of general chemistry for students in allied-health fields and students not requiring an



extensive chemistry background. Introduction to the properties of matter, atomic structure, bonding, stoichiometry, kinetics, equilibrium, states of matter, solutions, and acid-base concepts. Duplicate credit for CHEM 106 and CHEM 112 not allowed. 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 or CHEM 112. A survey of the chemical principles important to biological systems. 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 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. Prerequisites: A passing score on the Chemistry Placement Test, completion of one year of high school chemistry, and MATH 102 or concurrent enrollment in MATH 102. A C- or better grade in CHEM 095 may substitute for the Chemistry Placement Test. An in-depth examination of principles of chemistry including properties of matter, atomic structure, stoichiometry, reactions in aqueous solution, thermochemistry, electronic structure, periodic properties, bonding, states of matter, intermolecular forces, and the properties of solutions.

**CHEM 112L GENERAL CHEMISTRY I LAB**

(0-1) 1 credit. Prerequisite or corequisite: CHEM 112. The fundamentals of chemical laboratory techniques and practice, the behavior of chemical compounds and quantitative measurements illustrating the laws of chemical combination.

**CHEM 114 GENERAL CHEMISTRY II**

(3-0) 3 credits. Prerequisite: CHEM 112 completed with a grade of C- or better. Chemical thermodynamics; kinetics; gaseous and acid-base equilibria; electrochemistry and redox reactions; selected topics in the descriptive chemistry of the elements.

**CHEM 114L GENERAL CHEMISTRY II LAB**

(0-1) 1 credit. Prerequisite: CHEM 112L. Prerequisite or corequisite: CHEM 114. A laboratory course 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 115. 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 the elements. Periodic properties of the elements; fundamental chemical bonding and structure; acid-base and redox reactions; nonaqueous solvents; introduction to coordination complexes; main group and transition metal chemistry.

**CHEM 290 CHEMISTRY SEMINAR**

(.5-0) .5 credits. Prerequisite: Freshman or sophomore standing in the chemistry curriculum. A seminar in which students will present library and laboratory research on current topics in chemistry. Repeatable for a maximum of two credits.

**CHEM 292/292L 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 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. The chemistry of carbon compounds, including structure, preparation and reactions of aliphatic and alicyclic hydrocarbons. Conformational analysis, isomerism, stereochemistry, chemical intermediate stability, nucleophilic substitution, and elimination reactions are introduced. Free-radical and ionic mechanisms are represented using arrow formalism as an important tool to model product prediction.

**CHEM 326L EXPERIMENTAL ORGANIC CHEMISTRY I**

(0-2) 2 credits. Prerequisites or corequisites: CHEM 114L and CHEM 326. A laboratory 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. The structures, properties, syntheses, and reactions of remaining classes of organic molecules are considered in detail utilizing concepts of reaction mechanism representation introduced in CHEM 326. Principles of organic spectrometry with spectral interpretation are presented. Syntheses and use of the 50 top industrial organic chemicals are described.

**CHEM 328L EXPERIMENTAL ORGANIC CHEMISTRY II**

(0-2) 2 credits. Prerequisite: CHEM 327. Prerequisite or corequisite: CHEM 328. Syntheses of organic compounds. Structural characterization is performed by instrumental methods of analysis including infra-red and nuclear magnetic resonance spectrometry.

**CHEM 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 BIOL 332.

**CHEM 332 ANALYTICAL CHEMISTRY**

(3-0) 3 credits. Prerequisite: CHEM 114. An introduction to modern analytical chemistry. Advanced topics in the theory and application of acid-base and solubility equilibria; titrimetric and gravimetric analysis; and the statistical treatment of data. Spectroscopic methods (UV-Vis, IR and AA) of analysis are introduced.

**CHEM332L ANALYTICAL CHEMISTRY LAB**

(0-1) 1 credit. Prerequisite or corequisite: CHEM 114L. Laboratory to accompany CHEM 230 and CHEM 232. 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: PHYS 213. Physical transformations of pure substances; simple mixtures and phase diagrams; chemical equilibrium and equilibrium electrochemistry. Duplicate credit for CHEM 341 and 342 not allowed.

**CHEM 342 PHYSICAL CHEMISTRY I**

(3-0) 3 credits. Prerequisites: CHEM 114, MATH 225. Prerequisite or corequisite: PHYS 213. 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 342 not allowed.

**CHEM 343 PHYSICAL CHEMISTRY FOR ENGINEERS II**

(2-0) 2 credits. Prerequisites: CHEM 341 and PHYS 213. Kinetic theory of gases; statistical thermodynamics and properties of solids; chemical kinetics and kinetics at interfaces. Duplicate credit for CHEM 343 and 344 not allowed.

**CHEM 344 PHYSICAL CHEMISTRY II**

(3-0) 3 credits. Prerequisites: CHEM 342 and PHYS 213. 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 344 not allowed.

**CHEM 345 PHYSICAL CHEMISTRY I AND II LAB**

(0-1) to (0-2) 1 to 2 credits. Prerequisites: CHEM 220 or CHEM 326L, CHEM 232L, and CHEM 342. Prerequisite or corequisite: CHEM 344.

Experimental methods used in modern physical chemistry. Spectroscopic, kinetic, thermostatic, and electrochemical techniques are studied. Chemistry majors must register for two credits; chemical engineering majors register for one credit.

**CHEM 370 CHEMICAL LITERATURE**

(1-0) 1 credit. Prerequisites: CHEM 230 or CHEM 232 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 400 UNDERGRADUATE RESEARCH**

1 to 3 credits. Prerequisites: Advanced standing in the chemistry curriculum and permission of instructor. Research in chemistry including library and laboratory work supplemented by conferences with the instructor. A maximum of six (6) credit hours of undergraduate research will be allowed for degree credit.

**CHEM 420 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.

**CHEM 421/521 SPECTROSCOPIC ANALYSIS**

(3-0) 3 credits. Prerequisites: CHEM 230 or CHEM 232 and CHEM 328. Problems involving library and laboratory work. Students enrolling in CHEM 524 will be held to a higher standard than those enrolling in CHEM 424.

**CHEM 426/526 POLYMER CHEMISTRY**

(3-0) 3 credits. Prerequisites: CHEM 328 and CHEM 340 or CHEM 342. Fundamental polymer chemistry with discussions of monomers, polymer synthesis, structure, properties, characterization, additives, and overview of technology. Students enrolling in CHEM 526 will be held to a higher standard than those enrolling in CHEM 426.

**CHEM 434 INSTRUMENTAL ANALYSIS**

(3-0) 3 credits. Prerequisites: CHEM 230 or CHEM

232, CHEM 233 and CHEM 342. Topics include electroanalytical and thermal (TGA and DSC) methods of analysis and an introduction to chromatography (TLC, GC, and HPLC).

**CHEM 434L INSTRUMENTAL ANALYSIS LAB**

(0-2) 2 credits. Prerequisite or corequisite: CHEM 434. The laboratory to accompany CHEM 434 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. A discussion of the characteristics, SIC codes, and sectors of the chemical industry, upstream and downstream considerations, raw materials processing, fuels, and categories of industrial organic chemicals including commodity and fine organic chemicals. Students enrolling in CHEM 544 will be held to a higher standard than those enrolling in CHEM 444.

**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 enrolling in CHEM 548 will be held to a higher standard than those enrolling in CHEM 448.

**CHEM 452/552 INORGANIC CHEMISTRY**

(3-0) 3 credits. Prerequisites: CHEM 252, CHEM 328. Prerequisite or corequisite: CHEM 342. Discussion of the important models and concepts of modern inorganic chemistry. Students enrolling in CHEM 552 will be held to a higher standard than those enrolling in CHEM 452.

**CHEM 452L/552L INORGANIC CHEMISTRY LAB**

(0-1) 1 credit. Prerequisites: CHEM 434 and CHEM 435, concurrent CHEM 452. 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 enrolling in CHEM 553 will be held to a higher standard than those enrolling in CHEM 453.

**CHEM 455/555 ADVANCED INORGANIC CHEMISTRY**

(3-0) 3 credits. Prerequisite: CHEM 452. Contemporary inorganic chemistry; emphasis placed on nonaqueous solvents, organometallic compounds, and compounds of the representative elements. Students enrolling in CHEM 555 will be held to a higher standard than those enrolling 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 enrolling in CHEM 560 will be held to a higher standard than those enrolling in CHEM 460.

**CHEM 460L BIOCHEMISTRY LAB**

(0-1) 1 credit. Laboratory experiments in biochemistry including buffers; amino acid titration; protein isolation, characterization, and analysis; enzyme kinetics; nucleic acid isolation and characterization; spectrometric analysis of vitamins; and other experiments to correlate with selected lecture topics.

**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 enrolling in CHEM 580 will be held to a higher standard than those enrolling in CHEM 480.

**CHEM 482/582 ENVIRONMENTAL CHEMISTRY**

(3-0) 3 credits. Prerequisites: CHEM 314 or CHEM 328. The study of pollutants and their reactions, fate and transport in air, water and soil environments. Specific pollutants discussed include heavy metals, pesticides, and herbicides. Laboratory included. Students enrolling in CHEM 582 will be held to a higher standard than those enrolling 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 enrolling in CHEM 582L will be held to a higher standard than those enrolling in CHEM 482L.

**CHEM 490 SENIOR SEMINAR**

(.5-0) .5 credits. Prerequisite: Junior or senior standing in the chemistry curriculum. A seminar in which students will present library and laboratory research on current topics in chemistry. Repeatable for a maximum of two credits.

**CHEM 491 INDEPENDENT STUDY IN CHEMISTRY**

1 to 3 credits. 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 maximum of six (6) credits of special topics and independent study credits will be allowed for degree credit.

**CHEM 492 SPECIAL TOPICS IN CHEMISTRY**

(1, 2 or 3-0) 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 special topics and independent study credits 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, electrochemistry, 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 692 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: One full academic year of studies and have maintained a minimum 2.0 GPA. Credit is available for each semester or summer work experience upon approval by the departmental Cooperative Education Coordinator. After accepting an offer of a co-op position, students should notify Career Planning of their co-op employer, location, and dates. Students will be expected to utilize specialized skills learned in the classroom and to develop human relation 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 will include but not be limited to a written report of the work experience and an employer's evaluation of work performance. 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 CAREER PLANNING-COOPERATIVE INTERNSHIP**

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. This course is intended for the non-technical student who needs a solid understanding of basic computer concepts and terminology in order to make intelligent use of, and informed decisions about, computers. Topics covered include uses of computers, hardware devices, data storage concepts, operating systems, commonly used productivity software, and social and ethical issues in the use of computers. May not be used for credit toward an engineering or science degree (except IS).

**CSC 106 WEB SITE DEVELOPMENT**

(3-0) 3 credits. Prerequisites: CSC 105 or permission of instructor. This course teaches students how the World Wide Web works and how to develop web sites. Topics include: HTML programming; web page design packages; an introduction to the basic multimedia elements of text, images, sound, video, graphics, and animation. Emphasis will be placed on packages for creating and editing the electronic forms of these elements. Also included will be an introduction to operating systems and design language concepts necessary to create a web site.

**CSC 115 HARDWARE/NETWORKING ISSUES ON THE WEB**

(3-0) 3 credits. Prerequisites: CSC 105 (prerequisite) and CSC 106 (corequisite), 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 ADMINISTRATION**

(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. Prerequisites: Completion of college algebra or MATH 115 completed with a grade of "C-" or better or an acceptable score on the Algebra Placement Examination. Problem solving, algorithm development, and basic language syntax including data types, control structures, and procedures and functions will be covered.

**CSC 205 WEB PROGRAMMING I**

(3-0) 3 credits. Prerequisites: CSC 106 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 206 WEB PROGRAMMING II**

(3-0) 3 credits. Prerequisites: CSC 205 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 205 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 or CENG 241 or equivalent or permission of instructor. This course provides an introduction to structured programming principles. It includes fundamental computer science concepts, such as recursion, sorting, dynamic memory allocation, linked lists, and trees.

**CSC 251 FINITE STRUCTURES**

(4-0) 4 credits. Prerequisite: Completion of college algebra or Math 115 completed with a grade of "C-" or better or an acceptable score on the Algebra Placement Examination 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 DATA BASE PROCESSING**

(3-0) 3 credits. Prerequisite: CSC 205; corequisite: CSC 206 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 STUDIES IN COMPUTER SCIENCE I**

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 credit hours.

**CSC 292 SPECIAL TOPICS IN COMPUTER SCIENCE I**

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. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. May be repeated to a total of five credit hours.

#### **CSC 314/314L ASSEMBLY LANGUAGE**

(2-2) 4 credits. Prerequisites: CSC 250 or permission of instructor. Addressing modes, branching, interrupts, machine language, floating-point coprocessor, and concepts of machine organization for the Intel family of processors; also includes general principles of modularity, recursion, and mixed-language programming. This course is cross listed with CENG 314/314L. Graduation credit will not be allowed for both this course and CENG 314/314L.

#### **CSC 341/341L COMPUTER ORGANIZATION AND DESIGN**

(3-1) 4 credits. Prerequisites: CSC 314 and CENG 244, or permission of instructor. This course covers the evolution of computer architecture, CPU organization, combinational and sequential logic implementation of CPU functions, computer arithmetic, data types, hardwired and micro programmed control design, system analysis using simulation, and queuing theory with a lab experience.

#### **CSC 370 PROGRAMMING LANGUAGE CONCEPTS**

(3-0) 3 credits. Prerequisites: CSC 251 and CSC 250, or permission of instructor. Introduction to the theory and practice of programming languages. Theoretical topics include formal languages, programming language paradigms, design issues, specification of syntax and semantics, data abstraction, control mechanisms, scope, parameter passing. Students will also be given a survey of modern programming languages, such as Ada, C++, Lisp, and Prolog.

#### **CSC 371 DATA STRUCTURES**

(4-0) 4 credits. Prerequisites: CSC 251 and CSC 250 or permission of instructor. Considers lists, queues, trees, hashing, and graphs, with emphasis on analysis of algorithms.

#### **CSC 372 ANALYSIS OF ALGORITHMS**

(3-0) 3 credits. Prerequisites: CSC 371 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 STUDIES IN COMPUTER SCIENCE II**

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 credit hours.

#### **CSC 392 SPECIAL TOPICS IN COMPUTER SCIENCE II**

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. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. May be repeated to a total of five credit hours.

#### **CSC 400 UNDERGRADUATE RESEARCH**

Credit to be arranged; not to exceed six credits toward fulfillment of B.S. degree requirements. Junior or senior standing. Directed research investigation of a selected problem culminating in an acceptable report. May be repeated to a total of six credit hours.

#### **CSC 421/521 GRAPHICAL USER INTERFACES**

(3-0) 3 credits. Prerequisite: CSC 371. 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 enrolling in CSC 521 will be held to a higher standard than those enrolling in CSC 421.

#### **CSC 422/522 GUI PROGRAMMING**

(3-0) 3 credits. Prerequisites: CSC 371 or permission of instructor. This course in event-driven graphical user interface (GUI) programming will cover topics such as C++ programming for Windows. Students enrolling in CSC 522 will be held to a higher standard than those enrolling in CSC 422.

#### **CSC 431 THEORY OF COMPUTER GRAPHICS**

(3-0) 3 credits. Prerequisites: CSC 250, CSC 314, and MATH 225 or permission of instructor. Introduction to computer graphics hardware and

software. Drawing points, lines, polygons, simple curves. Coordinate systems, 2-D transformations, windowing, clipping. Drawing complex curves: splines, Bezier curves, fractals. Surfaces, 3-D transformations, projections. Hidden-line and hidden-surface algorithms. Light sources and shading.

**CSC 440/440L ADVANCED DIGITAL SYSTEMS**  
(3-1) 4 credits. Prerequisites: CSC 341 or permission of instructor. Memory and disk systems, bus and I/O 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 441/441L/541/541L DATA COMMUNICATIONS**  
(3-1) 4 credits. Prerequisites: CSC 250 and CENG 244 or permission of instructor. This course provides an introduction to digital communications concepts, characteristics of signals and transfer media, multiplexing, error control, circuit and packet switching, multi-access techniques, A/D and D/A conversion, local area networks. Graduation credit will not be allowed for both this course and CENG 444. This course will provide a two-hour lab experience. Students enrolled in CSC 541/541L will be held to a higher standard than those enrolling in CSC 441/441L.

**CSC 445/545 THEORY OF COMPUTATION**  
(3-0) 3 credits. Prerequisites: CSC 251 or permission of instructor. This course will cover automata as a model of computation, computability, and complexity including the theory of NP-Complete problems. Students enrolling in CSC 545 will be held to a higher standard than those enrolling in CSC 445.

**CSC 451 INTRODUCTION TO ARTIFICIAL INTELLIGENCE**  
(3-0) 3 credits. Prerequisite: CSC 371 or permission of instructor. Introduction to the theory and practice of artificial intelligence. Topics include AI languages such as Lisp or Prolog, problem solving using heuristic state space search, knowledge representations, game playing, expert systems, fuzzy logic, and neural networks.

**CSC 464 INTRODUCTION TO DIGITAL IMAGE PROCESSING AND COMPUTER VISION**  
(3-0) 3 credits. Prerequisites: CSC 371 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.

**CSC 465 SENIOR DESIGN PROJECT**  
(3-0) 3 credits. Prerequisites: CSC 477 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 471 THEORY OF COMPILERS** (3-0) 3 credits. Prerequisites: CSC 314, CSC 370, and CSC 371 or permission of instructor. Course covers formal languages, parsing, design of compilers, assemblers, and translators.

**CSC 472/472L OPERATING SYSTEMS**  
(3-1) 4 credits. Prerequisites: CSC 314 and CSC 371 or permission of instructor. This course will cover operating systems in large mainframes, minicomputers, workstations, and personal computers. It will include memory management, job scheduling, queuing, paging, device management, concurrent processing, interprocess communication, and virtual systems. Graduation credit will not be allowed for both this course and CENG 472.

**CSC 473 PARALLEL COMPUTING**  
(3-0) 3 credits. Prerequisites: CSC 472 or permission of instructor. This is an introductory course in parallel computing. This course will cover concurrent and parallel programming, the parallel architectures, and algorithms. Specific topics from threads, message passing, clustering, and high performance computing will be discussed.

**CSC 477 SOFTWARE ENGINEERING**  
(3-0) 3 credits. Prerequisites: CSC 371 or permission of instructor. This course will cover the study of software engineering principles, tools, and techniques used in the development of high-quality software. It includes software planning, ethical issues, team programming, cost estimation, software life cycles, and documentation milestones. This course together with CSC 478 form a two-course sequence.

**CSC 484 DATABASE MANAGEMENT SYSTEMS**  
(3-0) 3 credits. Prerequisites: CSC 371 or permission of instructor. This course covers database concepts and design with emphasis on the relational database model. Students will study commercial relational database systems and the industry standard language SQL.

**CSC 491 INDEPENDENT STUDIES IN COMPUTER SCIENCE**  
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 credit hours.

#### **CSC 492 SPECIAL TOPICS IN COMPUTER SCIENCE**

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 three credit hours.

#### **CSC 631 COMPUTER GRAPHICS**

(3-0) 3 credits. Scan-conversion algorithms, viewing transformations, visible-surface determination, illumination models, and color theory.

#### **CSC 661 ARTIFICIAL INTELLIGENCE**

(3-0) 3 credits. Prerequisites: CSC 371 or permission of instructor. Knowledge representation, problem solving algorithms, and expert systems.

#### **CSC 673 PARALLEL AND DISTRIBUTED SYSTEMS**

(3-0) 3 credits. Prerequisites: CSC 472 or permission of instructor. This course will cover topics in interprocess communication, synchronization, concurrent programming, parallel processors, distributed networks, and local networks.

#### **CSC 691 INDEPENDENT STUDIES IN COMPUTER SCIENCE**

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 credit hours.

#### **CSC 692 ADVANCED TOPICS IN COMPUTER SCIENCE I**

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 371 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 431 or CSC 631 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 751 IMAGE PROCESSING**

(3-0) 3 credits. Prerequisites: Permission of instructor, with calculus, linear algebra, data structures, and algorithms highly recommended. Image digitization and display, sampling theory, image enhancement and restoration using various spatial, and frequency domain techniques (histogram modification, filtering), Fourier transforms and convolution, image encoding, segmentation, and feature detection.

#### **CSC 752 COMPUTER VISION**

(3-0) 3 credits. Prerequisites: CSC 751 or permission of 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: CSC 661 or 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 371 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 472 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 371 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 GRADUATE RESEARCH (NON-THESIS)**

Credit to be arranged; not to exceed three 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 GRADUATE 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 STUDIES IN COMPUTER SCIENCE**

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 credit hours.

**CSC 792 ADVANCED TOPICS IN COMPUTER SCIENCE**

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. 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 GRADUATE RESEARCH (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. This course focuses on the basic principles of the production and distribution of wealth. History and current issues related to capitalism and resource allocation are developed and applied to microeconomic theory.

**ECON 202 PRINCIPLES OF MACROECONOMICS**

(3-0) 3 credits. Current public issues of economic policy are studied and discussed. A review is completed of government economic policy through history up to and including present public economic policy changes.

**EE 211/211L INTRODUCTION TO ELECTRICAL ENGINEERING I**

(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. 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 212/212L INTRODUCTION TO ELECTRICAL ENGINEERING II**

(3-1) 4 credits. Prerequisites: EE 211 completed with a grade of "C" or better and MATH 321. This course is a continuation of the material covered in EE 211. Topics covered include: balanced three phase circuits, frequency response, two-port networks, Fourier series, Fourier transforms, and Laplace transforms. 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 STUDIES IN ELECTRICAL ENGINEERING**

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 292 SPECIAL TOPICS IN ELECTRICAL ENGINEERING**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**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 212 completed with a grade of "C" or better, EM 219 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 212 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 321/321L ELECTRONICS I**

(3-1) 4 credits. Prerequisite or corequisite: EE 212. Presents concepts of electronic devices and circuits including modeling of semiconductor devices, analysis and design of transistor biasing circuits, and analysis and design of linear amplifiers. Use of computer simulation tools and breadboarding as part of the circuit design process is emphasized. Students are introduced to methods for designing circuits that still meet specifications even when there are statistical variations in the component values.

**EE 322/322L ELECTRONICS II**

(3-1) 4 credits. Prerequisite: EE212 and EE321. A continuation of EE 321 with emphasis on design applications of linear and nonlinear integrated circuits.

**EE 330/330L ENERGY SYSTEMS**

(3-1) 4 credits. Prerequisite: EE 212. 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 or corequisite: EE 211. 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 vector field theory as applied to electric and magnetic phenomena. Electrostatics, magnetostatics, Maxwell's equations, and plane wave phenomena.

**EE 382/382L APPLIED ELECTROMAGNETICS**

(2.5-0.5) 3 credits. Prerequisite: EE 381. This course covers the application of electromagnetic waves to boundary value problems, distributed parameter models, radiation, interference, and diffraction. Typical application systems will include transmission lines, waveguides, and antennas.

**EE 391 INDEPENDENT STUDIES IN ELECTRICAL ENGINEERING**

1 to 4 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 392 SPECIAL TOPICS IN ELECTRICAL ENGINEERING**

1 to 4 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**EE 400 UNDERGRADUATE RESEARCH**

Credit to be arranged: not to exceed four credits toward fulfillment of B.S. degree requirements. Prerequisite: Permission of department chair, junior or senior standing. Directed research investigation of a selected problem culminating in an acceptable written report. Taught as required.

**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 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 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 credits)

**EE 451/451L CONTROL SYSTEMS**

(3-1) 4 credits. Prerequisite: EE 311. Analysis and design of automatic control and process systems by practices encountered in modern engineering practice, including both linear and nonlinear systems with either continuous or discrete signals. (Design content - two 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 credits)

**EE 464 ELECTRICAL ENGINEERING DESIGN I**

(2-0) 2 credits. Prerequisites: Approved math elective. Prerequisite or corequisite: EE 311, EE 312, EE 322, 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 EE 492. 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 credits)

**EE 465 ELECTRICAL ENGINEERING DESIGN II**

(2-0) 2 credits. Prerequisites: EE 491. This course requires students to conduct their own design projects in a simulated industrial environment. Requirements include a detailed laboratory notebook, periodic written and oral progress reports, and a written and oral presentation of a final project report. (Design content - two credits)

**EE 481/481L MICROWAVE ENGINEERING**

(3-1) 4 credits. Prerequisite: EE 480 completed or concurrent. 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 credits)

**EE 482/482L LASER AND OPTO-ELECTRONIC SYSTEMS**

(3-1) 4 credits. Prerequisite: EE 480 completed or concurrent, 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 credits)

**EE 491 INDEPENDENT STUDIES IN ELECTRICAL ENGINEERING**

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 492 SPECIAL TOPICS IN ELECTRICAL ENGINEERING**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**EE 612/612L HIGH-SPEED DIGITAL DESIGN**

(2.5-0.5) 3 credits. Prerequisites: EE 211 and EE 321 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 multirate 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 341 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 341 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 341 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 448. 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 STUDIES IN ELECTRICAL ENGINEERING**

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 ADVANCED TOPICS IN ELECTRICAL ENGINEERING**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**EE 791 INDEPENDENT STUDIES IN ELECTRICAL ENGINEERING**

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 ADVANCED TOPICS IN ELECTRICAL ENGINEERING**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**EE 798 GRADUATE RESEARCH (THESIS)**

Credit to be arranged; not to exceed 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.

**EG 111 ENGINEERING GRAPHICS**

(0-2) 2 credits. A course in graphical

communication, expression and interpretation. The ability to visualize in three dimensions is developed through shape description, sketching and multiview projection exercises. Also includes engineering and architectural scales, engineering lettering, geometric constructions, use of instruments, dimensioning, sectional and auxiliary views. Introduction to descriptive geometry. Solid Works is the primary computer aided drafting tool used.

**EM 214 ENGINEERING MECHANICS (STATICS)**

(3-0) 3 credits. Prerequisite: MATH 125 completed with a grade of "C" or better. 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 ENGINEERING MECHANICS (DYNAMICS)**

(3-0) 3 credits. Prerequisite: EM 214 or EM 217. 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 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 moment equations and diagrams; combined stresses; Mohr's circle; beam deflections; and column action and equations.

**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 216 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 219 ENGINEERING MECHANICS (STATICS AND DYNAMICS)**

(4-0) 4 credits. Prerequisite: MATH 125 completed with a grade of "C" or better. **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 to 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 223 FLUID MECHANICS**

(3-0) 3 credits. Prerequisites: Preceded by or concurrent with EM 216, 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; and laminar and turbulent flow of fluids in closed conduits and around immersed bodies.

**EM 327 APPLIED FLUID MECHANICS**

(4-0) 4 credits. Prerequisites: EM 216, 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 216, EM 217, or permission of instructor. 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 680 ADVANCED STRENGTH OF MATERIALS**

(3-0) 3 credits. Prerequisites: EM 216, 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: Taken concurrently with ENGL 101. This basic writing course focuses on the fundamentals of writing, including syntax and paragraphing, grammar, usage, and punctuation. May not be used toward any baccalaureate or associate degree.

**ENGL 032 BASIC WRITING**

(2-0) 2 credits. Prerequisite: Taken concurrently with ENGL 101. This basic writing course focuses on the fundamentals of writing, including syntax and paragraphing, grammar, usage, and punctuation. May not be used toward any baccalaureate or associate degree.

**ENGL 033 BASIC WRITING**

(3-0) 3 credits. Prerequisite: Taken concurrently with ENGL 101. This basic writing course focuses on the fundamentals of writing, including syntax and paragraphing, grammar, usage, and punctuation. May not be used toward any baccalaureate or associate degree.

**ENGL 101 COMPOSITION I**

(3-0) 3 credits. A practical writing course emphasizing basic language conventions, style, and the organization and development of expository prose.

**ENGL 201 COMPOSITION II**

(3-0) 3 credits. Prerequisite: ENGL 101 or equivalent. A continuation of ENGL 101, with emphasis on literary analysis and appreciation. Requires a research report. (If not used as a requirement, this course counts as one credit humanities and two credits free elective.)

**ENGL 221 BRITISH LITERATURE I**

(3-0) 3 credits. A chronological survey of British literature before the Nineteenth Century. Covers works from the Anglo-Saxon and Medieval periods, the Renaissance, the Restoration, and the Eighteenth Century.

**ENGL 222 BRITISH LITERATURE II**

(3-0) 3 credits. Continues the survey of British literature with the Romantic Movement, the Victorian Age, and the Twentieth Century.

**ENGL 241 AMERICAN LITERATURE I**

(3-0) 3 credits. A study of representative works by major American writers from the colonial period to the mid-nineteenth century.

**ENGL 242 AMERICAN LITERATURE II**

(3-0) 3 credits. A study of representative works by major American writers from the mid-nineteenth century to the present.

**ENGL 250 SCIENCE FICTION**

(3-0) 3 credits. Study of the historical and philosophical roots of the science fiction genre with special emphasis on science fiction as a medium for predicting and understanding changes in future society.

**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: Junior or senior standing. Introduces relevant background material, but emphasizes understanding and appreciation of each play as a self-sufficient, integrated work.

**ENGL 343 SELECTED AUTHORS**

(1-0) 1 credit. Prerequisite: Junior or senior standing. Readings in the original works of a major American, English, or world author. May be taken up to three 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 or senior standing. Offers systematic study of prose types and styles, practical experience in writing articles and essays, and workshop critiques of student writings.

**ENGL 391 INDEPENDENT STUDIES IN TECHNICAL COMMUNICATIONS**

1 to 3 credits. Prerequisite: Permission of department chair. 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.

**ENGL 392 SPECIAL TOPICS IN TECHNICAL COMMUNICATIONS**

1 to 3 credits. Prerequisite: Junior or senior standing or permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. A maximum of six (6) credits of special topics will be allowed for degree credit.

**ENGL 468 CONTEMPORARY FICTION**

(3-0) 3 credits. Prerequisite: Junior or senior standing. Aims to reveal significant trends in modern fiction through a close examination of selected major American and European novels of the twentieth century.

**ENVE 201 INTRODUCTION TO MINING AND EXPLORATION**

(3-0) 3 credits. The principles of discovery, development, and operation of mineral properties with background material for the more advanced work that follows. Subjects include the fundamentals of exploration, mining law, mine development, surface and underground mining operations, ore reserve calculations, mineral processing, mine maintenance, and safety. This course is cross-listed with MINE 201.

**ENVE 217 CHEMICAL ENGINEERING I**

(3-0) 3 credits. Prerequisites: Concurrent registration in CHEM 114 and PHYS 211. The first course on the theory and practice of Chemical Engineering. A study of engineering measurements, real and ideal gas calculations, material balances, 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 302 SURFACE MINING**

(3-0) 3 credits. Prerequisites: MINE 201. Surface mining techniques including mine design and planning; surface drilling and blasting; the applicability and performance characteristics of earth-moving equipment; and an introduction to slope stability and mine drainage. This course is cross-listed with MINE 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 flotation, 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 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 MET 310L.

**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 205, 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 223, 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 MINE 326.

#### **ENVE 327/327L WATER AND WASTE WATER TREATMENT**

(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 of the design and analysis of municipal water and waste water treatment systems. 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 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 400 UNDERGRADUATE RESEARCH**

1 to 6 credits. Prerequisite: Junior or senior standing. Credits toward fulfillment of B.S. degree requirements. Directed research investigation of a selected problem culminating in an acceptable written report. Oral defense of the report and research findings are required.

#### **ENVE 423/523 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 enrolling in

ENVE 523 will be held to a higher standard than those enrolling in ENVE 423. This course is cross-listed with CEE 423/523.

#### **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 enrolling in ENVE 526 will be held to a higher standard than those enrolling 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 of 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 enrolling 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 enrolling in ENVE 527 will be held to a higher standard than those enrolling 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 enrolling in ENVE 528 will be held to a higher standard than those enrolling in ENVE 428. This course is cross-listed with CEE 428/528.

**ENVE 433/433L/533/533L COMPUTER APPLICATIONS IN GEOSCIENCE MODELING**

(3-1) 4 credits. 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 an essential part of the course. Students enrolling in ENVE 533 will be held to a higher standard than those enrolling in ENVE 433. This course is cross-listed with MINE 433/533.

**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 enrolling in ENVE 540 will be held to a higher standard than those enrolling 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 enrolling in ENVE 545 will be held to a higher standard than those enrolling in ENVE 445. This course is cross-listed with MET 445/545, CHE 445/545, ME 445/545.

**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 enrolling in ENVE 555 will be held to a higher standard than those enrolling 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 491. 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 ENGINEERING AND ENVIRONMENTAL GEOLOGY**

(2-1) 3 credits. Prerequisites: GEOE 322, EM 216, and senior standing. The application of geology to engineering, including topics such as landslides, earthquakes, fluvial processes, and land subsidence. Field trips and laboratory exercises illustrate the influence of geology on man's 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. This course is cross-listed with GEOE 466/466L.

**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 491 INDEPENDENT STUDIES IN ENVIRONMENTAL ENGINEERING**

1 to 3 credits. 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.

**ENVE 492 SPECIAL TOPICS IN ENVIRONMENTAL ENGINEERING**

1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**FREN 101 INTRODUCTORY FRENCH I  
FREN 102 INTRODUCTORY FRENCH II**

(4-0) 4 credits each. FREN 101 is open to any

student except those who have had two or more years of high school French or equivalent; prerequisite for FREN 102: FREN 101 or equivalent (no less than two years of high school French). Fundamentals of the language, enabling the student to understand, speak, read, and write simple French.

**FREN 201 INTERMEDIATE FRENCH I  
FREN 202 INTERMEDIATE FRENCH II**

(3-0) 3 credits each. Prerequisite for FREN 201: FREN 102 or equivalent; prerequisite for FREN 202: FREN 201. Studies French life and culture through selected readings. Advances the student's ability to use French.

**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 113 INTRODUCTION TO PERSONAL COMPUTER AND ENGINEERING WORKSTATION PROGRAMMING**

(3-0) 3 credits. Prerequisite: College Algebra completed with a grade of C- or better or its equivalent as determined by the mathematics placement process. The course provides an introduction to engineering problem solving using personal computers and engineering workstations. Emphasis is on EXCEL spreadsheets, and FORTRAN programming. An introduction to using workstations and UNIX is presented. Programming on workstations is covered, including program development, input/output, branching, repetitive loops, subscripted variables, array manipulations, subroutines, compiling and linking. Professional ethics and statistics are introduced. This is course is required for students majoring in chemical engineering. Students majoring in other departments should consult their advisor.

**GE 115/115L PROFESSIONALISM IN ENGINEERING AND SCIENCE**

(1-1) 2 credit. A course based upon professional issues pertinent to engineers and scientists along with an overview of the various engineering and science disciplines. Case studies based upon actual technical problems will be presented by practicing engineers and scientists. These case studies will involve both societal and professional questions. The format for a particular case study will involve an overview of a

particular engineering or science discipline, and introduction to an actual technical problem, and a discussion of the societal implications of decisions that result.

#### **GE 117/117L PROFESSIONALISM IN ENGINEERING AND SCIENCE II**

(1-1) 2 credits. This course is a continuation of GE 115. A survey of team skills, problem solving skills, and communication skills necessary for today's environment. The laboratory component continues the societal and professional questioning required of engineers and scientists through the application of student teams working on applied projects with faculty mentors.

#### **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 211/211L EARTH SYSTEMS ENGINEERING ANALYSIS**

(2-1) 3 credits. Introduction to the application of computational analysis 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. Spreadsheet and word-processing techniques will be used to develop analysis of discipline-specific problems. Techniques for presentation of the data and analysis will be important as well. 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 205, 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 small-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 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 enrolling in GEOE 525 will be held to a higher standard than those enrolling 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 enrolling in GEOE 531 will be held to a higher standard than those enrolling 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 enrolling in GEOE 552 will be held to a higher standard than those enrolling 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.

**GEOE 462 DRILLING ENGINEERING**

(3-0) 3 credits. Prerequisites: EM 216 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 ENGINEERING AND ENVIRONMENTAL GEOLOGY**

(2-1) 3 credits. Prerequisites: GEOE 322 and EM 216. The application of geology to engineering, including topics such as landslides, earthquakes, fluvial processes, and land subsidence. Field trips and laboratory exercises illustrate the influence of geology on man's 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. This course is cross-listed with ENVE 466/466L.

**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 201L, or GEOE 221; GEOL 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 STUDIES IN GEOLOGICAL ENGINEERING**

1 to 3 credits. Student should have obtained permission of an instructor in the Geological Engineering program 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 three credit hours. Research findings are required.

#### **GEOE 492 SPECIAL TOPICS IN GEOLOGICAL ENGINEERING**

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 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. (Experimental)

#### **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 216, 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 STUDIES IN GEOLOGICAL ENGINEERING**

1 to 3 credits. Prerequisite: Senior or graduate standing. 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 ADVANCED TOPICS IN GEOLOGICAL ENGINEERING**

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 GRADUATE 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 GRADUATE RESEARCH (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 RESEARCH**

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 COLLEGE GEOGRAPHY**

(3-0) 3 credits. This course is designed to help students understand and analyze our world from a geographic point of view. It will provide an overview of the many aspects of geography, both cultural and physical. It also emphasizes the unique quality of world regions, the spatial relation of world regions, and shared problems.

**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 300 CULTURAL GEOGRAPHY**

(3-0) 3 credits. Prerequisites: GEOG 101, GEOG 240 or GEOG 250. Cultural geography compares the changing distribution of culture areas with the distribution of other features of Earth's surface. It describes and classifies cultural landscapes. These landscapes are the result of the progressive manipulation of the physical environment by



humans. Cultural diffusion, the spread of cultural elements, is emphasized, as is cultural ecology, the complex relationship between a culture and its physical setting.

### **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. 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. Engineering implications of geological processes are emphasized throughout the course. GEOL 201L should be taken concurrently.

### **GEOL 201L PHYSICAL GEOLOGY LABORATORY**

(0-1) 1 credit. Prerequisites: GEOL 201 or concurrent registration. 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 271 THE SEARCH FOR OUR PAST**

(3-0) 3 credits. The history of life on earth as revealed by fossils with emphasis on the principles used in interpretation of fossils, the common fossils of South Dakota, and human origin. This course is cross-listed with PALE 271.

### **GEOL 276 DINOSAURS**

(3-0) 3 credits. An introduction to the study of dinosaurs with emphasis on their origin, diversification, ecology, and extinction. This course is cross-listed with PALE 276.

### **GEOL 321 HISTORICAL GEOLOGY**

(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 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 372/372L VERTEBRATE PALEONTOLOGICAL 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. This course is cross-listed with PALE 372/372L.

**GEOL 403/503 REGIONAL FIELD GEOLOGY**  
(0-1) 1 credit. Prerequisites: GEOL 201 or GEOE211. A one-week guided field trip to an area of outstanding geologic interest. Students enrolling in GEOL 503 will be held to a higher standard than those enrolling 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 enrolling in GEOL 507 will be held to a higher standard than those enrolling 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 small 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 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 enrolling in GEOL 513 will be held to a higher standard than those enrolling 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 enrolling in GEOL 516 will be held to a higher standard than those enrolling in GEOL 416.

**GEOL 417/417L/517/517L GIS II: SPATIAL DATABASE DEVELOPMENT**

(2-1) 3 credits. Prerequisite: GEOL 416 or GEOL516 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 Arc/Info, the most utilized GIS software in science, government, and industry. Lab assignments include hands-on practice downloading, processing, editing, and digitizing map and image data. Students are expected to complete a semester GIS project that relates to their own research interests. Students enrolling in GEOL 517 will be held to a higher standard than those enrolling in GEOL 417.

**GEOL 419/519 GIS III: ADVANCED GIS ANALYSIS**

(3-0) 3 credits. Prerequisites: GEOL 417 or GEOL517 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 enrolling in GEOL 519 will be held to a higher standard than those enrolling in GEOL 419. May be repeated once for additional credit.

**GEOL 442/442L/542/542L OPTICAL PETROLOGY**

(2-1) 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 enrolling in GEOL 542 will be held to a higher standard than those enrolling in GEOL 442.

**GEOL 464 SENIOR RESEARCH I**

3 or 6 credits. Prerequisite: GEOL 410. 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. This course is cross-listed with PALE 4464.

**GEOL 465 SENIOR RESEARCH II**

3 or 6 credits. Prerequisite: GEOL 410. 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. This course is cross-listed with PALE 465.

**GEOL 471/471L INVERTEBRATE PALEONTOLOGY**

(2-1) 3 credits. Prerequisites: GEOL 321. 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. This course is cross-listed with PALE 471/471L.

**GEOL 472/472L 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. This course is cross-listed with PALE472.

**GEOL 491 INDEPENDENT STUDIES IN GEOLOGY**

1 to 3 credits. Student should have obtained permission of an instructor in the Department of Geology and Geological Engineering 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 three credit hours. This course is cross-listed with PALE 491.

**GEOL 492 SPECIAL TOPICS IN GEOLOGY**

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 office. This course is cross-listed with PALE 492.

**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 lithotectonic 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-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 MICROPALAEONTOLOGY**

(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 STUDIES IN GEOLOGY**

1 to 3 credits. Prerequisite: Senior standing. 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 ADVANCED TOPICS IN GEOLOGY**

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 GRADUATE 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 GRADUATE RESEARCH (THESIS)**

Credit to be arranged; not to exceed six credits towards 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 GEOLOGY AND GEOLOGICAL ENGINEERING**

(3-0) 3 credits. The course available only for doctoral candidates involves description, analysis, and proposed methods of attack of long-standing,

fundamental geologic and geological engineering problems. Independent work is emphasized with goals of understanding these basic questions and proposing practical designs and experiments for their solution.

#### **GEOL 898 DISSERTATION RESEARCH**

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. GER 101 is open to any student except those who have had two or more years of high school German or equivalent; pre-requisite for GER 102: GER 101 or equivalent (no less than two years of high school German). Fundamentals of the language, enabling the student to understand, speak, read, and write simple German.

#### **HIST 121 WESTERN CIVILIZATION TO 1648**

(3-0) 3 credits. The focus of this course is on the social, economic, political and cultural history from the earliest Western societies to the Reformation. The course also covers the religious wars, focusing upon the Greco-Roman civilization, early Christianity, Islam, the successor states to Rome, medieval civilization, the Renaissance, the new monarchies, the Reformation, wars of religion, the age of exploration, scientific discoveries, and economic transformation.

#### **HIST 122 WESTERN CIVILIZATION SINCE 1648**

(3-0) 3 credits. A social, economic, political and cultural history of Western society from the religious wars of the seventeenth century to the present, focusing upon the rise of absolutism, the rise of the scientific world view, the Enlightenment, the economic and political revolutions of the eighteenth century, the development of nationalism, liberalism, socialism and imperialism in the nineteenth century, and wars and revolutions of the twentieth century.

#### **HIST 151 AMERICAN HISTORY TO 1877**

(3-0) 3 credits. This course is a survey of American history in all its phases - political, social, economic, and intellectual - from exploration period through the Reconstruction (1500-1877).

#### **HIST 152 AMERICAN HISTORY SINCE 1877**

(3-0) 3 credits. A survey of American history in all its phases - political, social, cultural, economic, and intellectual - from 1877 to the present.

#### **HIST 360 STUDIES IN HISTORY**

(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. A prior college level history course is recommended. The interdisciplinary study of selected periods, problems, or topics in history. 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 course introduces students to humanistic knowledge and inquiry by focusing on connections among humanities disciplines (such as art, languages, literature, music, philosophy, and religion) as they have appeared throughout the history of western civilization.

#### **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 STUDIES IN HUMANITIES**

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.

#### **HUM 292 SPECIAL TOPICS IN HUMANITIES**

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 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.

#### **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 STUDIES IN HUMANITIES**

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.

**HUM 492 SPECIAL TOPICS IN HUMANITIES**

1 to 3 credits. Prerequisite: Junior or senior standing or permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. 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. Prerequisite: IENG/MATH 381 concurrently. 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 HUMAN FACTORS ENGINEERING**

(2-1) 3 credits. Prerequisite: MATH 281 or IENG/MATH 381. 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 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 BAD 345.

**IENG 362 STOCHASTIC MODELS**

(3-0) 3 credits. Prerequisite: MATH 321 or Math 315 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 381 INTRODUCTION TO PROBABILITY AND STATISTICS**

(3-0) 3 credits. Prerequisite: MATH 225 concurrently. 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 BAD 291. 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 481. Development of computer simulation models of real or conceptual systems. Interpretation of results of computer simulation experiments.

#### **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 464 SENIOR DESIGN PROJECT I**

(0-3) 3 credits. Prerequisite: Senior standing or graduation within 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 478. 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 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 485 STATISTICAL QUALITY AND PROCESS CONTROL**

(3-0) 3 credits. Prerequisites: IENG 381 or MATH 481 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 485.

#### **IENG 491 INDEPENDENT STUDIES IN INDUSTRIAL ENGINEERING**

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.

#### **IENG 492 SPECIAL TOPICS IN INDUSTRIAL ENGINEERING**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

#### **IS 191 INDEPENDENT STUDIES IN INTERDISCIPLINARY STUDIES**

1 to 3 credits. Prerequisite: Permission of instructor. This is a directed independent study of a topic agreed upon by the student and a faculty member willing to supervise the project.

#### **IS 192 SPECIAL TOPICS IN INTERDISCIPLINARY STUDIES**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture or seminar on a topic of special interest as determined by the faculty. A maximum of six credits will be allowed for degree credit.

#### **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.

#### **IS 291 INDEPENDENT STUDIES IN INTERDISCIPLINARY STUDIES**

1 to 3 credits. Prerequisite: Permission of Instructor. This is a directed independent study of a topic agreed upon by the student and a faculty member willing to supervise the project.



**IS 292 SPECIAL TOPICS IN INTERDISCIPLINARY STUDIES**

1 to 3 credits. Prerequisite: Permission of Instructor. Lecture or seminar on a topic of special interest as determined by the faculty. A maximum of six credits will be allowed for degree credit.

**IS 370 APPLICATIONS OF RESEARCH METHODS USING COMPUTER SYSTEMS**

(1-0) 1 credit. Prerequisite: CSC 106 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.

**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.

**IS 391 INDEPENDENT STUDIES IN INTERDISCIPLINARY STUDIES**

1 to 3 credits. Prerequisite: Permission of instructor. This is a directed independent study of a topic agreed upon by the student and faculty member willing to supervise the project.

**IS 392 SPECIAL TOPICS IN INTERDISCIPLINARY STUDIES**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture or seminar on topic of special interest as determined by the faculty. A maximum of six credits will be allowed for a degree credit.

**IS 464 RESEARCH METHODS FOR THE INTERDISCIPLINARY STUDIES**

(3-0) 3 credits. Prerequisites: Junior class standing and ENGL 289. This course provides students with a basic understanding of the various types of research methods used by scholars in the Humanities and in the Social and Behavioral Sciences. Students formulate and present a research proposal/project. The course presents both qualitative and quantitative research techniques. This course is required in the IS degree program.

**IS 465 SENIOR PROJECT**

(0-3) 3 credits. Prerequisite: Senior standing, an approved Letter of Intent on file in the IS Office, and successful completion of IS 464. During this course the senior project or capstone experience will be

completed on the topic agreed upon by the student and the professor. Classroom topics will also include such areas as professionalism and entry to the world of professional work. This course is required in the IS degree program.

**IS 491 INDEPENDENT STUDIES IN INTERDISCIPLINARY STUDIES**

1 to 3 credits. Prerequisite: Permission of instructor. This is a directed independent study of a topic agreed upon by the student and a faculty member willing to supervise the project.

**IS 492 SPECIAL TOPICS IN INTERDISCIPLINARY STUDIES**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture or seminar on a topic of special interest as determined by the faculty. A maximum of six credits will be allowed for degree credit.

**IS 691 INDEPENDENT STUDIES IN INTERDISCIPLINARY STUDIES**

.5 to 3 credits. Prerequisite: Permission of department chair. 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.

**IS 692 SPECIAL TOPICS IN INTERDISCIPLINARY STUDIES**

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**JAPN 101 JAPANESE CULTURE AND LANGUAGE I**

(3-0) 3 credits. A survey of modern Japanese history with emphasis on the nation's culture and on fundamentals of the Japanese language enabling the student to conduct simple conversation and recognize 100 Japanese characters.

**JAPN 102 JAPANESE CULTURE AND LANGUAGE II**

(3-0) 3 credits. Prerequisite: JAPN 101 or equivalent. A continuation of JAPN 101 with emphasis on ancient and medieval Japanese history and culture. Includes additional fundamentals of the Japanese language beyond those included in JAPN 101.

**LAK 101 LAKOTA LANGUAGE I**

(3-0) 3 credits. This is an introduction to the Lakota Language. Emphasis will be placed on the Lakota alphabet, kinship terms, numerical system and simple sentence structure. Added emphasis will be on active everyday survival, language skills - speaking the language. Writing will be minimal. (Offered in collaboration with Oglala Lakota College).

**LAK 102 LAKOTA LANGUAGE II**

(3-0) 3 credits. Prerequisite: LAK 101. A course designed to continue teaching correct pronunciation of Lakota, the fundamentals of grammar, a mastery and increase of basic vocabulary and idiomatic expressions with additional emphasis on reading and writing in Lakota. Students will be expected to compose original short stories and to retell them. The emphasis will be on verbal skills. (Offered in collaboration with Oglala Lakota College.)

**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. This course will cover signed numbers, absolute values, fractions, polynomials and their operations, factoring, solution of first-degree equations, solution of simultaneous equations, exponents, roots, ratio and proportion. This course may not be used for credit for any SDSM&T degree. This course is not adequate preparation for calculus, and those students preparing for calculus should take MATH 102, or MATH 115. May not be used for credit toward any baccalaureate or associate degree.

**MATH 101 INTERMEDIATE ALGEBRA**

(3-0) 3 credits. This course will cover set theory, operations with real numbers, algebraic fractions, polynomials, and radicals. It will also include absolute value, factoring polynomials, solution of linear, quadratic, and simultaneous equations, inequalities, graphing equations, rules of exponents, and functions. May not be used for credit toward a science or engineering major. Those students preparing for Calculus should continue with College Algebra. May not be used for credit toward a baccalaureate degree, but may be used toward the associate degree.

**MATH 102/102L COLLEGE ALGEBRA**

(2-1) 3 credits. Prerequisites: Suitable ACT Math score or COMPASS placement exam score or MATH 101, and concurrent enrollment in MATH 102L. This is a traditional course in college algebra, covering linear equations and inequalities, polynomials, functions, exponents, radicals, quadratic equations, logarithmic and exponential functions, and other topics as time permits. 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: Two years of high school algebra. This course is designed for students who plan to take the calculus sequence. Topics will include polynomial, rational, exponential and logarithmic functions and their graphs; systems of equations and inequalities, and the algebra and geometry of complex numbers. This course is an advanced treatment of college algebra with special emphasis on the study of functions. May not be used for credit toward an engineering or science degree (except for Interdisciplinary Science, Chemistry, and Associate of Arts).

**MATH 120/120L TRIGONOMETRY**

(2-1) 3 credits. Prerequisite: Completion of MATH 102 or MATH 115 completed with a "C-" or better, or an acceptable score on the COMPASS Placement Exam. Covers radian measure, trigonometric functions, vectors, graphing, trigonometric equations and identities, inverse functions, logarithms, complex numbers, and other topics as time permits. 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. Prerequisites: College Algebra. Prerequisite or corequisite Trigonometry. The College Algebra prerequisite can be met by completing MATH 102 (College Algebra) with a grade of "C-" or better or by an acceptable score on the Algebra Placement Examination. The Trigonometry requirement can be met by completing MATH 120 (Trigonometry) with a grade of "C-" or better, or by achieving an acceptable score on the Trigonometry Placement Examination, or by concurrent enrollment in MATH 120. (Concurrent enrollment in MATH 123 and MATH 120 will not be allowed for students whose Trigonometry Placement Examination scores fall below an established minimum.) Differentiation, antidifferentiation, and integration of algebraic and trigonometric functions with applications in each area.

**MATH 125 CALCULUS II**

(4-0) 4 credits. Prerequisites: MATH 120 (Trigonometry) completed with a grade of "C-" or better or an acceptable score on the departmental Trigonometry Placement Examination, and MATH 123 completed with a grade of "C-" or better. (Trigonometry is a critical prerequisite for this course. Students should ensure that they have passed MATH 120 or the departmental Trigonometry Placement Examination before enrolling in MATH 125.) Continuation of MATH 123 for transcendental functions, integration techniques, infinite series, parametric curves, and polar coordinates.

**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 grade of "C-" or better. Polar coordinates, vector functions, functions of several variables, multiple and line integrals. MATH 225 and 321 may be taken concurrently or in either order.

**MATH 241 MATHEMATICS OF FINANCE**

(3-0) 3 credits. Prerequisite: College algebra or MATH 115 or equivalent completed with a grade of "C-" or better. The course directs itself toward such day-to-day money matters as finance charges, mortgage payments, retirement annuities, bonds, and life insurance.

**MATH 281 INTRODUCTION TO STATISTICS**

(3-0) 3 credits. Prerequisite: Completion college algebra or MATH 115 or equivalent completed with a grade of "C-" or better. Study of descriptive statistics including measures of central tendency, variability, sampling distributions, regression, correlations, and applications. Course is designed for students in medical and interdisciplinary studies disciplines.

**MATH 291 INDEPENDENT STUDIES IN MATHEMATICS I**

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 credit hours.

**MATH 292 SPECIAL TOPICS I**

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. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. May be repeated to a total of five credit hours.

**MATH 315 LINEAR ALGEBRA**

(4-0) 4 credits. Prerequisite: MATH 225 and MATH 321 or permission of instructor. Vector spaces, linear transformations, and matrices.

**MATH 321 DIFFERENTIAL EQUATIONS**

(4-0) 4 credits. Prerequisite: MATH 125 completed with a grade of "C-" or better. Ordinary differential equations of the first order, linear differential equations, Laplace transformations, systems of equations, numerical analysis, matrix methods, and applications. MATH 225 and 321 may be taken concurrently or in either order.

**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. Prerequisites: MATH 321 and competence in at least one computer programming language or permission of instructor. Numerical solution of algebraic and transcendental equations, solution of systems of equations, calculation of eigenvalues and eigenvectors, curve fitting and interpolation and approximation of functions, numerical differentiation and integration, numerical solution of differential equations. Computer applications are emphasized.

**MATH 381 INTRODUCTION TO PROBABILITY AND STATISTICS**

(3-0) 3 credits. Prerequisite: MATH 225 concurrently. Introduction to probability, discrete and continuous distributions, sampling distributions and central limit theorem, general principles for statistical inference. 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 STUDIES IN MATHEMATICS II**

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 in advance, by student and instructor. May be repeated to a total of five credit hours.

**MATH 392 SPECIAL TOPICS II**

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. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. May be repeated to a total of five credit hours.

**MATH 400 UNDERGRADUATE RESEARCH I**

(1-0) 1 credit. Junior or senior standing required. The student must arrange with a department faculty member to pursue a research investigation of a jointly selected topic.

**MATH 402 UNDERGRAUATE RESEARCH II**

(1-0) 1 credit. Prerequisite: MATH 400. The student will produce a word-processed technical report of research conducted in MATH 400 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. Mathematical systems including the elementary theory of 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. Prerequisites: MATH 423 - MATH 225; MATH 424 - MATH 423. Theoretical treatment of limits, continuity and differentiability of functions of a single variable and of several variables, convergence of sequences and series of functions, implicit function theorems, L'Hospital's Rule, Taylor series, and Riemann integration. Emphasis will be placed on developing students'

skills in understanding and writing mathematical proofs.

**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 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 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 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 332 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**

(3-0) 3 credits. Prerequisites: MATH 373 or CSC 372, or permission of instructor. Interpolation, solution of higher degree algebraic and transcendental equations, least squares, numerical differentiation and integration, direct and iterative methods for solving systems of linear, algebraic equations, approximation theory.

**MATH 485 STATISTICAL QUALITY AND PROCESS CONTROL**

(3-0) 3 credits. Prerequisites: IENG 381 or MATH 481 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 485.

**MATH 491 INDEPENDENT STUDIES ADVANCED**

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 three credit hours.

**MATH 492 SPECIAL TOPICS ADVANCED**

1 to 6 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.

**MATH 685 STATISTICAL APPROACHES TO RELIABILITY**

(4-0) 4 credits. Prerequisite: MATH 481 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 481 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 STUDIES IN MATHEMATICS**

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 ADVANCED TOPICS IN MATHEMATICS**

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.

**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. Introduction to the product

development process. Topics covered include life-cycle design, engineering and management aspects of manufacturing processes, automated manufacturing, the relationship of technology to society. Students work in teams to produce an actual prototype.

**ME 311 ENGINEERING THERMODYNAMICS**

(3-0) 3 credits. Prerequisites: ME 211, ME 221. A detailed study of applications of thermodynamic principles to practical engineering systems, e.g. steam power cycles, internal combustion engines, gas turbines, refrigeration systems, energy systems, etc. One-dimensional gas dynamics, isentropic compressible flow functions, normal shock functions, thermodynamics of mixtures and reacting systems, psychrometrics, combustion, and dissociation.

**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 216 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 or corequisite: EE 211. 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 216 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 216, 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 STUDIES IN MECHANICAL ENGINEERING**

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.

**ME 392 SPECIAL TOPICS IN MECHANICAL ENGINEERING**

Credit: Variable (1 to 3). Prerequisite: Permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**ME 400/500 MECHANICAL ENGINEERING RESEARCH EXPERIENCE**

1 to 3 credits. This course allows an undergraduate student or dual enrolled undergraduate/graduate student the opportunity to participate in a research project under the direction of a faculty mentor. Students enrolling in ME 500 will be held to a higher standard than those enrolling in ME 400.

**ME 411/411L INTERNAL COMBUSTION ENGINES I**

(3-1) 4 credits. Prerequisites: ME 311 (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 412/512 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 enrolling in ME 512 will be held to a higher standard than those enrolling in ME 412.

**ME 414 HEATING, VENTILATING, AND AIR CONDITIONING**

(3-0) 3 credits. Prerequisites: ME 311 (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 416 THERMOSCIENCE LAB**

(0-1) 1 credit. Prerequisites: ME 351, ME 311, ME 313, ME 331, and ME 419 as a corequisite. 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 THERMO-FLUID SYSTEMS DESIGN**

(3-0) 3 credits. Prerequisites: ME 311, ME 313, ME 331, and ME 416 as a corequisite. Investigation and design of thermal and fluid systems as a creative, decision making process; 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.

**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 MET430.

**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 MET440. 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 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 enrolling in ME 545 will be held to a higher standard than those enrolling in ME 445. This course is cross-listed with ENVE 445/545, CHE 445/545, MET 445/545.

**ME 453 DIGITAL CONTROL CONCEPTS AND APPLICATIONS IN MECHANICAL ENGINEERING**

(3-0) 3 credits. Prerequisite: ME 352. The main intention of this course is to expand the students' knowledge in the field of control systems in general and real-time control applications in particular. The course will cover discretization methods and difference equations, Z transform and its application, discrete block diagrams, time and frequency domain analysis, discrete root-locus, state-space development from discrete equations, stability, and other theoretical tools necessary for real-time controller synthesis. The course will also include the introduction to the TMS320C30 controller board, as a preparation for its practical use within the ME 456 laboratory.

**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 464 MECHANICAL ENGINEERING DESIGN I**

(0-2) 2 credits. Prerequisite: Senior standing or graduation within three semesters, ME 322, ME 351 (concurrent). The first semester of a two 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 465 MECHANICAL ENGINEERING DESIGN II**

(0-2) 2 credits. Prerequisite: Senior standing or graduation within three semesters, ME 322, ME 351 (concurrent). The second semester continuation of ME 464. 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 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 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 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 TO RELIABILITY**

(4-0) 4 credits. Prerequisite: MATH 481 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 STUDIES IN MECHANICAL ENGINEERING**

1 to 3 credits. 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 ADVANCED TOPICS IN MECHANICAL ENGINEERING**

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 790 GRADUATE 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 STUDIES IN MECHANICAL ENGINEERING**

1 to 3 credits. 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 ADVANCED TOPICS IN MECHANICAL ENGINEERING**

1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**ME 798 GRADUATE RESEARCH (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.

**MES 601 THERMOCHEMICAL PROCESSING FUNDAMENTALS**

(1 to 5-0) Prerequisite: Admission to MS/MES or Ph.D./MES program or permission of instructor. Modules listed below will be selected based on the students written and oral interview. The MS/MES Steering committee decision is binding.

Module 1: (1-0) 1 credit. Transport Phenomena. Material covered: fluids(velocity distributions in laminar flow, friction factors, Bernoulli Equation), heat transfer (conduction, convection, radiation), and mass transfer (diffusion, interphase transport).

Module 2: (1-0) 1 credit. Physical Chemistry of Surfaces. Material covered: chemical kinetics, surface diffusion, surface energy, adsorption, and analysis.

Module 3: (1-0) 1 credit. Chemical Thermodynamics. Material covered: heat balances, one component equilibrium, multicomponent equilibrium, Gibbs Phase Rule, and thermodynamic computer codes.

Module 4: (1-0) 1 credit. Solution Thermodynamics and Phase Diagrams. Material covered: change in standard states, Gibbs-Duhem integration, tangent-

intercept method, solution models, phase diagrams from thermodynamic data, and ternary phase diagrams.

Module 5: (1-0) 1 credit. Process Kinetics. Material covered: Arrhenius Equation, topochemical models, mass transfer control, heat and mass transfer control, and chemical kinetics.

### **MES 603 ATOMIC/MOLECULAR STRUCTURE OF MATERIALS**

1 to 7 credits. Prerequisite: Admission to MS/MES or MES Ph.D. program or permission of instructor. Modules listed below will be selected based on the students written and oral interview. The MS/MES Steering committee decision is binding.

Module 1: (1-0) 1 credit. Crystal Bonding and Crystallography. Material covered: Elements of quantum mechanics, electronic structure of atoms, ionic crystals, covalent crystals, metal crystals, hydrogen bonding, the Van der Waals attraction, Bravais lattice, positions and orientation of planes in crystals, atom positions in the unit cell, simple crystal structures, crystal diffraction by x-rays and electron diffraction.

Module 2: (1.5-0) 1.5 credits. Physical Properties. Material covered: Elements of statistical physics, electronic band theory of solids, classification of solids: metals, dielectrics, semiconductors, dynamics of electrons in crystals, electrical and optical properties of solids, lattice dynamics, acoustic properties, and thermal properties of solids.

Module 3: (1-0) 1 credit. Electronic Properties. Material covered: doped semiconductors, p-n junctions and hetero-junctions, surfaces and interfaces.

Module 4: (0.5-0) 0.5 credit. Mechanical Properties. Material covered: mechanical properties, elements of continuum mechanics.

Module 5: (2-0) 2 credits. Structure of Organic Materials. Material covered: classes of organic compounds, organic reactions, bonding and geometry of organic materials.

Module 6: (1-0) 1 credit. Polymer Chemistry. Material covered: classification of polymers, chain formation, degree of polymerization, thermoplastics, and thermosetting polymers.

### **MES 604/604L STRUCTURE-PROPERTY RELATIONSHIPS OF MATERIALS**

(1 to 5-0.5) Prerequisite: Admission to MS/MES or MES Ph.D. program or permission of instructor. Modules listed below will be selected based on the

students written and oral interview. The MS/MES Steering committee decision is binding.

Module 1: (1-0) 1 credit. Defects in Crystals. Material covered: point defects, dislocations, grain boundaries, twin boundaries domain boundaries, phase boundaries, and surfaces.

Module 2: (1-0.5) 1.5 credits. Mechanical Testing and Properties. Material covered: tensile test, bend test, hardness test, impact test, fracture toughness, the fatigue test, and the creep test. Other related topics are strain-hardening mechanisms, microstructure and residual stress, the three stages of annealing, hot working and superplasticity. These topics are presented as they appropriately relate to metals, ceramics, polymers and composite materials.

Module 3: (1-0) 1 credit. Strengthening Mechanisms. Material covered: mechanisms of elasticity and plasticity of metals and ceramics. Mechanisms of viscoelasticity of polymers. Mechanisms of solidification strengthening, solid solution strengthening, dispersion strengthening, strengthening by phase transformation, heat treatment and chemical modification (cross-linking, branching, or degree of polymerization are examples).

Module 4: (1-0) 1 credit. Structure and Properties of Ceramics. Material covered: structure of crystalline ceramics and silicates, structure of glasses, imperfections in crystalline structures, and failure mechanisms.

Module 5: (1-0) 1 credit. Structure and Properties of Electronic Materials. Material covered: dielectric properties, magnetic properties (dia-, para-, and ferro-magnetism), piezoelectricity, electrostriction, and ferroelectricity.

### **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 STUDIES IN MATERIALS ENGINEERING AND SCIENCE**

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 ADVANCED TOPICS IN MATERIALS ENGINEERING AND SCIENCE**

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 ADVANCED INSTRUMENTAL ANALYSIS**

1 to 5 credits variable. D/L 14.1801 FS

Prerequisites: CHEM 232, CHEM 235, CHEM 344, or required modules for MS/MES core or permission of instructor. A modularized course consisting of four self-contained units covering the theory and laboratory work of various types of modern chemical instrumentation. Modules listed below will be selected based on a written and/or oral interview of the student. Any, or all, of the modules may be taken for one credit each. Module 1 is recommended, but not required, for all students taking the course.

Module 1: (1-0) 1 credit. Electromagnetic radiation and its interaction with matter. Components of instruments. Introduction to spectroscopy.

Module 2: (1-0) 1 credit. Atomic Spectroscopy (AA, AE AF), Emission Spectroscopy (arc, spark, and plasma), X-Ray Methods (absorption, diffraction, and emission), Electron Spectroscopy (Auger, ESCA, PES).

Module 3: (1-0) 1 credit. UV-VIS Spectrometry, Molecular Fluorescence, Infrared Spectrometry, and Raman spectroscopy.

Module 4: (1-0) 1 credit. Solution and solid state Magnetic Resonance Spectrometry and Mass Spectrometry.

Module 5: (1-0) 1 credit. Microstructure Analysis. Materials covered: optical microscopy, scanning electron microscopy, and transmission electron microscopy. The laboratory includes exercises on all three instruments.

Enrollment in Modules 2, 3, or 4 requires registration of one-credit hour from MES 709 (0-2) Experimental Advanced Analysis. Enrollment in Module 5 requires registration of one-credit hour from MES 709 (0-2) Experimental Advanced Instrumental Analysis.

**MES 708L EXPERIMENTAL ADVANCED INSTRUMENTAL ANALYSIS**

1 to 2 credits. Prerequisites: Concurrent enrollment in MES 708. Students enrolled in modules 2, 3 or 4 of MES 708 will enroll in module 1. Students enrolled in module 5 of MES 708 will enroll in module 2. Students enrolled in module 5 and any combination of modules 2 or 3 or 4 of MES 708 must enroll in both modules 1 and 2. Modules listed

below will be selected based on a written and/or interview of the student.

Module 1: (0-1) 1 credit. Atomic Spectroscopy (AA, AE, AF), Emission Spectroscopy (arc, spark, and plasma), X-Ray Methods (absorption, diffraction, and emission), Electron Spectroscopy (Auger, ESCA, PES), UV-VIS Spectrometry, Molecular Fluorescence, Infrared Spectrometry, Raman spectroscopy, Solution and solid state Magnetic Resonance Spectrometry and Mass Spectrometry. Time devoted to each instrument is tailored to the students' research interests.

Module 2: (0-1) 1 credit. Optical microscopy, scanning electron microscopy, and transmission electron microscopy. The laboratory includes exercises on all three instruments.

**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 GRADUATE RESEARCH (NON-THESIS)**

Credit to be arranged; not to exceed 5 credit hours toward fulfillment of the Masters of Science in Materials Engineering and Science (MS/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 GRADUATE 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 ADVANCED TOPICS IN MATERIALS ENGINEERING AND SCIENCE**

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 GRADUATE RESEARCH (THESIS)**

Credit to be arranged; not to exceed 6 credit hours toward fulfillment of the Masters of Science in Materials Engineering and Science (MS/MES). Prerequisite: approval of advisor. An original investigation of a materials engineering or materials science subject normally presented as a thesis for the MS/MES degree.

**MES 898 DISSERTATION RESEARCH**

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 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 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 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 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, electrowinning, 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 320. 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, lectures on modeling and simulation, statistical process controls, 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 and electrical properties; the relationship among structure, bonding imperfections, and properties; and failure diagnosis and avoidance is included. Students enrolling in MET 521 will be held to a higher standard than those enrolling 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 enrolling in MET 526 will be held to a higher standard than those enrolling 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 ME430.

**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 in EM 217. 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 enrolling in MET 540 will be held to a higher standard than those enrolling in MET 440.

**MET 440L/540L MECHANICAL METALLURGY LABORATORY**  
(0-1) 1 credit. Prerequisites: MET 330, MET332 and completion or concurrent enrollment in EM217 and MET440/540. 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 311 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 enrolling in MET 545 will be held to a higher standard than those enrolling 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 310 and MET 320, 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 enrolling in MET 554 will be held to a higher standard than those enrolling 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 STUDIES IN METALLURGICAL ENGINEERING**  
1 to 3 credits. 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 492 SPECIAL TOPICS IN METALLURGICAL ENGINEERING**  
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**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. Prerequisites: MET 332, MET 440 or 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 STUDIES IN METALLURGICAL ENGINEERING**

1 to 3 credits. 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 in advance, by student and instructor.

**MET 792 ADVANCED TOPICS IN METALLURGICAL ENGINEERING**

1 to 3 credits. Lecture course or seminar on a topic

or field of special interest, as determined by the instructor.

**MINE 201 INTRODUCTION TO MINING AND EXPLORATION**

(3-0) 3 credits. The principles of discovery, development, and operation of mineral properties with background material for the more advanced work that follows. Subjects include the fundamentals of exploration, mining law, mine development, surface and underground mining operations, ore reserve calculations, mineral processing, mine maintenance and safety. This course is cross-listed with ENVE 201.

**MINE 202 UNDERGROUND MINING**

(3-0) 3 credits. Prerequisite: MINE 201 or permission of instructor. Techniques of underground mining, including a study of mining methods, drilling, blasting, excavation, underground mining equipment, and an introduction to mine ventilation.

**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 302 SURFACE MINING**

(3-0) 3 credits. Prerequisites: MINE 201. Surface mining techniques including mine design and planning; surface drilling and blasting; the applicability and performance characteristics of earth-moving equipment; and an introduction to slope stability and mine drainage. This course is cross-listed with ENVE 302.

**MINE 316/316L ENGINEERING AND CONSTRUCTION MATERIALS**

(2-1) 3 credits. Prerequisite: Preceded by or concurrent with EM 216, 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 223, 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 I**

(2-1) 3 credits. Prerequisite: EM 216 and CEE 284 or permission of instructor. Composition, structure, index and engineering properties of soils; soil classification systems; introduction to soil engineering problems involving stability, settlement, seepage, consolidation, and compaction; laboratory work on the determination of index and engineering properties of soils. Computer applications are required. Computer-aided graphics and word processing are 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 enrolling in MINE 512 will be held to a higher standard than those enrolling in MINE 412.

**MINE 433/433L/533/533L COMPUTER APPLICATIONS IN GEOSCIENCE MODELING**

(3-1) 4 credits. 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 an essential part of the course. Students enrolling in MINE 533 will be held to a higher standard than those enrolling in MINE 433. This course is cross-listed with ENVE 433/533.

**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 enrolling in MINE 540 will be held to a higher standard than those enrolling 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 442 ECONOMICS OF MINING II**

(3-0) 3 credits. Prerequisite: MINE 441 or equivalent, or permission of instructor. The study of advanced factors in the evaluation of a mineral deposit. These factors include the study of corporate goals, study of a company's annual report, cost of capital and the optimum capital structure, operating and capital costs, profitability, risks in the investment, forecasting and production planning. (Experimental)

**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. Vectorial 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 enrolling in MINE 550 will be held to a higher standard than those enrolling 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 202, 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 302, 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, 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 enrolling will

be required to perform an engineering project with written and oral presentations. Students enrolling in MINE 574 will be held to a higher standard than those enrolling in MINE 474. This course is cross-listed with CEE 474/574.

**MINE 490 UNDERGRADUATE SEMINAR**

(1-0) 1 credit. Preparation, oral and/or written presentation, and discussion of mining related problems.

**MINE 491 INDEPENDENT STUDIES IN MINING ENGINEERING**

1 to 3 credits. 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.

**MINE 492 SPECIAL TOPICS IN MINING ENGINEERING**

1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**MINE 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. This course is cross-listed with TM 631.

**MINE 678 MINING EXPERIENCE ON THE GREAT PLAINS**

(2-0) 2 credits. The course is an intense one week educational experience that presents a variety of topics which will acquaint the students with the evolution of the mining industry, the history of mining in the Black Hills region, the process of providing the minerals required by society from exploration through to recovery of the final product. Environmental and legal consideration will be covered in detail. The lecture material will be enhanced by field trips. The course credits cannot be used for an SDSM&T graduate degree.

**MINE 691 INDEPENDENT STUDIES IN MINING ENGINEERING**

1 to 3 credits. 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.

**MINE 692 ADVANCED TOPICS IN MINING ENGINEERING**

1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**MINE 732 STOCHASTIC MODELS IN OPERATIONS RESEARCH**

(3-0) 3 credits. Probabilistic quantitative methods are developed. These include project control, decision trees, risk analysis, queuing, Markov chains, forecasting, mathematical modeling and Monte Carlo simulation. Computer programs are used to solve practical problems after the techniques are developed and understood. This course is cross-listed as TM 732.

**MINE 742 ENGINEERING MANAGEMENT AND LABOR RELATIONS**

(3-0) 3 credits. Principles of management, supervision, administrative policies, human-factors engineering, and labor-management relationships. This course is cross-listed with TM 742.

**MINE 788 GRADUATE RESEARCH (NON-THESIS)**

1 to 5 credits. Supervised original or expository research culminating in a written report on the work. The course will allow M.S. students to participate in research projects that are of limited scope and not suitable for a thesis.

**MINE 790 GRADUATE SEMINAR**

(1-0) 1 credit. May be repeated once for degree credit. Preparation, oral and/or written presentation, and discussion of mining research problems.

**MSC 101 INTRODUCTION TO ORGANIZATIONAL DEVELOPMENT I**

(1-0) 1 credit. Overview of the Army, its organization and preliminary skills needed to integrate into an organization. Subjects develop skills that foster independence, self-confidence, and interaction. Rappelling, mountaineering and marksmanship are among the topics covered. Co-enrollment in MSC 111 is highly encouraged.

**MSC 102 INTRODUCTION TO ORGANIZATIONAL DEVELOPMENT II**

(1-0) 1 credit. Students learn and understand the function of leadership in management. The course also introduces the basic concepts of outdoor survival, land navigation and rifle marksmanship. The course is comprised of a series of one hour lectures. In conjunction with the lab, the course concludes with a live fire exercise at an approved range facility and an outdoor exercise in the Black Hills to test the student's skill levels.

**MSC 111 PHYSICAL FITNESS AND ORGANIZATIONAL SKILLS I**

(0-1) 1 credit. Designed to accompany MSC 101. Provides the student with hands-on experience to supplement and reinforce classroom instruction. Subjects addressed include drill and ceremony, physical fitness training, marksmanship, first aid, rappelling and basic mountaineering skills. Voluntary off-campus activities enhance course work. This course is cross-listed with PE 111.

**MSC 112 PHYSICAL FITNESS AND ORGANIZATIONAL SKILLS II**

(0-1) 1 credit. Designed to accompany MSC 102. Provides the student with hands-on experience to supplement and reinforce classroom instruction. Subjects addressed include drill and ceremony, physical fitness training, marksmanship, first aid, rappelling and basic mountaineering skills. Voluntary off-campus activities enhance course work. This course is cross-listed with PE 112.

**MSC 120/120L ORIENTEERING**

(1-2) 3 credits. Students participate in indepth 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 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.

**MSC 201 HUMAN BEHAVIOR AND LEADERSHIP DEVELOPMENT**

(1-0) 1 credit. Concurrent registration in MSC 211 is required. Introduction to the basic concepts of leadership and management. Students have the opportunity to increase their understanding of human behavior, develop their leadership skills, explore the functions of management and the roles a manager may play. The course consists of a series of one hour lectures with information applicable to any field of study.

**MSC 202 MANAGEMENT TECHNIQUES**

(1-0) 1 credit. Concurrent registration in MSC 212 is required. Realistic simulation exercises are utilized to teach management concepts. Emphasis is placed on problem analysis, decision-making, planning, organizing, delegation, administrative control, and interpersonal management skills including oral communication, initiative, sensitivity, listening, persuasiveness, and tenacity.

**MSC 211 PHYSICAL FITNESS AND PRACTICAL APPLICATIONS IN MANAGEMENT I**

(0-1) 1 credit. Concurrent registration in MSC 201 is

required. 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 use of a lensatic compass and a topographic map, as well as various survival skills. Voluntary off-campus activities enhance course work. This course is cross-listed with PE 211.

**MSC 212 PHYSICAL FITNESS AND PRACTICAL APPLICATIONS IN MANAGEMENT II**

(0-1) 1 credit. Concurrent registration in MSC 202 required. 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 enhance course work. This course is cross-listed with PE 212.

**MSC 221 BASIC MILITARY SCIENCE INTERNSHIP**

(0-4) 4 credits. The mission of ROTC Basic Camp is to serve as an alternative for the first two years of on-campus ROTC enrollment. Basic Camp offers students who did not take ROTC courses during their first two 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.

**MSC 290 BASIC SMALL UNIT LEADERSHIP**

(2-0) 2 credits. Concurrent registration in either MSC 101/111 or MSC 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.

**MSC 291 INTERNSHIP IN LEADERSHIP I**

(2-0) 2 credits. This course is designed for ROTC Cadets who have completed Msi and II but are not academically aligned to contract as MS 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 times, for a maximum of four (4) credits, with permission of department chair.

**MSC 301 LEADERSHIP DEVELOPMENT AND PLANNING**

(2-0) 2 credits. Students study an in-depth analysis of the 16 leadership dimensions and their application. Students plan operations using problem solving and effective writing techniques for class presentation and peer critique in methods.

**MSC 302 LEADERSHIP AND PROBLEM SOLVING**

(2-0) 2 credits. Students study problem analysis and resource allocation. Field of study extends the use of effective leadership in organization operations. Emphasis is placed on the power of individual counseling techniques and interpersonal relationships.

**MSC 311 APPLICATIONS IN ADVANCED LEADERSHIP TECHNIQUES I**

(0-2) 2 credits. Concurrent registration in MSC 301 is required. Provides the student with practical experience to supplement and reinforce classroom instruction. Subjects include drill and ceremonies, physical training, instruction techniques and leadership that will compliment the student's preparation for ROTC Advanced Camp. Off-campus training is required.

**MSC 312 APPLICATIONS IN ADVANCED LEADERSHIP TECHNIQUES II**

(0-2) 2 credits. Concurrent registration in MSC 302 is required. Provides the student with additional training in land navigation, drill and ceremonies, physical training, instruction techniques and leadership, which will compliment the students preparation for ROTC Advanced Camp. Off-campus training is required.

**MSC 321 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.

**MSC 401 TRAINING DEVELOPMENT AND SCHEDULING**

(2-0) 2 credits. Concurrent registration in MSC 411 is required. Extends the study of leadership by introducing the student to formal management skills that include problem analysis, planning techniques, and the delegation and control of activities. The course also provides an understanding of the command and staff organization used in the modern army and provides a forum in which the students are

able to discuss professional and ethical decisions faced by a commissioned officer.

#### **MSC 402 ETHICAL DECISION MAKING FOR LEADERS**

(2-0) 2 credits. Concurrent registration in MSC 412 is required. Provides cadets with the information necessary for transition to active or reserve commissioned service. Course includes the study of military organizations, and elements of a fighting team. The development of administrative controls essential in managing a military organization, as well as an introduction to the management of personal and financial affairs is presented. This course continues to provide time for discussion and analysis of the ethical decision-making process.

#### **MSC 403 THIRD YEAR ADVANCED MILITARY SCIENCE 5**

(2-0) 2 credits. Completion of MSC 401 and MSC 402 are required. Provides scholarship students with a transition class prior to entering active or reserve commissioned service. Course includes an in-depth study of military decision making, and gives the student experience in planning and conducting military exercises at squad and platoon level. The class also provides the student the opportunity to learn about the Uniform Code of Military Justice and gives the student a perspective on the Army maintenance and logistics programs. This course will also provide the student an opportunity to develop counseling techniques that will be useful in their continuing leadership experiences.

#### **MSC 404 THIRD YEAR ADVANCED MILITARY SCIENCE 6**

(2-0) 2 credits. Completion of MSC 401 and MSC 402 are required. Provides scholarship students with a transition class prior to entering active or reserve commissioned service. Course includes a study of military decision making, and gives the student experience in planning and conducting military exercises at squad and platoon level. This course will also provide the student an opportunity to develop leadership techniques that will be useful in their continuing leadership experiences.

#### **MSC 411 DEVELOPING SUBORDINATE LEADERS I**

(0-2) 2 credits. Concurrent registration in MSC 401 required. Provides the student with practical experience to supplement and reinforce classroom instruction. Subjects addressed include drill and ceremonies, physical fitness training, instruction techniques, and operation of the cadet battalion. Cadets are placed in leadership positions and used as assistant instructors to develop their expertise. Off-campus training is required.

#### **MSC 412 DEVELOPING SUBORDINATE LEADERS II**

(0-2) 2 credits. Concurrent registration in MSC 402 required. Provides the student with practical experience to supplement and reinforce classroom instruction. Subjects addressed include drill and ceremonies, physical fitness training, instruction techniques, small unit leadership, and familiarization with duties of commissioned officers. Off-campus training is required.

#### **MSC 490 ADVANCED SMALL UNIT LEADERSHIP**

(2-0) 2 credits. Concurrent registration in either MSC 301/311 or MSC 401/411 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.

#### **MSC 491 ADVANCED INTERNSHIP IN LEADERSHIP**

(2-0) 2 credits. This course is designed for ROTC Cadets who have completed MS 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 times, for a maximum of four (4) credits, with the permission of department chair.

#### **MUAP 152 APPLIED MUSIC-GENERAL**

(1-0) 1 credit. Prerequisite: Permission of instructor. Development of vocal or instrumental skills and aesthetic perception through independent and private study. (May be used to fulfill the humanities credit for graduation.)

#### **MUEN 100 CONCERT CHOIR**

(1-0) 1 credit. The study and performance of accompanied and unaccompanied choral music of all styles. The concert choir performs in campus concerts and for other campus and community functions. (Any combination of P.E. and MUEN 100-level course may be allowed toward fulfillment of the physical education credit for graduation.)

#### **MUEN 122 CONCERT BAND**

(1-0) 1 credit. The study and performance of contemporary and traditional band repertory. The symphonic band performs in campus concerts and for other campus functions. The symphonic band performs in campus concerts and for other campus and community functions. (Any combination of P.E. and MUEN-100 level course 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.

**MUEN 260 NON-CREDIT MUSIC ENSEMBLE**

No credit. Development of vocal or instrumental skills and aesthetic perception through the study and performance of music.

**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 study of various musical styles and related cultural phenomena. Emphasis upon composers, musical literature, and elements of melody, rhythm, form, and expression.

**MUS 110 BASIC MUSIC THEORY I**

(4-0) 4 credits. Provides the amateur musician with a foundation in the fundamentals of music theory. Designed for students with some background in music. Emphasizes aural and visual analysis of the structure of music through the harmony, part writing, and formal structure of varying musical styles.

**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 times with different topics.

**PALE 271 THE SEARCH FOR OUR PAST**

(3-0) 3 credits. The history of life on earth as revealed by fossils with emphasis on the principles used in interpretation of fossils, the common fossils of South Dakota, and human origin. This course is cross-listed with GEOL 271.

**PALE 276 DINOSAURS**

(3-0) 3 credits. An introduction to the study of dinosaurs with emphasis on their origin, diversification, ecology, and extinction. This course

is cross-listed with GEOL 276.

**PALE 372/372L VERTEBRATE PALEONTOLOGICAL 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. This course is cross-listed with GEOL372/372L.

**PALE 464 SENIOR RESEARCH I**

(3-0) (6-0) 3 or 6 credits. Prerequisite: GEOL 410. 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. This course is cross-listed with GEOL 464.

**PALE 465 SENIOR RESEARCH II**

(3-0) (6-0) 3 or 6 credits. Prerequisite: GEOL 410. 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. This course is cross-listed with GEOL 465.

**PALE 471/471L INVERTEBRATE PALEONTOLOGY**

(2-1) 3 credits. Prerequisites: GEOL 231. 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. This course is cross-listed with GEOL 471/471L.

**PALE 472/472L 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. This course is cross-listed with GEOL 472/472L.

**PALE 491 INDEPENDENT STUDIES IN GEOLOGY**

1 to 3 credits. Student should have obtained permission of an instructor of the Department of Geology and Geological Engineering 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 3 credit hours. This course is cross-listed with GEOL 491.

**PALE 492 SPECIAL TOPICS IN GEOLOGY**

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 492.

**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 MICROPALAEONTOLOGY**

(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 American 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 684/684A.

**PALE 691 INDEPENDENT STUDIES IN GEOLOGY**

1 to 3 credits. Prerequisite: Senior standing. 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 ADVANCED TOPICS IN GEOLOGY**

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 GRADUATE 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 GRADUATE RESEARCH (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. This course is cross-listed with GEOL 798.

**PE 102 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 106 BASKETBALL/TEAM HANDBALL**

(1-0) 1 credit. Focus of this course is on the fundamental skills, rules, and strategies of each sport. This course can only be taken one time for credit.

**PE 109 BOWLING/BILLIARDS**

(1-0) 1 credit. This course will focus upon the rules, scoring, skill development, etiquette, and terminology as they pertain to bowling and billiards. This course can only be taken one time for credit.

**PE 110 VARSITY SPORTS I**

(1-0) 1 credit. 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 twice for credit, however it may only be used one time to fulfill Physical Education graduation requirements.

**PE 111 PHYSICAL FITNESS AND ORGANIZATIONAL SKILLS I**

(0-1) 1 credit. Designed to accompany MSC 101. Provides the student with hands-on experience to supplement and reinforce classroom instruction. Subjects addressed include drill and ceremony, physical fitness training, marksmanship, first aid, rappelling and basic mountaineering skills. Voluntary off-campus activities enhance course work. This course is cross-listed with MSC 111.

**PE 112 PHYSICAL FITNESS AND ORGANIZATIONAL SKILLS II**

(0-1) 1 credit. Designed to accompany MSC 102. Provides the student with hands-on experience to supplement and reinforce classroom instruction. Subjects addressed include drill and ceremony, physical fitness training, marksmanship, first aid, rappelling and basic mountaineering skills. Voluntary off-campus activities enhance course work. This course is cross-listed with MSC 112.

**PE 113 AEROBIC FITNESS ACTIVITIES**

(1-0) 1 credit. This course is designed to develop and improve personal fitness through a variety of aerobic activities. This course can only be taken one time for credit.

**PE 122 FLAG FOOTBALL/FLICKERBALL**

(1-0) 1 credit. Focus is on fundamental skill of passing and receiving which will be used in both sports. Basis strategies, teamwork, and conditioning will be covered. This course can only be taken one time for credit.

**PE 124 BEGINNING AND INTERMEDIATE GOLF**

(1-0) 1 credit. Beginning and intermediate golf will contain elements of golf that are basic to the understanding and progress of the student golfer. Time will also be spent in learning the rules and etiquette of the game of golf. This course can only be taken one time for credit.

**PE 125 INDOOR RACQUET SPORTS: RACQUETBALL, SQUASH, BADMINTON**

(1-0) 1 credit. Skill development, strategies, and etiquette of the sports will be taught. (Your own racquet for racquetball is suggested.) This course can only be taken one time for credit.

**PE 129 SOCCER/SPEEDBALL**

(1-0) 1 credit. This course will focus upon the rules, scoring, skill development, etiquette and sportsmanship as they pertain to soccer. This course can only be taken one time for credit.

**PE 130 SOFTBALL**

(1-0) 1 credit. Basic skills of throwing, fielding, batting, and strategies of softball will be covered. This course can only be taken one time for credit.

**PE 133 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 137 TENNIS**

(1-0) 1 credit. Fundamental skills along with rules and court etiquette are covered. (Your own racquet is required.) This course can only be taken one time for credit.

**PE 138 VOLLEYBALL**

(1-0) 1 credit. Skills of passing, setting, serving, and spiking will be covered in order to play a competitive level of volleyball. Rules and terminology will be covered. This course can only be taken one time for credit.

**PE 140 WEIGHT TRAINING**

(1-0) 1 credit. This course will focus upon the basic movements and techniques of weight lifting. Both free weights and machines will be used. Safety is essential. 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.

**PE 180 WELLNESS AND PHYSICAL FITNESS**

(1-0) 1 credit. For men and women. This course provides a positive, realistic approach to the basics of health and physical fitness. Activities and lectures present a simple, logical, and individualized approach to developing a high level of well being. Topics are presented in the areas of fitness, nutrition, weight control, heart disease, stress management, aging, and other aspects of wellness. This course can only be taken one time for credit.

**PE 181 CONTEMPORARY ISSUES IN HEALTH AND SAFETY**

(2-0) 2 credits. Students will learn First Aid and CPR; will receive practical experience in the modalities of evaluation and treatment of injuries; and will discuss contemporary issues within the Health Services. This course cannot be used to fulfill the PE activity requirement for graduation.

**PE 209 ADVANCED SWIMMING (MEN AND WOMEN)**

(1-0) 1 credit. Designed to strengthen strokes and emphasize safety factors in swimming. Course attempts to work on endurance in each of the four basic strokes. The course provides instruction for those who wish to learn techniques of rescue and lifesaving. This course can only be taken one time for credit.

**PE 210 VARSITY SPORTS II**

(1-0) 1 credit. A student must be a member of a varsity sports team which is sponsored by SDSM&T to be enrolled in this course. This course can only be taken twice for credit, however it may only be used one time to fulfill Physical Education graduation requirements.

**PE 211 PHYSICAL FITNESS AND PRACTICAL APPLICATIONS IN MANAGEMENT I**

(0-1) 1 credit. Concurrent registration in MSC 201 is required. 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 use of a lensatic compass and a topographic map, as well as various survival skills. Voluntary off-campus activities enhance course work. This course is cross-listed with MSC 211.

**PE 212 PHYSICAL FITNESS AND PRACTICAL APPLICATIONS IN MANAGEMENT II**

(0-1) 1 credit. Concurrent registration in MSC 202 required. 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 enhance course work. This course is cross-listed with MSC 212.

**PHIL 100 INTRODUCTION TO PHILOSOPHY**

(3-0) 3 credits. Designed to acquaint the student with the meaning, aim, scope, and language of philosophy, to survey traditional problems of philosophy, and to relate these to the individual's philosophy of life.

**PHIL 200 INTRODUCTION TO LOGIC**

(3-0) 3 credits. An introduction to the logic of ordinary discourse with an emphasis on the informal fallacies of reasoning. Acquaints the students with basic methods of analyzing advertisements, speeches, and ordinary language for logical coherence. Utilizes a workshop, learn-by-doing approach.

**PHIL 220 INTRODUCTION TO ETHICS**

(3-0) 3 credits. Examines current trends in ethical theory in terms of traditional backgrounds and contemporary society. Focuses upon readings and discussions of social violence, sexual practices, ethical consequences of science, and other 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: Completion of college algebra or equivalent; previous exposure to trigonometric functions is strongly recommended but not required. Elementary kinematics, vectors, units of measurements, simple machines, introduction to Newton's laws of motion, elementary rotational kinematics and dynamics, work and energy. Mathematical methods and techniques for solving physics problems will be emphasized. 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: Concurrent registration in PHYS 111 and permission of advisor. Introduction to Mechanical systems and the measurement of physical phenomena. Supplements the lecture material in PHYS 111. This course is not required with 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 113/113L INTRODUCTION TO PHYSICS II/LAB**

(3-1) 4 credits. Prerequisite: PHYS 111, PHYS 112 and permission of advisor. Temperature and heat, thermodynamics, basic electric and magnetic phenomena, geometrical optics, waves and sound, x-rays and NMR. 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 185 INTRODUCTION TO ASTRONOMY**

(3-0) 3 credits. This course provides an introduction to the historic and modern 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 the complete spectrum of objects found in the universe, from gas and dust particles to galactic clusters. Observation sessions and laboratory experiences are included in this course.

**PHYS 211/211A UNIVERSITY PHYSICS I**

(3-0) 3 credits. Prerequisites: Physics 111 or an acceptable score on the Physics I Qualifying

Examination and concurrent registration in MATH 125. The basic physical principles of Newton's laws of motion and the conservation laws concerning momentum, energy and angular momentum are applied to the linear and curvilinear motion of particles, simple harmonic motion and the rotation of rigid bodies.

**PHYS 213/213A UNIVERSITY PHYSICS II**

(3-0) 3 credits. Prerequisites: PHYS 211 and MATH 125 and concurrent registration in either MATH 225 or MATH 321. Extends the application of the basic physical principles of PHYS 211 to electric and magnetic interaction of charged particles and electric currents. Electric fields, magnetic induction, and the basic dc and ac circuits are studied. PHYS 213L is suggested as an optional laboratory to be taken concurrently with this course.

**PHYS 213L UNIVERSITY PHYSICS II LABORATORY**

(0-1) 1 credit. Prerequisite: Concurrent registration in or completion of 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 213L.

**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 IN PHYSICS**

1 to 3 credits. Prerequisite: Permission of department chair. 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 292 SPECIAL TOPICS IN PHYSICS**

1 to 3 credits. Prerequisite: Permission of department chair. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**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. The first and second laws of thermodynamics, the Kelvin temperature scale, entropy, transfer of heat. Applications to gases and other physical systems.

#### **PHYS 343 STATISTICAL PHYSICS**

(4-0) 4 credits. Prerequisite: PHYS 213 and MATH 225. Statistical approach to microscopic systems, first and second law of thermodynamics, entropy.

#### **PHYS 357 DYNAMICS II**

(3-0) 3 credits. Prerequisite: PHYS 213 and concurrent registration in MATH 321 or equivalent. Methods of classical mechanics developed from Newton's laws, Lagrange's equations, and conservation principles with applications to equilibrium, particle motion, central forces, small oscillations, and rigid-body dynamics. Uses vectors, calculus, and generalized coordinates.

#### **PHYS 361 OPTICS**

(3-0) 3 credits. Prerequisite: PHYS 213. Basic principles of reflection, refraction, wave propagation, ray tracing, lens systems, matrix and computer methods, stops and apertures, aberrations, interference, and diffraction. The application of these topics to optical instruments is emphasized.

#### **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 385/385L 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 images cameras and software for data collection and image manipulation. Observing sessions will involve students in ongoing searches for near-earth asteroids. (Experimental)

#### **PHYS 391 INDEPENDENT STUDY IN PHYSICS**

1 to 4 credits. Prerequisite: Permission of department chair. 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 392 SPECIAL TOPICS IN PHYSICS**

1 to 3 credits. Prerequisite: Permission of department chair. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

#### **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 ELECTROMAGNETISM**

(4-0) 4 credits. Prerequisite: PHYS 213 and concurrent registration in MATH 321 or equivalent. Maxwell's equations, electrostatics, magnetostatics, introduction to propagating electromagnetic waves.

#### **PHYS 423 ELECTRICITY AND MAGNETISM II**

(3-0) 3 credits. Prerequisite: PHYS 213; concurrent registration in MATH 321 or equivalent. Fundamental laws of static electricity and magnetism with application of solutions of Laplace's equation. Maxwell's equations are developed and applied to problems such as reflection and refraction at dielectric boundaries, radiation from antennas, plasma physics, superconductivity, etc.

#### **PHYS 433 NUCLEAR AND PARTICLE PHYSICS**

(3-0) 3 credits. Prerequisite: PHYS 213; concurrent registration in MATH 321 or equivalent. These courses cover topics in atomic physics, solid state physics, nuclear physics, particle physics and the special theory of relativity. Schroedinger's equation is introduced early in the course and elementary quantum mechanics is used throughout.

**PHYS 439 SOLID STATE PHYSICS**

(4-0) 4 credits. Prerequisite: PHYS 213; concurrent registration in MATH 321. Crystal structures and diffraction of x-rays. Lattice dynamics and phonons. Electron energy structures of solids. Electronic and thermal properties of metals, dielectrics and semiconductors. Basic semiconductor devices.

**PHYS 451 CLASSICAL MECHANICS**

(4-0) 4 credits. Prerequisite: PHYS 113 or PHYS 213 and concurrent registration in MATH 321. Newton's Laws, motion in one and three dimension, central forces, harmonic oscillations, non-inertial reference frames, rotations of rigid bodies, and Lagrangian Mechanics.

**PHYS 471 QUANTUM MECHANICS**

(4-0) 4 credits. Prerequisite: PHYS 213 and concurrent registration in MATH 321 or equivalent. Wave mechanics and Schrodinger equation, angular momentum, theory of the hydrogen atom, elements of atomic and particle physics.

**PHYS 481 MATHEMATICAL PHYSICS**

(4-0) 4 credits. Prerequisite: MATH 332 or equivalent. Series solutions, complex variables, Green's functions, transform methods, variational methods, eigenfunctions and introduction to perturbation theory.

**PHYS 491 INDEPENDENT STUDY IN PHYSICS**

1 to 4 credits. Prerequisite: Permission of department chair. Directed independent study of a topic or field of special interest. This may involve readings, research, laboratory or field work, and preparations of papers, as agreed to in advance, by student and instructor.

**PHYS 492 TOPICS**

1 to 3 credits. Prerequisite: Permission of department chair. Lecture course or seminar on a topic or field of special interest, as determined by the instructor.

**PHYS 671 MATHEMATICAL PHYSICS I**

(3-0) 3 credits. Prerequisite: MATH 332 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 332 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 STUDIES IN PHYSICS**

1 to 3 credits. Prerequisite: Permission of department chair. 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 SPECIAL TOPICS IN PHYSICS**

1 to 3 credits. Prerequisite: Permission of department chair. 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. Prerequisite: PHYS 431 or equivalent. Physical basis of quantum mechanics, Schrodinger's equation and its solution, matrix mechanics, operator methods, approximate methods with an introduction to the relativistic wave equation.

**PHYS 791 INDEPENDENT STUDIES IN PHYSICS**

1 to 3 credits. Prerequisite: Permission of department chair. 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 in advance, by student and instructor.

**PHYS 792 ADVANCED TOPICS IN PHYSICS**

1 to 3 credits. Prerequisite: Permission of department chair. 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. The structures and processes of American government, with emphasis on the national level are examined in the course.

**POLS 210 STATE AND LOCAL GOVERNMENT**

(3-0) 3 credits. Prerequisite: POLS 100 or equivalent. A survey of the structures and processes of American government on the state and local level. Special attention given to South Dakota.

**POLS 301 INTRODUCTION TO LAW AND LEGAL STUDIES**

(3-0) 3 credits. This course, taught by the University of South Dakota law faculty, will use traditional law school teaching methods to introduce a student to law courses and the study of law. This course may be particular interest to students interested in law school. (Experimental)

**POLS 330 CONSTITUTIONAL LAW**

(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. A course covering the following subjects: judicial power; the rights of the accused; freedom of expression, association, and religion; equality under the law; the concept of state action and Congressional enforcement of civil rights.

**POLS 340 COMPARATIVE GOVERNMENT**

(4-0) 4 credits. Prerequisite: POLS 100 or equivalent. A comparative study of the political institutions and processes of major world governments.

**POLS 350 INTERNATIONAL RELATIONS**

(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. Analyzes the principal concepts in world politics, including international law and organization, diplomacy, collective security, imperialism, and the balance of power.

**POLS 353 AMERICAN FOREIGN POLICY**

(3-0) 3 credits. Prerequisite: POLS 100. Examines the significant factors in the formulation and execution of United States foreign policy.

**POLS 412 ENVIRONMENTAL LAW AND POLICY**

(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. This course analyzes environmental quality in terms of law and policy. Specific public policy issues in pollution control are surveyed to develop alternative approaches for dealing with ecological problems. Statutes, regulations and judicial decisions are emphasized to provide an analysis of environmental law.

**PSYC 101 GENERAL PSYCHOLOGY**

(3-0) 3 credits. General psychology is an introduction to the extensive field of psychology. Intended as a survey course, topics that may be covered include historical views of the field, physiology, stress, consciousness, learning and memory, development, motivation and emotion, personality, abnormal behavior and psychotherapy. An introduction to the language and orientation of modern psychology as well as basic principles of human behavior are discussed.

**PSYC 251 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 327 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: Junior or senior standing or permission of instructor. The course is a study of the applications of psychological principles in business and industry.

**PSYC 341 SOCIAL PSYCHOLOGY**

(3-0) 3 credits. Prerequisite: SOC 100, 150 or PSYC 101. Utilizes the behavioral sciences to examine the influence of the social environment upon individual behavior.

**PSYC 361 FOUNDATIONS OF PERSONALITY**

(3-0) 3 credits. Prerequisite: PSYC 101. A study of

the major theories of personality and their applications to personality development.

**PSYC 391 INDEPENDENT STUDIES IN PSYCHOLOGY**

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.

**PSYC 392 SPECIAL TOPICS IN PSYCHOLOGY**

1 to 3 credits. Prerequisite: Junior or senior standing and at least one other course in Psychology/Sociology. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. May be repeated twice with different topics for a maximum of six credits.

**PSYC 451 PSYCHOLOGY OF ABNORMAL BEHAVIOR**

(3-0) 3 credits. Prerequisite: PSYC 101 or permission of instructor. Deals with the growth of the personality, the dynamics of abnormal behavior, and disorders of psychogenic origin.

**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**

(2-0) 2 credits. A comparison of contemporary religious systems of the world with emphasis upon their interactions and influence upon current affairs.

**SOC 100 INTRODUCTION TO SOCIOLOGY**

(3-0) 3 credits. Fundamental characteristics of social relationships, culture, personality, population and ecology, social institutions and processes, and cultural change.

**SOC 150 SOCIAL PROBLEMS**

(3-0) 3 credits. A survey of current national and international social problems such as: population growth, war, multinational corporations, global inequality, and social change. A central theme of the course is how societies other than North America shape and are shaped by the forces of social change.

**SOC 250 MARRIAGE AND THE FAMILY**

(3-0) 3 credits. A study of major family types with emphasis on premarital behavior, courtship patterns, marital adjustment, and the role of the family in American society.

**SOC 260 SEX AND GENDER**

(3-0) 3 credits. This course examines the changing organization, culture, and dynamics of gender roles as a principle feature of the contemporary national and global society. The course is designed to expand the student's understanding of the origin and definition of gender and sexuality, various cultural definitions of gender and gender roles, global workplace inequality, and the theoretical explanations for gender differences and role differentiation.

**SOC 320 CRIMINOLOGY**

(3-0) 3 credits. Prerequisite: SOC 100, 150, or PSYC 101. A study of some of the explanations of criminal behavior; the extent and distribution of crime in America, including white collar crime and the sociological effects of drug abuse; costs to society and businesses of criminal activity; and current trends in treatment and control.

**SOC 350 DEVIANT BEHAVIOR**

(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. The course examines the contemporary definitions, causes, and theories of deviant behavior within the framework of social norms and institutions. A major focus of the course is in developing an understanding of how the social constructionist perspective is used to explain the creation of social deviance. Throughout the course major films, research, and readings are integrated to demonstrate the location of deviant behavior within the larger society. The evaluation of student performance is based on the discussion of two major books and several readings, four (4) papers five to eight pages in length, and three essay exams.

**SOC 391 INDEPENDENT STUDIES IN SOCIAL SCIENCES**

1 to 3 credits. Prerequisite: Permission of department chair. 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.

**SOC 392 SPECIAL TOPICS IN SOCIAL SCIENCES**

1 to 3 credits. Prerequisite: Junior or senior standing or permission of instructor. Lecture course or seminar on a topic or field of special interest, as determined by the instructor. A maximum of six (6) credits of special topics will be allowed for degree credit.

**SOC 410/510 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 enrolling in SOC 510 will be held to a higher standard than those enrolling in SOC 410.

**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 enrolling in SOC 520 will be held to a higher standard than those enrolling in SOC 420.

**SOC 459 SOCIOLOGY OF DEATH AND DYING**

(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. A study of the social processes of death and dying. This course will provide (1) an understanding of the sociological view of death and dying, (2) a framework for understanding social situations, (3) an approach to value based decision-making, and (4) knowledge of the various dying and death topics from a sociological perspective.

**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. SPAN 101 is open to any student except those who have had two or more years of high school Spanish or equivalent; prerequisite for SPAN 102: SPAN 101 or equivalent (no less than two years of high school Spanish). Fundamentals of the language, enabling the student to understand, speak, read, and write simple Spanish.

**SPCM 101 FUNDAMENTALS OF SPEECH**

(3-0) 3 credits. Introduction to the principles of oral communication with emphasis on the preparation and presentation of public speeches. This course can not count as social science/humanities credit.

**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. This course is cross-listed with MINE 631.

**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 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 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) This course is cross-listed with ME 663.

**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 720 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 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. This course is cross-listed with MINE 732.

**TM 742 ENGINEERING MANAGEMENT AND LABOR RELATIONS**

(3-0) 3 credits. Principles of management, supervision, administrative policies, human-factors engineering, and labor-management relationships. This course is cross-listed with MINE 742.

**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 791 INDEPENDENT STUDIES IN TECHNOLOGY MANAGEMENT**

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 ADVANCED TOPICS IN TECHNOLOGY MANAGEMENT**

1 to 3 credits. Prerequisite: Permission of instructor. 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 GRADUATE RESEARCH (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 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 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 MULTIMEDIA SUPPORT**

(1-0) 1 credit. Prerequisite: Attendance at TTL-NA Core Curriculum, or equivalent as determined by instructor. Students will learn Vtel support, MS 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 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.



*TECHFact: Tech has an active Army Reserve Officer Training Corps (ROTC) unit comprised of cadets attending the South Dakota School of Mines and Technology, Black Hills State University, and National American University. Cadets are commissioned as officers from the Mount Rushmore Battalion and have the opportunity to enter active duty military service, become a U.S. Reservist, or enter the National Guard.*

**2002-2003 ACADEMIC YEAR  
(As of June 2002)**

**EXECUTIVE COUNCIL**

**GOWEN, RICHARD J.** (1978-1984) (1987) President. B.S., Rutgers University; M.S., Ph.D., Iowa State University. Registered Professional Engineer (Colorado).

**BODDICKER, GAIL L.** (1989) Assistant to the President.

**HENDERSON, TIMOTHY G.** (1981) Vice President for Business and Administration. B.S., University of South Dakota.

**MAHON, PATRICIA G.** (2000) Vice President for 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).

**SMORAGIEWICZ, JULIE A.** (1994) Vice President for University Relations. B.A., M.Ed., University of Toledo.

**WHITEHEAD, KAREN L.** (1981) Vice President for 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 Bernardino; 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) Chair and Professor, Department of Humanities. B.A., M.A., Augustana College, Ph.D., University of Minnesota.

**ARNESON-MEYER, LOIS L.** (1991) Instructor, Department of Civil and Environmental Engineering. B.S., Dakota State University; B.S., South Dakota School of Mines and Technology; M.S., University of South Dakota.

**ARRINGTON, DALE E.** (1980) Professor, Department of Chemistry and Chemical Engineering. B.S., University of Washington; Ph.D., University of Kansas.

**AZAR, MICHELE L.** (2002) Assistant Librarian, Devereaux Library. B.S., Fort Hays State University; M.L.S., Emporia State University.

**BAKER, BRADLY M.** (2000) Assistant Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., University of Washington, Seattle; Ph.D., University of Colorado, Boulder.

**BANG, SANGCHUL** (1985) Interim Dean, College of Earth Systems; Professor, Department of Civil and Environmental Engineering. B.S., Seoul National University, Korea; M.S.,

Ph.D., University of California, Davis. Registered Professional Engineer (South Dakota).

**BANG, SOOKIE S.** (1985) Professor, Department of Chemistry and Chemical Engineering (Biology). B.S., M.S., Seoul National University, Korea; Ph.D., University of California, Davis.

**BATCHELDER, MICHAEL J.** (1974-1984) (1986) Professor, Department of Electrical and Computer Engineering; Co-Director, Center of Excellence for Advanced Manufacturing and Production. B.S., M.S., Oklahoma State University; Ph.D., Virginia Polytechnic Institute and State University.

**BISHOP, GALE A.** (2001) Professor, Department of Geology and Geological Engineering; Director, Museum of Geology. B.S., M.S., South Dakota School of Mines and Technology; Ph.D. University of Texas, Austin.

**BLOCH, JONATHAN I.** (2002) Assistant Professor, Department of Geology and Geological Engineering; Melvin Haslem Postdoctoral Fellow in Paleontology, Museum of Geology. B.S., University of California at Santa Cruz; M.S., Ph.D., University of Michigan, Ann Arbor.

**BOYLES, DAVID A.** (1980) Professor, Department of Chemistry and Chemical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., Purdue University.

**BOYSEN, ALFRED R.** (1969) Professor, Department of Humanities. B.A., Augustana College; M.A., Ed.D., University of South Dakota.

**BUCK, GREGORY A.** (1993) Associate Professor, Department of Mechanical Engineering. B.S., Carnegie Mellon University; M.S., Ph.D., Arizona State University. Registered Professional Engineer (Arizona, Pennsylvania).

**BURGOYNE, JANET** (1989) Associate Professor, Department of Mathematics and Computer Science. B.S., Arizona State University; M.S., D.A., Idaho State University.

**CABRERA, AGAPITO J.** (1993) Assistant Professor, Department of Humanities. M.S., Indiana University-Bloomington; B.M.E., Chartrand Conservatory in Havana; B.S., B.A., LaSalle College in Havana; L.L.D., University of Havana.

**CAPEHART, WILLIAM J.** (1997) Assistant Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., University of North Carolina at Asheville; M.S., Ph.D., Pennsylvania State University Main Campus.

**CARDA, HAROLD E.** (1965) Professor, Department of Mathematics and Computer Science. B.S., Southern State College; M.N.S., University of South Dakota.

**CHAMBERLAIN, NEIL F.** (1990) Professor, Department of Electrical and Computer Engineering. B.S. Honors, King's College, London; M.S., Ph.D., The Ohio State University.

**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.

**CORWIN, EDWARD M.** (1981) Professor, Department of Mathematics and Computer Science. B.A., M.S., Ph.D., Lehigh University; M.S., Ph.D., Texas Tech University.

**CROSS, WILLIAM** (1984) Instructor and 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.

**DAHL, JULIE J.** (1982) Assistant Professor, Department of Mathematics and Computer Science. B.S., M.S., South Dakota School of Mines and Technology.

**DAVIES, CINDY L.** (1987) Associate Librarian Cataloger. B.A., University of South Dakota; M.L.I.S., Louisiana State University.

**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).

**DENDINGER, ROGER E.** (1998) Assistant 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.

**DETWILER, ANDREW G.** (1987) Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences; Program Coordinator, Ph.D. Atmospheric, Environmental, and Water Resources. B.S., University of Michigan; M.S., Ph.D., State University of New York, Albany.

**DIXON, DAVID J.** (1993) Associate Professor, Department of Chemistry and Chemical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Texas.

**DOLAN, DANIEL F.** (1981) Professor, Department of Mechanical Engineering; Co-Director, Center of Excellence for Advanced Manufacturing and Production. B.S., M.S., Ph.D., University of Minnesota.

**DUKE, EDWARD F.** (1984) Professor, Department of Geology and Geological Engineering; Manager, Analytical Services, Engineering and Mining Experiment Station. B.S., Beloit College; A.M., Ph.D., Dartmouth College.

**FAUBERT, ROBERT A.** (2001) Director of Drama Activities, Department of Humanities. B.A., Boston College; M.Ed., Boston College; M.H.A., Ohio State University.

**FEISZLI, JAMES D.** (1983) Professor, Department of Humanities; Director, Music. B.M.E., Mount Union College; M.M., University of Akron; D.M.A., Arizona State University.

**FELDERMAN, BARBARA A.** (1981) Professor, Department of Physical Education; Head Women's Basketball Coach. B.S., Northern State College; M.S., University of Wyoming.

**FONTAINE, THOMAS A.** (1994) Associate Professor, Department of Civil and Environmental Engineering. B.S., M.S., Ph.D., University of Wisconsin. Registered Professional Engineer (South Dakota, Wisconsin).

**FOX, JAMES E.** (1976) Professor, Department of Geology and Geological Engineering. B.S., Gustavus Adolphus; M.A., University of South Dakota; Ph.D., University of Wyoming.

**FOYGEL, MIKHAIL** (1991) Professor, Department of Physics. M.S., Ph.D., Odessa University; D.Sc., Leningrad Polytechnic Institute.

**GILCREASE, PATRICK C.** (2002) Assistant Professor, Department of Chemistry and Chemical Engineering. B.S., Colorado School of Mines; M.S., Ph.D., Colorado State University.

**GEARY, LAURA M.** (1985) Instructor, Department of Mathematics and Computer Science. B.S., M.S., South Dakota School of Mines and Technology.

**GOSS, SIDNEY G.** (1974) Professor, Department of Social Sciences. B.S., M.S., Ph.D., South Dakota State University.

**HAN, KENNETH KOOK-NAM** (1981) Associate 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.

**HANSEN, MARION R.** (1985) Professor, Department of Civil and Environmental Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., North Carolina State University. Registered Professional Engineer (Oregon, South Dakota, Wyoming, Washington); Registered Structural Engineer (Oregon, Washington); Registered Land Surveyor (South Dakota).

**HASAN, ABUL R.** (1988) Chair beginning spring 2003 and Professor, Department of Electrical and Computer Engineering. B.S., Bangladesh; M.S., University of North Dakota; Ph.D., University of Wyoming.

**HEGLUND, DANIEL L.** (1997) Assistant Professor, Department of Chemistry and Chemical Engineering; Program Coordinator and Steering Committee Chair, M.S. Materials Engineering and Science. B.S., Bemidji State University; M.S., Ph.D., University of North Dakota.

**HELDSON 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.

**HEMMELMAN, BRIAN T.** (1999) Assistant Professor, Department of Electrical and Computer Engineering. B.S., M.S., Ph.D., South Dakota School of Mines and Technology.

**HERBEL, CARRIE L.** (1995) Instructor, Department of Geology and Geological Engineering; Collections Manager and Preparator, Museum of Geology. B.S., M.S., University of Nebraska, Lincoln.

**HJELMFELT, MARK R.** (1988) Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., Kansas State University; M.S., South Dakota School of Mines and Technology; Ph.D., University of Chicago.

**HLADYSZ, ZBIGNIEW** (1981) Professor, Department of Civil and Environmental Engineering (Mining Engineering). M.S., Technical University, Gliwice, Poland; Ph.D., Central Mining Institute, Katowice, Poland.

**HOWARD, STANLEY M.** (1971) Professor, Department of Materials and Metallurgical Engineering. B.S., Ph.D., Colorado School of Mines.

**HUDGENS, MICHAEL T.** (1991) Assistant Professor, Department of Humanities. B.A., M.A., Loyola Marymount University; Ph.D., University of South Dakota.

**JENKINS, CHRISTOPHER H.M.** (1991) Professor, Department of Mechanical Engineering. B.S., Florida Institute of Technology; M.S., Ph.D., Oregon State University. Registered Professional Engineer (California, Oregon, South Dakota).

**JOHNSON, DONNA L.** (1985) Instructor, Department of Mathematics and Computer Science. B.S., M.S., South Dakota School of Mines and Technology.

**JOHNSON, ROGER W.** (1996) Associate Professor, Department of Mathematics and Computer Science. B.S., University of Minnesota; M.A., Ph.D., University of California, San Diego.

**KALANOVIC, VOJISLAV D.** (1991) Associate Professor, Department of Mechanical Engineering. B.S., M.S., University of Belgrade; Ph.D., Clemson University.

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## **ADMINISTRATION**

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### **SDSM&T ALUMNI ASSOCIATION LIAISON**

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### **SDSM&T FOUNDATION LIAISON**

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**COLLEGE OF MATERIALS SCIENCE AND ENGINEERING**

**PUSZYNSKI, JAN A.** (1991) Dean; Robert L. Sandvig Professor, Department of Chemistry and Chemical Engineering. M.S., Technical University, Wroclaw, Poland; Ph.D., Institute of Chemical Technology, Prague, Czechoslovakia.

**COLLEGE OF SYSTEMS ENGINEERING**

**KRAUSE, WAYNE B.** (1970-1978) (1983) Dean; Professor, Department of Mechanical Engineering; Executive Director, Center of Excellence for Advanced Manufacturing and Production. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Nebraska. Registered Professional Engineer (South Dakota).

**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 (RUSS)** (1997) Research Scientist I. B.S., Montana College of Mineral Science and Technology.

**GRADUATE EDUCATION AND RESEARCH**

**FARWELL, SHERRY O.** (1995) Dean; Director, South Dakota Space Grant Consortium. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., Montana State University.

**CAI, ZHONG TAO** (1999) Research Scientist II. B.S., East China Institute of Chemical Technology, Shanghai.

**HAN, KENNETH KOOK-NAM** (1981) Associate 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.

**REID, SHARON L.** (1974) Proposal/Grant Services Manager.

**INFORMATION TECHNOLOGY SERVICES**

**McCARVILLE, KATHERINE** (1997) Director. B.S., University of California, Los Angeles; M.S., Colorado School of Mines. Registered Professional Geologist (Wyoming).

**LORENZ, MARVIN W.** (1987) (1992) Network Manager. A.A., North Dakota School of Science; B.S., South Dakota School of Mines and Technology.

**SCHUMACHER, BRYAN J.** (1991) Acting Director. B.S., South Dakota School of Mines and Technology.

**INSTITUTE OF ATMOSPHERIC SCIENCES**

**ZIMMERMAN, PATRICK R.** (1997) Director; Chair and Professor, Department of Atmospheric Sciences. B.S., M.S., Washington State University; Ph.D. Colorado State University.

**FARLEY, RICHARD D.** (1974) Research Scientist IV. B.S., M.S., South Dakota School of Mines and Technology.

**FOY, ELAINE E.** (2001) Assistant Director. B.S., South Dakota School of Mines and Technology.

**JOHNSON, GARY N.** (1971) Research Scientist III. B.S., M.S., South Dakota School of Mines and Technology.

**KLICHE, DONNA** (1994) Research Scientist I 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.

**KOPP, FRED J.** (1971) Research Scientist III. B.S., M.S., South Dakota School of Mines and Technology.

**LALONDE, KARL A.** (1999) Research Scientist II. B.S., M.S., South Dakota School of Mines and Technology.

**ROOT, THOMAS A.** (1995) Research Scientist III. B.S., Kent State University.

**SUMMERS, CHARLES M.** (1992) Research Scientist III. B.S., University of Nebraska, Lincoln; M.S., Troy State University.

**WARNER, TOM A.** (2000) Research Scientist II. B.S., University of California, Davis.

**LIBRARY**

**ANDERSEN, PATRICIA M.** (1984) Director. B.S., University of South Dakota; M.L.I.S., Louisiana State University.

**AZAR, MICHELE L.** (2002) Assistant Librarian. B.S., Fort Hays State University; M.L.I.S., Emporia State University.

**DAVIES, CINDY L.** (1987) Associate Catalog 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.

**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.

**BEEGLES, BARBARA J.** (2000) Assistant Professor, Department of Military Science, Captain. B.S., Black Hills State 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.

**VANCUREN, JEFFERY** (2001) Assistant Professor, Department of Military Science, Captain. B.S., South Dakota School of Mines and Technology.

### MUSEUM OF GEOLOGY

**BISHOP, GALE A.** (2001) Director; Professor, Department of Geology and Geological Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D. University of Texas, Austin.

**BLOCH, JONATHAN I.** (2002) Melvin Haslem Postdoctoral Fellow in Paleontology; Assistant Professor, Department of Geology and Geological Engineering. B.S., University of California at Santa Cruz; M.S., Ph.D., University of Michigan, Ann Arbor.

**HERBEL, CARRIE L.** (1995) Collections Manager and Preparator; Instructor, Department of Geology and Geological Engineering. B.S., M.S., University of Nebraska, Lincoln.

**GREENWALD, MICHAEL T.** (1997) Research Scientist II. B.S., Wichita State University; M.S., South Dakota School of Mines and Technology.

**MARTIN, JAMES E.** (1979) Curator of Vertebrate Paleontology; Professor, Department of Geology and Geological Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Washington.

### SOUTH DAKOTA LOCAL TRANSPORTATION ASSISTANCE PROGRAM

**SWENSON, MERLE D.** (2000) Western Satellite Coordinator.

### SOUTH DAKOTA SPACE GRANT CONSORTIUM

**FARWELL, SHERRY O.** (1995) Director; Dean, Graduate Education and Research. B.S., M.S. South Dakota School of Mines and Technology; Ph.D., Montana State University.

**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 for

Business and Administration. B.S., University of South Dakota.

**PAINTER, AUDREY L.** (1981) Senior Secretary.

### ADMINISTRATIVE SERVICES (ACCOUNTING)

Director - Vacant

### BOOKSTORE

**KINZER, MARLIN L.** (1993) Director. B.S., Black Hills State University.

### BUDGET

**MARKEN, MARJORIE M.** (1967) Manager of Budgets.

### BUSINESS SERVICES (PURCHASING / TELECOMMUNICATIONS)

**FISCHER, SANDRA R.** (1972) Director.

**HARGINS, JANET K.** (1979) Assistant Director.

### DINING SERVICES

Services contracted through ARAMARK.

### FACILITIES SERVICES

Services contracted through ARAMARK.

### HIGH PRIORITY CONNECTIONS

**BENDER, VICKIE M.** (1986) Director. A.A., Northern State University.

**PALLADINO, PAULETTE J.** (2000) Customer Service Representative. B.S., Black Hills State University.

### HUMAN RESOURCES

**SLOAT, DEBORAH L.** (1994) Director. B.S., South Dakota School of Mines and Technology; M.S. University of South Dakota.

### INTERCOLLEGIATE ATHLETICS

**WELSH, D. HUGH** (1986) Director; Head Men's Basketball Coach; Professor, Department of Physical Education. B.S., Valley City State College, M.S., University of Mary.

**ALLGIER, KRISTY L.** (2001) Head Women's Volleyball Coach; Intramural Director. B.S., National American University.

**COBLE, LORI D.** (1984) Assistant Women's Basketball Coach. B.S., Dakota State College; M.A., University of Minnesota.

**COLLINS, STACY S.** (2002) Assistant Football Coach; Assistant Intramural Director; Weight Room Supervisor. B.S., M.A., Western Oregon University.

**FELDERMAN, BARBARA A.** (1981) Head Women's Basketball Coach; Professor, Department of Physical Education. B.S., Northern State College; M.S., University of Wyoming.

**GACKLE, DEREK D.** (2001) Assistant Football Coach; Palmerton Hall Director and Assistant Director of Residence Life. B.S.E., Minot State University.

**HENRY, JASON P.** (2002) Assistant Men's Basketball Coach. B.S., Minot State University.

**MECHLING, SHAWN M.** (1999) Certified Athletic Trainer; Athletic Equipment Manager. B.S., South Dakota State University; M.Ed., University of Virginia.

**ROEBER, AARON M.** (2001) Golf Coach. B.S., South Dakota State University.

**RUDEBUSCH, THOMAS R.** (1980) Sports Information Director.

**SCHAFFER, JERALD R.** (1984) Assistant Athletic Director; Head Cross Country and Track Coach; Chair and Associate Professor, Department of Physical Education. B.A., M.A., Adams State College.

**SOUCY, DARREN M.** (2000) Head Football Coach; Assistant Professor, Department of Physical Education. B.S., Boston University; M.S., Humboldt State University, California.

### UNIVERSITY SCHEDULING AND CONFERENCES

Services contracted through ARAMARK.

## STUDENT AFFAIRS

**MAHON, PATRICIA G.** (2000) Vice President for 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

**VAN METER, ERIC** (2002) Minister, United Campus Ministry. B.A. Arkansas Tech University; M.Div., Asbury Theological Seminary.

### 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

**BOLMAN, JACQUELYN R.** (2000) Director. B.A., M.A., Ed.D., University of South Dakota.

### RESIDENCE LIFE

**WILSON, MAUREEN C.** (1999) Director; Judicial Affairs Director. B.A., Northern State University; M.A., Eastern New Mexico University, Portales.

**GACKLE, DEREK D.** (2001) Assistant Director; Residence Hall Director for Palmerton; Assistant Football Coach. B.S.E., Minot State University.

**HOLT, CHERYL L.** (2002) Residence Hall Director for March Dake. B.S., M.Ed., South Dakota State University.

**NEBELSICK, DANIEL D.** (2002) Residence Hall Director for Connolly Hall. B.S., South Dakota School of Mines and Technology.

### STUDENT ACTIVITIES AND LEADERSHIP CENTER

**HOWELL, MICHELLE C.** (1997) Director. B.A., University of Nebraska-Lincoln; M.Ed., University of Maryland at College Park.

## UNIVERSITY AND PUBLIC RELATIONS

**SMORAGIEWICZ, JULIE A.** (1994) Vice President for University Relations. B.A., M.Ed., University of Toledo.

**GOLABIEWSKI, RUTH A.** (2002) Senior Secretary. B.S., Dickinson State University.

### CHILDREN'S SCIENCE CENTER

**COX, SARA K.** (2002) Marketing Coordinator. B.S., Black Hills State University.

## PUBLICATIONS

SMITH, TIFFANY C. (2000) Publications Manager. B.A., Chadron State College.

## PUBLIC INFORMATION

BUCHHOLZ, STEPHEN G. (2000) Public Information Manager. B.A., Mansfield 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 four elected representative councils 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, and the SDSM&T Foundation President.

### **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, 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, SDSM&T Foundation President, Dean of the College of Earth Systems, Dean of

the College of Interdisciplinary Studies, Dean of the College of Materials Science and Engineering, Dean of the College of Systems Engineering, Dean of Graduate Education and Research, and Chair of the Faculty.

### **Career Service Council**

The Career Service Advisory Council is elected by Career Service Employees. Council members are: Tonette L. Schauer, Chair; Marilyn M. Haskell, Vice President; Cassie M. Schweigerdt, Secretary; Brenda L. Brown and Gayla J. Schlei.

### **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. Council members are: Tiffany C. Smith, Chair; Dr. Jacquelyn R. Bolman, Thomas V. Durkin, Melissa M. Jensen, and Marlin L. Kinzer.

### **Faculty Advisory Council**

Members are: Dr. Michael A. Langerman, Chair; Dr. Janet Burgoyne, Dr. Neil F. Chamberlain, Dr. Edward M. Corwin (Past Chair), Dr. Brian T. Hemmelman, Dr. Stuart D. Kellogg, Dr. Sally B. Palmer, Dr. Rodney P. Rice, Dr. Gregg T. Stubbendieck, and Dr. John M. Weiss.

### **Institutional Council**

The Institutional Council meets monthly to consider and coordinate recommendations for policy and other matters of interest to the constituencies of the university. Council members are: the President, Chair of the Faculty, Career Service Council Chair, Student Association President, and Exempt Employees Council Chair.

### **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. The President is Matt Goeden and Vice President is Chris Hill.

# INDEX

Absences	53	Chemical Engineering	
Academic Calendar	Inside Front Cover	Graduate	198
Academic Advising	71	Undergraduate	126
Academic Affairs	313	Chemicals and Materials Management	313
Academic Amnesty Policy	65	Chemistry	
Academic and Enrollment Services	313	Graduate	200
Academic Initiatives	313	Undergraduate	130
Academic Integrity Policy	68	Child-care Services	84, 316
Academic Loads (Graduate)	173	Children's Science Center	74, 316
Academic Organization	48	Civil Engineering	
Academic Organizations	89	Graduate	189
Academic Orientation	71	Undergraduate	97
Academic Probation Policy		Classification of Undergraduate Students	49
Graduate	175	College of Earth Systems	93, 313
Undergraduate	69	College of Interdisciplinary Studies	109, 314
Accreditation	4	College of Material Sciences and Engineering	123, 314
Additional Admissions Policies and Practices	13	College of Systems Engineering	140, 314
Administration	313	College Level Exam Program (CLEP)	55
Administrative Services (Accounting)	315	Comprehensive Examination, The	183
Admission Requirements and Regulations	9	Computer Engineering	141
Admissions		Computer Science	
Graduate	168	Graduate	205
Undergraduate	9	Undergraduate	145
Admission to Candidacy	184	Computer and Network Usage Guidelines and Policy	65
Advanced Placement Program	55	Computing and Networking Resources and Services	76
Advanced Materials Processing (AMP) Center	73, 313	Concurrent Enrollment in Ph.D./M.S. Programs	171
Advanced-Degree Grade Requirements	174	Conduct	53
Affirmative Action	5	Conference Coordination	82
AISES and AISA	86	Continuing Registration	172
Alumni Association	8, 313	Cooperative Education	83
Americans with Disabilities Act (ADA) Services	84	Counseling Services	84, 316
Anit-Harrasment	68	Course Abbreviations and Definitions	223
Appeal Procedure	176	Course Descriptions	223
APEX Gallery	90	Course Numbering System	49
Applications and Procedures	14	Credit Hours Definition	48
Assistantships and Fellowships for Graduate Students	170	Credit by Examination	55
Associate of Arts Degree	110	Deadline for Adding Courses	57
Athletics	91	Deadline for Dropping a Course	58
Athletic Eligibility Requirements	91	Debit Card System	23
Atmospheric, Environmental, and Water Resources	213	Defense of the Dissertation	184
Atmospheric Sciences		Degree Programs	
Graduate	186	Graduate	167
Undergraduate	94	Undergraduate	93
Attendance	53	Degrees	4
Audited Courses	57	Description of Fees	21
Authorization for Individual Institutional Policies	9	Dining Services	84, 315
Bachelor of Science Graduation Requirements	59	Dissertation, The	184
Biology	124	Distance Education	77
Black Hills Natural Sciences Field Station	73, 313	Doctor of Philosophy Programs	180
Board of Regents	4	Dropping a Course	58
Bookstore	73, 315	Dual Enrollment of High School Students	13
Budget	315	Dual Majors	178
Business and Administration	315	Dual Use of Credit	56
Business Services (Purchasing/Telecommunications)	315	Educational Outreach	82
CAAP Proficiency Exams	64	Educational Resources	73
Campus Buildings	5	Educational Rights and Privacy Act	66
Campus Clearing Policy	53	Electrical Engineering	
Campus Map	Inside Back Cover	Graduate	207
Campus Ministry	83, 316	Undergraduate	149
Campus Safety	7	Electronic University Consortium	16
Career Planning and Placement	83, 316	Eligibility Requirements for Athletics	91
Career Service Council	317	Emergency Procedures	7
Center of Excellence for Advanced		Emeriti Faculty	310
Manufacturing and Production (CAMP)	73, 313	Engineering and Mining Experiment Station	74, 314
Certification for the Degree	176	Environmental Engineering	163
Change of Major (Graduate)	171	Equal Opportunity Policy	5

INDEX

Excused Absences	53	Mandatory Placement Procedure	58
Executive Council	306, 317	Master of Science Programs	177
Exempt Employees Council	317	Materials and Metallurgical Engineering (Graduate)	201
Facilities Services	315	Materials Engineering and Science	202, 216
Faculty	306	Mathematics	156
Faculty Advisory Council	317	Mechanical Engineering	
Family Educational Rights and Privacy Act (FERPA)		Graduate	210
of 1974 or Buckley Amendment	66	Undergraduate	160
Federal Grant and Work-Study	29	Media Relations	81
Federal Student Loan Programs	30	Mentoring	71
Fees, description of	21	Message from the President	1
Fees, schedule of	26	Metallurgical Engineering	134
Final Examination Policy		Military Science	118, 314
Graduate	179	Minimum Registration	172
Undergraduate	66	Mining Engineering	106
Financial Aid	27	Minority Student Study Center	86
Foundation (SDSM&T)	8, 313	Minors	
Freshman Checklist	15	Graduate	178, 182
Full-Time/Half-Time Defined (Graduate)	170	Undergraduate	48
General Information	48	Mission and Objectives	3
Geographic Information Systems (GIS)		M.S. Degree Requirements	177
and Remote Sensing Laboratory	74	Multicultural Affairs	86, 316
Geological Engineering		Multicultural Organizations	89
Graduate	191	Museum of Geology	80, 315
Undergraduate	100	Music Program	90
Geology		Music Organizations	89
Graduate	191	Nature and Purpose of the Doctoral Programs	180
Undergraduate	103	Off-Campus Housing	88
Governance	317	On-Campus Living	87
Grading System	50	Optional Grades a Professor May Use	52
Graduate Credit	49	Other Sources of Financial Aid	31
Graduate Education and Research	167, 314	Outreach Services	73
Graduate Housing	87	Overloads	57
Graduate Student General Information	168	Paleontology	196
Graduation Requirements (University)	59	Parking	23
Graduation with Honors	59	Pass/Fail Option	
Graphic Design and Layout	81	Graduate	176
Greek Organizations	89	Undergraduate	56
Grievance Procedures	67	Payment of Tuition	23
Harassment (Anti-)	68	Payroll (See Human Resources)	5
Health Services	85, 316	Peer Advising	71
High Priority Connections	75, 315	Ph.D. Degree Requirements	180
History	7	Photography	81
Honor Societies	89	Physical Education	120
Honors List	52	Physics	
Humanities	116	Graduate	204
Human Resources	5, 315	Undergraduate	137
Immunizations	14	Policies and Procedures	65
Industrial Engineering	153	Policies Governing Financial Aid Awards	27
Information Systems	113	Policy Governing Academic Integrity	68
Information Technology Services (ITS)	75, 314	Pre-Professional Studies	113
Institute of Atmospheric Sciences	78, 314	President, Office of the	313
Institutional Council	317	Probation Policy	
Instructional Plan	48	Graduate	175
Intercollegiate Athletics	91, 315	Undergraduate	69
Interdisciplinary Sciences	112	Program Descriptions	29
International Baccalaureate (IB)	56	Program of Study (Graduate)	178, 183
International Student Admission		Publications	81, 317
Graduate	169	Public Information	81, 317
Undergraduate	15	Purchasing and Telecommunications	
Intramural Sports	92	(Business Services)	315
Ivanhoe International Center	85, 316	Qualifying Examination, The	183
Language Requirements	178, 181	Refunds	23
Library	80, 314	Registration	55
Little Miner's Clubhouse	84, 316	Registration Changes	55
Living Accommodations	86	Registrations for No Credit	57
Loans, Short Term	46	Reinstatement Policy (Graduate)	175
Location	7	Religious Organizations	89

Repeated Courses	56	Student Organizations, Clubs, Societies	89
Requirements for Graduation	59	Student Services	83
Research (and Graduate Education)	314	Student Success Publications	71
Reservation of Rights	Inside Front Cover	Supervision of the Doctoral Program	182
Reserve Officers Training Corps (ROTC)	118	Supervision of the Master's Program	178
Residence Hall Applications	87	Support Services	71
Residence Hall Exemptions	89	Table of Contents	2
Residence Life	86, 316	Tech Learning Center	71
Residence Requirements	181	Technology Management	220
Resident/Non-Resident Classification	17	Textbook Refund Policy	25
Resident/Non-Resident Tuition	20	Thesis	179
Scientific Knowledge for Indian Learning and Leadership (SKILL)	86	Thesis and Non-Thesis Options	177
Scholarship Applications	31	Third Registration	56
Scholarships	31	Time Limitation	180, 185
Safety	7	Transfer Admission (Undergraduate)	12
Semester Honors List	52	Transfer Checklist	15
Social Sciences	121	Transcript of Credits	53
Software and Intellectual Rights	69	Transfer Studies	113
Software Copyright Statement	69	Tuition and Fees	20
South Dakota Board of Regents	4	Tuition Rates	20, 26
South Dakota Local Transportation Assistance Program	315	Tutoring	71
South Dakota Public Higher Education Institutions	4	Two Bachelor of Science Degrees	59
South Dakota Space Grant Consortium	81, 315	Undergraduates Taking Graduate Courses/ Graduates Taking Undergraduate Courses	173
Special Events and Educational Programs	82	University and Public Relations	82, 316
Special Interest Organizations	89	University Cabinet	317
Special Students		University Scheduling and Conferences	82, 316
Graduate	172	Visual and Performing Arts	90
Undergraduate	13	Western Undergraduate Exchange	20
Student Activities and Leadership Center	89, 316	Withdrawal From Courses	51
Student Affairs	316	Withdrawal From University	52
Student Assessment	71	Work Taken at Another Institution	174
Student Association	90		
Student Government Organizations	90		
Student Media	90		

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*TECHFact: Tech has a proud tradition of preparing students for excellence in engineering and science. Junior Andy Farke (GEOL, Armour) was named as a Barry M. Goldwater Scholar for the 2002-2003 academic year. Barry M. Goldwater Scholars are selected on the basis of academic merit from a field of 1,200 mathematics, science, and engineering students who are nominated by the faculties of colleges and universities nationwide.*