Welcome to the South Dakota School of Mines and Technology!

Our goal is to provide you an environment in which you will have excellent opportunities to continue your education. We offer programs in all of the major branches of engineering and the physical sciences. Degrees are offered at the baccalaureate, master's, and doctoral levels. Our College of Interdisciplinary Studies offers technically oriented studies in management, business, and writing leading to a baccalaureate degree. You may also major in interdisciplinary studies if you would like to begin your university studies with us and then transfer and complete your degree elsewhere.

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

We will encourage you to excel and to try just a little harder so that you will be the very best that you want to be. We will also be ready to assist you just in case the going may get a little rough as you move along the road to your chosen profession.

We invite you to join the South Dakota Tech family and combine our traditions of excellence with the newest of computers, technologies, and discoveries. 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,

Richard J. Gowen
President

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. Rudy Nef, Milbank
Mr. Shance Penfield, Vermillion
Mr. Jack Rentschler, Sioux Falls

OFFICERS OF THE BOARD

President: Harvey Jewett
Vice President: Curt Jones
Secretary: Jack Rentschler

SOUTH DAKOTA STATE EDUCATIONAL INSTITUTES

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

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, sex, 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 Deborah Sloat, Director of Human Resources, South Dakota School of Mines and Technology, 501 East St. Joseph Street, Rapid City, SD 57701, 605-394-1203.

RESERVATION OF RIGHTS

The information contained in this catalog is the most accurate available at the time of publication, but changes may become effective before the next catalog is printed. It is ultimately the student's responsibility to stay abreast of current regulations, curricula, and the status of specific programs being offered. Further, the university reserves the right, as approved by the Board of Regents, to modify requirements, curricula offerings, and charges, and to add, alter, or delete courses and programs through appropriate procedures. While reasonable efforts will be made to publicize such changes, a student is encouraged to seek current information from appropriate offices.

TABLE OF CONTENTS

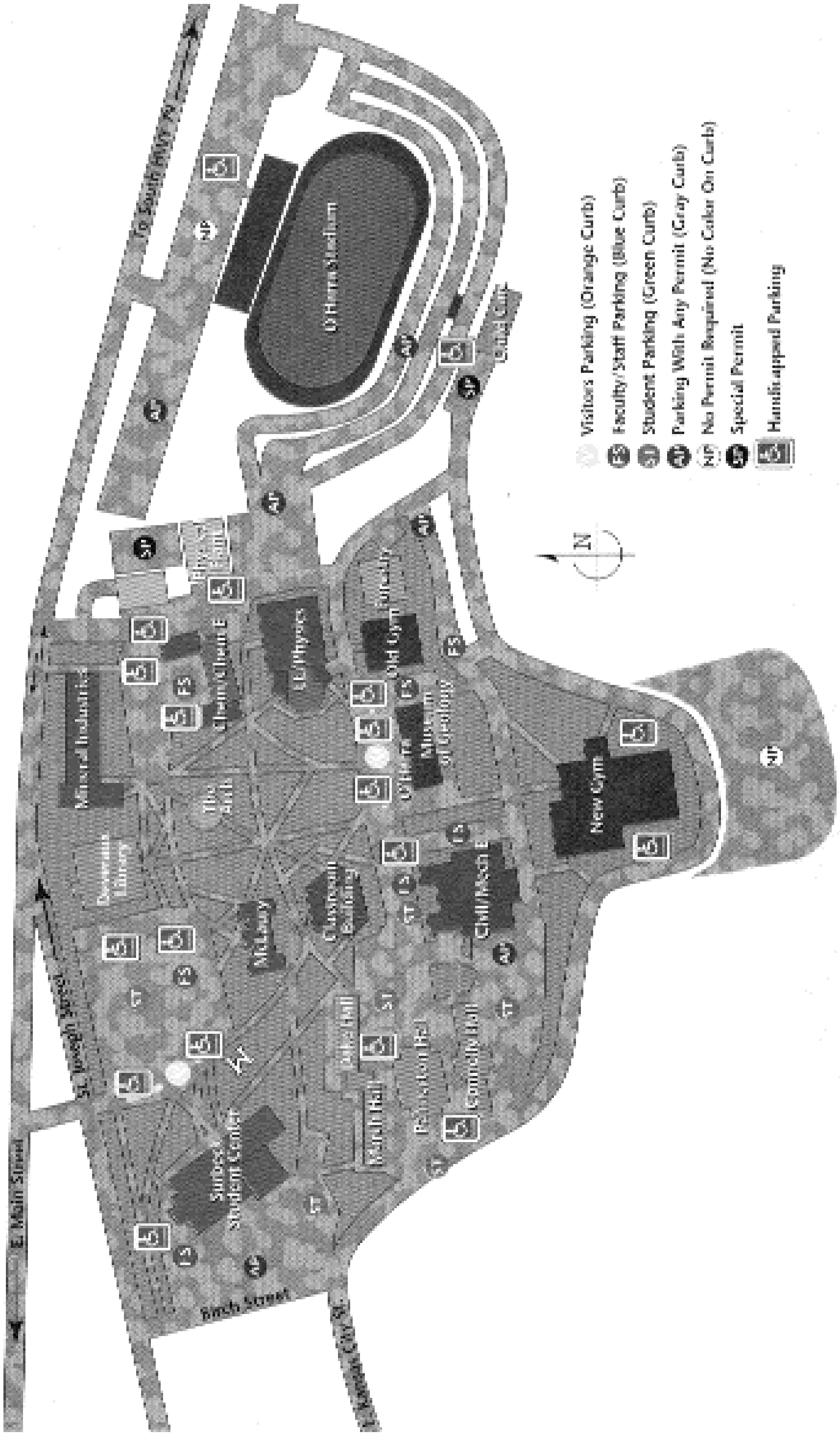
FALL SEMESTER 1999

Registration	August 30
First semester begins	August 30
Classes begin	August 31
Labor Day Holiday	September 6
Last day to add or drop a course and to adjust fees	September 14
Native Americans' Day Holiday	October 11
Early registration week	November 8 - 15
Last day to drop classes	November 10
Veterans Day Holiday	November 11
Thanksgiving Holiday begins at end of class day	November 24
Classes resume	November 29
Final examinations	December 16 - 22
Semester ends	December 22
Fall Graduation	December 18
Final grades due by 8 AM in Academic and Enrollment Services	December 27

SPRING SEMESTER 2000

Second semester begins	January 12
Registration	January 12
Classes begin	January 13
Martin Luther King, Jr. Day Holiday	January 17
Last day to add or drop a course and adjust fees	January 27
Presidents' Day Holiday	February 21
Spring vacation begins at end of class day	March 3
Classes resume	March 13
Last day to drop classes	March 31
Early registration week	April 10 - 14
Easter Holiday begins at end of class day	April 20
Classes resume	April 25
Final examinations	May 8 - 12
Semester ends	May 12
Spring Graduation	May 13
Final grades due by 8 AM in Academic and Enrollment Services	May 18

This calendar conforms to guidelines established by the Board of Regents, but is subject to change at its discretion.


To South Hwy 79
O'Harra Stadium
Physical Plant
Chem/Chem E
EE/Physics
Old Gym
Mineral Industries
The Arch
Devereaux Library
McLaury
Classroom Building
O'Harra
Museum of Geology
Civil/Mech E
New Gym
Surbeck Student Center
Dake Hall
Palmerton Hall
Connolly Hall
Mead Hall
St. Joseph Street
E. Main Street
Birch Street
Kansas City St.
N
FS
ST
AP
NP
SP
Visitors Parking (Orange Curb)
FS Faculty/Staff Parking (Blue Curb)
ST Student Parking (Green Curb)
AP Parking With Any Permit (Gray Curb)
NP No Permit Required (No Color On Curb)
SP Special Permit
Handicapped Parking

THE CAMPUS

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 Departments 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 is currently undergoing renovations scheduled for completion during the summer of 2000.

The **Electrical Engineering/Physics Building**, completed in 1973, provides offices and laboratory facilities for the Electrical and Computer Engineering and 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, Biology program, Atmospheric Sciences Department, and the Institute of Atmospheric Sciences.

The **Mineral Industries Building** was occupied in 1962. It is a three-story building of 52,000 square feet. Three academic departments, Geology and Geological Engineering, Materials and Metallurgical Engineering, and Mining Engineering, are housed in this building. The Engineering and Mining Experiment Station, Graduate Education and Research Office, Institute for Minerals and Materials, the Mining and Mineral Resources Research Institute, and Academic Services 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 Rural Development Telecommunications Network studios. This three-story building of 44,000 square feet provides over 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.

The **Forest Service Experiment Station Building** was completed and occupied in 1960. Its office, laboratory, and display space provides facilities for the research activities of the United States Forest Service. This building was constructed on the campus by the United States Department of Agriculture.

The **Old Gymnasium** is used for intramural activities and storage. It also houses the campus radio station offices and studios, graduate student offices, and the Scientific Knowledge for Indian Learning and Leadership (SKILL) Program.

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 which 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 which 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 Instructional Technology Services help desk.

Surbeck Student Center, including an addition completed in December of 1971 and renovations in 1994, provides over 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, health service facilities, the alumni office, 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'Harra, President and Professor of Geology at the university from 1911 to his death in 1935.

CAMPUS SAFETY AND SECURITY

The South Dakota School of Mines & Technology is committed to the safety and security of our students and employees. Security 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 quad and in campus buildings. In addition, the campus escort service may be utilized 24 hours a day by calling campus security.

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 Student Handbook and in the Faculty/Staff Handbook.

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 nine engineering and six science undergraduate degrees and graduate programs leading to the master of science degree in 13 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 is 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 two million visitors each year enjoy the Black Hills/Badlands area.

MISSION

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 assure 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.

Dr. Karen L. Whitehead,
Vice President for Academic Affairs

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

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

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

DEGREES

The following degrees are offered at SDSM&T in the designated fields of study.

BACHELOR OF SCIENCE

Chemical Engineering
Chemistry
Civil Engineering
Computer Engineering
Computer Science
Electrical Engineering
Geological Engineering
Geology
Industrial Engineering
Interdisciplinary Sciences

Mathematics
Metallurgical Engineering
Mechanical Engineering
Mining Engineering
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*
Geology and Geological Engineering
Materials Engineering & Science

*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.

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 are required for a minor.
- No less than 9 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 effected no later than the time of registration for the first semester of the senior year (96.01 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.

TECH QUALITY PLAN

The Tech Quality Plan (TQP) provides the opportunity for each student to participate in an outstanding educational experience that will prepare them for a lifetime career as a leader in the professions of engineering and sciences. The TQP is the guiding principle in achieving the SDSM&T mission and is critical to student success. The TQP is comprised of four components:

1. K-12 activities that help to prepare pre-enrollment students for success in the study of engineering and science.
2. First and second year activities that prepare SDSM&T underclassmen to enter into their majors.
3. Third and fourth year activities that prepare SDSM&T upperclassmen to be successful engineers and scientists and instill in them the desire for lifelong learning.
4. The executive graduate program provides for continuing education and advancement for SDSM&T alumni and other professionals who are practicing in an engineering or science field.

INDIVIDUALIZED EDUCATION PROGRAM (IEP)

The Individualized Education Program

(IEP), is designed to provide students with a personalized educational experience, one in which faculty member mentors and advisors have a thorough knowledge of student career goals and objectives and what deficiencies or strengths might hinder or aid in the student's ability to complete his or her plan of study.

Essential components of this information chain are the Freshman Goals Survey, the Early Alert Survey, and student records available through the Colleague information system. This information is geared to assisting mentors/advisors in placing students in the proper classes, suggesting additional work when necessary, and helping students achieve their educational and career goals. Placement testing, proficiency testing, department competencies, and exit exams are evaluated to determine student readiness and monitor progress through the academic program. In all phases of the plan, feedback of information to those supplying the classes and other services is provided.

GRADUATE STUDIES

Information regarding the courses of study leading to the Master of Science and Doctor of Philosophy degrees in selected fields of Engineering and Science is listed in the “Graduate Information” portion of this catalog.

PRE-PROFESSIONAL STUDIES

Legal and Medical Fields

Please see the Interdisciplinary Sciences section of this catalog on pages 110-113.

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.

BLACK HILLS NATURAL SCIENCES FIELD STATION

The Black Hills Natural Sciences Field Station functions in cooperation with colleges and universities from South Dakota, North Dakota, Minnesota, 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, and the geology of the Black Hills 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 site.

Geology and Geological Engineering:
1 week, dates open

GEOL 107 Geology of the Black Hills
(1 semester hour)
GEOL 410 Field Geology
(5 semester hours)
GEOE 410 Engineering Field Geology
(5 semester hours)

Further information may be obtained from Dr. Perry H. Rahn, Acting Director, (394-2464). Applications should be received by April 10, and all deposit fees are non-refundable upon acceptance into the course.

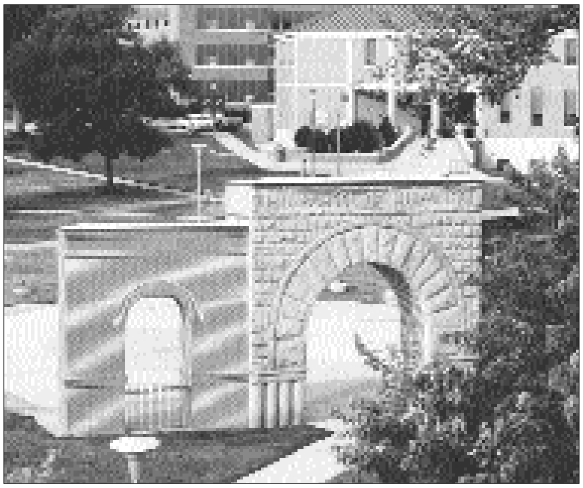
Center of Excellence for Advanced Manufacturing and Production (CAMP)

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.

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 student members are primarily from the EE and ME programs although others may participate. CAMP members must complete the following courses:

ME 261	Introduction to Manufacturing
IE 366	Management Processes
GE 399	Communications and Networking Issues in Manufacturing
GE 499	Integrative Design and Production (the senior design course taken by CAMP students).



TECHFact: The Memorial Arch and Plaza is both a link to SDSM&T's past and a central part of the current campus culture. The historic structure, a popular spot on campus, is often a meeting place, a scenic backdrop for photographs, and a point of interest for campus visitors. The three arches symbolize the first three buildings on campus with the center arch previously serving as the entry to the SDSM&T Liberal Arts Building which was completed in 1901.

TECHFact: Tech has a proud tradition of excellent students. SDSM&T physics major Robert B. Anderson III of Pierpont was named the 1998 Barry M. Goldwater Scholar. 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.

LIBRARY

The Devereaux Library, located in a four-story building on the north side of the campus along St. Joseph Street, 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. Also located in the library is the Instructional Technology Services Help Desk.

The lower level of the library contains an extensive journal collection, an audiovisual listening and viewing room, study areas, and a PC laboratory. The Ivanhoe International Student Center and South Dakota Engineering Society Office 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 and the Devereaux Instruction Center.

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 also includes hundreds of CD ROMs.

Devereaux Library is a "library without walls," providing electronic access to many of its resources. The Library has developed its own WWW home page, providing access to other library catalogs, electronic databases, and all other resources on the Internet. Patrons may use the web page to ask reference questions, order interlibrary loans, make suggestions about the library's resources and services, search the online catalog, and renew books. Devereaux is a teaching library, offering classes that introduce patrons to the state's on-line catalog (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.

INSTRUCTIONAL TECHNOLOGY SERVICES (ITS)

In 1996, to better serve the academic technology needs of the campus, Computing and Networking Services (CNS) joined with Educational and Distance Technology Services (EDTS) to form Instructional Technology Services. Together, these groups support and enhance the technology resources available for students, faculty and staff engaged in academic pursuits.

The mission of CNS is to provide responsive, people-oriented support and training for technology in the SDSM&T computing and networking environment. CNS operates and maintains the campus Local Area Network (LAN) and all centralized computing resources that are available to faculty, staff, and students, as well as gateways to external networks. Network connections for individuals in the residence halls (Connolly and Palmerton) is also managed through CNS; please note, there is an additional charge for this service.

The mission of EDTS is to pioneer new learning technologies and be a cost-effective provider of quality educational experiences outside the traditional classroom. Many of these technologies are also employed to enhance traditional learning environments. EDTS coordinates distance learning classes, and is responsible for campus video services, videoconferencing, satellite down-links, RDTN (Rural Development Telecommunications Network) in CB 109, and audiovisual resources to support classroom instruction. All ITS staff assist faculty in the transfer of cutting-edge instructional technology tools into the classroom, making the learning process more efficient, effective, and exciting. Staff also work to educate and inform students regarding technology. If you need reasonable accommodation to make use of technology, please contact the ITS Help Desk for assistance.

In support of both groups, the ITS Help Desk staff assist students, faculty and staff with software and hardware questions, and provide scheduling services for many shared resources. Contact the Help Desk with any questions about your computer accounts, or resources that you may need. The Help Desk can be reached by telephone at 605-394-1295, Internet mail (helpdesk@silver.sdsmt.edu) and by visiting the desk in the Devereaux Library—or check out our web page at http://support.sdsmt.edu. Help Desk hours of operation during the academic year are Monday - Thursday 7:30 a.m. - 9 p.m., Friday 7:30 a.m. - 5 p.m., Sunday 5 p.m. - 9 p.m. Holiday and summer hours vary according to need.

COMPUTING AND NETWORKING RESOURCES

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. About 125 PCs are located in campus labs, accessible to all students. Many of the campus labs are reserved for class use much of the day but can be used as open labs otherwise. The Civil/Mechanical lab is located on the lower floor of the Library during renovation of the Civil/Mechanical Building. Labs in residence halls are available only to residents. Some labs are kept open in the evening. PC labs are located in:

Chemistry	Room 208
Civil/Mechanical	Library (Lower Floor; temporary)
Classroom Building	South Entrance
EE/Physics	Room 307
Library	Room 109
March-Dake	Room 156
McLaury	Room 304
MI Building	Room 227
Palmerton Hall	Room 11
Surbeck Student Center	Room 106

In these labs, and through in-room network connections in all residence halls, students have access to word processing, spreadsheet, and graphics software, as well as electronic mail and World Wide Web/Internet. Students may also use our audio-visual production facilities in their presentations and projects. These include audio and video recording and editing capability, scanners, digital cameras, slide projectors, computer projectors and projection panels, and TV/VCRs.

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.

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. Starting in Fall 1998, these courses are offered to other campuses through the Distance Learning programs using the Governor's Electronic Classroom.

DISTANCE EDUCATION

Course Delivery Systems

At present, distance education courses are available via video tape, cable television, Internet, and various interactive media. 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 these become available, they will be incorporated into our offerings.

Many distance learning video-based courses at SDSM&T include segments filmed in the classroom as the lecture is being presented to the students on campus during the current semester. This is especially important in the science and engineering classes because of today's rapid advances in knowledge and technology. Because of this structure, distance learning classes are "semester based" in the sense that distance students are expected to complete each class within the semester it is taken. This also gives distance students the opportunity to meet and work with other students who are taking the class at the same time.

At the present time, the EDTS group, a division of Instructional Technology Services, is responsible for televising and videotaping the distance education courses as well as mailing materials to distance learning students. EDTS can be reached directly at (605) 394-2378, (800) 544-8162 ext. 2378 or via email at edts@silver.sdsmt.edu. You may also request assistance through the ITS Help Desk via email at helpdesk@silver.sdsmt.edu, or telephone at (605) 394-1295. The EDTS home page is located at www.sdsmt.edu/services/edts.

Interactive Supplemental Instruction

All faculty at SDSM&T have access to Internet and electronic mail facilities. Faculty also have the capability to use interactive videoconferencing technologies to meet with students. In some cases, faculty post handouts and other course materials on the Internet. Other faculty provide online questions and answers while still others provide links to supplementary information and material related to the course. Some classes use listserves or chat groups to distribute additional material and for communication and discussion among students.

Students also have the option of corresponding through mail, telephone, fax and electronic mail with the course instructor. The course syllabus will list options for course material delivery. Your instructor will provide contact information (email address and telephone number) which will be mailed along with course materials. If you have privacy concerns regarding using Internet-based communications, please contact the ITS Help Desk for assistance.

Cable Television

Courses on cable television are available to those individuals in the Rapid City area with access to the WANT TV cable TV service. Classes are broadcast live at the times given in the course list for the upcoming semester. Students are expected to come to campus to take tests with the classroom students, or to make other arrangements with the professor.

Interactive Television

Through the technology available through the South Dakota Rural Development Telecommunications Network (RDTN), SDSM&T courses are received simultaneously at various sites around the state. In most cases the SDSM&T campus is the origination site. All sites are fully interactive: that is, students at every site receiving the class can see and hear the faculty member. When the instructor is at a remote site, students view the instructor on television screens. They can ask questions of the faculty member and students at the other sites, and participate in class discussion.

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.

TECH PRINT CENTER

The Tech Print Center is located in the Physical Plant Building and is open normal office hours throughout the year. The Center specializes in providing media and instructional materials for the particular requirements of students, faculty, administration, and staff. Many brochures, booklets, lab books, flyers, and other instructional material used on campus are produced here. Graphic services offered include: layout design, paste-up, drafting, laminating, and blue and black line printing.

Various printing methods allow black and/or colored ink to be printed on a wide selection of paper stock. Binding and finishing capabilities include: folding, collating, velo binding, spiral binding, stapling, drilling, and padding.

Letterheads, envelopes, and business cards can be produced for each of the department needs. Many students use our services for printing resumes with a highly professional appearance. We also help the graduate students with theses formatting and copying. We then send the thesis off for hard-binding.

The Tech Print Center also has photocopiers with various types of black and white reproduction located throughout buildings on campus. The copiers are periodically replaced by upgraded models. Color copies and color overhead transparencies are available at the Tech Print Center.

TECH LEARNING CENTER

The Tech Learning Center, or TLC, provides tutoring in all the core subjects - math, chemistry, physics, computer science, English, and more. The tutoring is provided by peer tutors and is free of charge to all Tech students. The TLC staff also functions as a liaison between faculty and students when necessary; and tutoring to accommodate special circumstances or disabilities is available upon request. The TLC also has computers, televisions/video cassette recorders (VCR), textbooks, and other study aids available for students use.

The TLC is open seven days/evenings a week during the regular semester and on a more limited schedule during the summer sessions. The center is located in the Devereaux Library. For more information call 605-394-2547 or 605-394-1287.

TECHNICAL ASSISTANCE

The mission of the Technical Assistance Program (TAP) is to tap the resources of faculty, staff, students, and facilities to provide focused technical assistance. TAP links companies and individuals with expert technical assistance in the design, development, management, and production of products and services. Faculty and staff provide technical assistance in the application of advances in materials, computer integrated manufacturing, information and technology management, production processes and control, and many other areas. Information is also provided to economic development partnerships from across the state as they seek to attract and retain technology-based businesses. In addition to direct technical assistance, TAP offers seminars and workshops and works with distance education and the Patent & Trademark Depository located in the Devereaux Library. A variety of seminars and workshops are available for professional development with many awarding professional engineer continuing education and teacher renewal credits. Programs can also be developed to meet individual and company needs. Graduate and undergraduate programs are offered via video tape, TV cable service, SD Rural Development Telecommunications Network, and the Governor's Electronic Classrooms.

MUSEUM OF GEOLOGY

The Museum of Geology is an outstanding part of the School of Mines and Technology. Tens 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 Oligocene of the Big Badlands and the Upper Cretaceous of Western South Dakota, giving a vivid impression of Dakota life long ago. Also of interest are the spectacular Dana-arranged minerals from throughout the world. The South

Dakota room 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 collections form the basis for staff and student research. Graduate students may pursue studies leading to the degree Master of Science in Paleontology and work closely with Museum staff. 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 1-800-544-8162 extension 2467.

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 include gold and silver assays, chemical analysis of minerals, ores, raw materials, manufactured products, fluid inclusions in rocks, and environmental (asbestos, etc.) assessments. In addition to supplying a wide variety of analytical services to the community, the EMES provides, maintains, and upgrades analytical facilities and develops new analytical methods. Short courses on SEM, AA-ICAP, X-ray diffraction, and fluid inclusion analytical techniques are offered by EMES through SDSM&T academic departments to both the campus and industrial communities. The courses or equivalent training are prerequisite to "hands on" use of EMES instrumentation by students, faculty, and others.

INSTITUTE OF ATMOSPHERIC SCIENCES

The Institute has conducted research in the atmospheric sciences since its establishment at the School 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, image processing systems, a tethered-balloon sampling system, a hand-held dual UV/NVIR (350-1050 nm) spectroradiometer, plant canopy instrumentation, analytical instrumentation, a walk-up tower, and eddy-correlation flux instrumentation, and a variety of computers. 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 now collocated on the campus. A local computer network facilitates the handling of large data sets and nationwide communication via Internet.

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, Montana, Oklahoma, Texas, North American High Plains region from Texas to Alberta, in the southeastern U.S., and in Switzerland, and Canada. The aircraft carries instruments to measure state variables (air temperature, humidity, atmospheric pressure, etc.) 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 using NEXRAD data and to develop remote sensing estimates of precipitation in support of hydrological studies.

Laboratory equipment 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 includes quantitative analysis of particulate compounds and source apportionment modeling by mass balance. Chemical speciation of ambient gaseous and particulate components is of current interest. Another developing area is atmospheric chemical meteorology, the overall science and engineering associated with the reliable measurement of chemical species in the earth's atmosphere. 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).

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 which 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. More recently, work on remote sensing of land surface processes and use of remotely sensed data in initializing mesoscale models is underway.

In the last year IAS has broadened its research focus to include biogeochemistry. Research projects are underway to investigate the links among biology, atmospheric chemistry, and global change. Of special interest are 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 densing capacity of the atmosphere. Facilities to conduct this research include a unique tethered-balloon atmospheric profilers, tower systems, and gas chromatographic instrumentation.

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; (a B.S. through the Interdisciplinary Sciences Sciences program); an M.S. degree; and an interdisciplinary recently established Ph.D. program in Atmospheric, Environmental and Water Resources. The Institute employs a number of graduate students from Atmospheric Sciences and other departments as Graduate Research Assistants. A few undergraduate assistants are occasionally employed.

INSTITUTE FOR MINERALS AND MATERIALS (IMM)

The Institute for Minerals and Materials (IMM) was established in June 1987 as the successor to the Institute for Advanced Metallurgy. The mission of IMM is to foster, undertake, and coordinate basic and applied research, development, and education and training for the advancement of technologies associated with the extraction, refining, processing, and application of materials. Innovative technologies are necessary to revitalize the domestic materials industry in a very competitive global economy.

The Institute is headed by a Director who reports to the Vice President. Members of IMM normally hold a research appointment in IMM and an academic appointment in his or her home department. Some members may hold joint appointments in other campus research institutes. Other research and/or teaching faculty may become involved in IMM activities as Associates. Cooperating industries are identified as Industrial Affiliates. The IMM utilizes primarily the facilities of member’s homes and departments.

Graduate students working on Institute projects may earn a master's degree in any one of several engineering or science disciplines depending upon the primary field of his or her materials research. At the doctoral level, however, the Institute has its closest academic association with the Materials Engineering and Science Ph.D. program.

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 EROS Data Center; Horizons, Inc., Hughes STX and Raven Industries are industrial affiliates. The South Dakota Discovery Center and Aquarium in Pierre; Scientific Knowledge for Indian Learning & Leadership (SKILL), SDSM&T; Science Linkages in the Community (SLIC), Rapid City and Operation SMART, a program of Girls Inc. of Rapid City are educational affiliates. A primary Consortium objective is to enhance the capability for aerospace-related research and manufacturing in the state. The Consortium provides undergraduate scholarships and graduate fellowships in aerospace-related fields. It also provides summer faculty fellowships tenable at the 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, 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 235. The Consortium also maintains an Outreach Office in MI 228 to help foster wider use of aerospace-related materials in K-12 educational programs throughout the state. Outreach activities include sponsorship of South Dakota Space Day, teacher workshops, publishing a newsletter, Visiting Scientist programs in schools, Exploring Space Science Day, and Aviation Careers Exploration Academy.

MINORITY STUDENT STUDY CENTER

The center provides minority students, primarily Native Americans, with a study area on the top floor of the Devereaux Library. Services include peer tutoring and mentoring, scholarships, co-op and internship information, AISES (American Indian Science and Engineering Society) chapter meetings and activities. The center is staffed through the Dean of Students Office.

IVANHOE INTERNATIONAL CENTER

The Ivanhoe International Center (IIC) was established through the generosity of alumnus Lytton F. "Buster" Ivanhoe, fall semester 1994. The Center is located in the Devereaux Library and is the focal point for international students activities. The Center offers a multitude of services to students such as computer access, native language publications, and a place to just "hang out". The professional staff is available to assist students with: US Immigration & Naturalization services, Federal Income Tax requirements, on and off campus organizations, housing, international student list serve, and advocacy services. Students are also served through cooperative English as a Second Language (ESL) program and comprehensive orientation sessions. The Ivanhoe International Center / Student Services is a department in the Division of Student Affairs.

SCIENTIFIC KNOWLEDGE FOR INDIAN LEARNING AND LEADERSHIP (SKILL)

The SKILL program provides summer and after-school math and science education programs and activities for American Indian Students in grades 4-12. All programs are free and are both campus-based and school-based.

CHILDREN'S SCIENCE CENTER

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

Scheduled to open November 15, 1999, the Center will be located near downtown Rapid City in the Halley Park facility at 515 West Boulevard.

SDSM&T will operate the Center as an educational and community outreach project to help foster children's interest at an early age in science and technology careers. Another goal is to increase the preparedness of students for university-level study in engineering and sciences.

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 authorization, 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 workman's 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).

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.

DEFINITION OF CREDIT HOURS

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, is not pursuing a degree, and will be permitted to accumulate more than 30 hours only on an exceptional basis.

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 credit - 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 6 credit hours total during the summer term. A three-quarter time undergraduate student is one who is enrolled in 9 to 11 credit hours during a regular semester or 4 to 5 credit hours total during the summer term. A half-time undergraduate student enrolls in 6 to 8 credit hours during a regular semester or at least 3 credit hours total during the summer term.

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

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.

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

Undergraduates 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) Courses primarily for graduate students (open to selected junior and senior undergraduate students on an exceptions basis). Not open to

freshmen and sophomores. Also see "Graduate Credit."

600-699 Graduate level

Courses for graduate students only. Also, see "Graduate Credit."

700-799 Graduate level

Courses for Doctoral and post-doctoral students only.

800-899 Doctoral and post-doctoral level

Experimental Courses

Courses at the 100 to 800 levels ending in 97, 98, or 99 are experimental courses. They 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.

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 3, 4 or 5 may receive course credit. South Dakota Board of Regents policy on specific courses for which credit is given is found on the World Wide Web at http://www.ris.sdbor.edu/Universities/admissions/APguide.htm. The student shall receive credit without specific grade for the exempted basic course. 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)

In certain cases, SDSM&T will award a limited number of credit hours toward the Bachelor of Science degree requirements based upon an individual's CLEP score. This score must meet or exceed the minimum qualifying scores for Subject Examinations that are equivalent to SDSM&T courses. Credit will be awarded only when the student is registered as a regular student at SDSM&T.

The CLEP Subject Examinations are given on established testing dates. Students may take these examinations either before or after they enroll at SDSM&T.

Credit will not be awarded if the student has received prior credit for the same course or its equivalent. CLEP Examination credit will not be awarded if a student has been enrolled previously in the subject and failed the course or if this student has withdrawn from the course after more than six weeks of instruction. 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 of the student's department chair. Grades will not be assigned and hours will not be used in the computation of grade point averages. No credit will be awarded for the General Examinations.

Specific information about this program may be obtained from either the Dean of Students Office or the Office of Academic and Enrollment Services.

CREDIT BY EXAMINATION

The faculty has adopted a policy to permit college credit by 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. Credit by 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.

3. After determining eligibility to take an examination, the candidate pays a per subject fee at the Business Office and then secures the proper permit from the Office of Academic and Enrollment Services.
4. If the student successfully completes the examination, the permanent record will show "Credit by Examination." No grade will be awarded, but the student will receive the appropriate number of credits. No entry will be made on the permanent record if the examination is failed.
5. No more than 20 of the credits earned at this institution can be taken by examination.

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.

GRADUATE CREDIT

Graduate credit for SDSM&T seniors, per faculty adopted regulations: "An undergraduate student who has senior standing at the 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:

(a) 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.

(b) The course(s) must be numbered 500.

(c) 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's degree.

(d) The extra courses should not create an overload upon the individual student involved.

(e) 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 canceled.

(f) Not over 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.

(g) 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)

(h) Grades for courses so taken will not be included in undergraduate honor-point average or class standing.

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 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 (Omitted in calculation of average)
Incomplete - A temporary grade issued when work is of 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 (Omitted in calculation of GPA)
No Credit - 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 (Omitted in calculation of average)
In progress - 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 the SDSM&T for 12 consecutive months.

SP (Omitted in calculation of GPA)
Satisfactory Progress - 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 (Omitted in calculation of GPA)
Unsatisfactory Progress - A grade that may be issued any semester which 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 (Omitted in calculation of GPA)
Satisfactory - 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 (Omitted in calculation of GPA)
Unsatisfactory - 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. (Grade: Meaning)

AU Audit - The student must file a petition with the Academic and Enrollment Services office 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 Academic and Enrollment Services Office 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 ten days of classes by dropping or adding courses with refund or assessment of tuition. There is NO refund of tuition for a dropped course after the tenth day of classes. Before the end of the 10th 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 drop-add card by securing the signatures of his or her instructor and advisor and submitting the card to the Academic and Enrollment Services Office.

A student may not drop a course with a passing grade after the 10th week of the semester. Each semester after the 10th 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 which 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

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 grade point ratios.
4. Credits earned under this option may be used to reduce 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 days 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.

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 and guarantee deposits.

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.

SEMESTER HONORS LIST

All regular undergraduate students who carry 9 or more credit hours and receive an honor-point ratio of 3.4 or better are listed as honor students. The honors list is published at the close of each semester. Students with "F" or "I" grades are not listed, regardless of average attained.

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 6 hours.

To register for heavy loads, students must consult with their academic advisors. To register for overloads, students must have a cumulative honor point ratio 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 Academic and Enrollment Services Office.

Appeals must be made to the Faculty

through the Chair of the Faculty.

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 a 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.

Minimum Progression Standards

Class	Credit Hr. Range	GPA Standard
FR.	0-31.99	1.8
SO.	32-63.99	1.9
JR.	64-95.99	2.0
SR.	96-more	2.0

(Source: B.O.R. revised 1998).

Any student denied registration on the basis of this policy may apply for re-admission to the college following the lapse of at least two regular semesters. No courses, neither regular, evening nor summer, may be taken during the required suspension period 2.
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. The Student Enrollment Appeals Committee and/or the student may request that the student's advisor and/or department head be consulted during the appeal and review process act.

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 5 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 SDSM&T transcript;
    c. 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.

DEADLINES FOR ADDING COURSES

1. Students may add daytime or night courses to their schedules through the 10th day of classes.
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, during the period from the 11th to the 15th day of classes.

3. Students wishing to add any daytime or night courses beyond the period specified above must file a written appeal with the Vice President (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 fifth day of classes.
5. In extreme circumstances, students may add summer school courses after the fifth day with permission of the instructor and the Vice President of Academic Affairs (or their designee).
6. No student will be permitted to attend any class unless he/she is registered and so listed on the class attendance roll.

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. The tuition refund schedule in the catalog is followed if a student withdraws from the university during the first four weeks of a regular semester. 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 Academic Support Services. A withdrawal from the university will be processed only when all courses, and whenever all courses, are being dropped by a student.

If a student withdraws from the university after the 10th 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 which 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 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.

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 5-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 (2 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.

TRANSCRIPT OF CREDITS

A transcript of credits is an authentic copy of the student's academic record. The fee is $5.00 for each copy. A transcript must include all courses attempted. Transcripts are released only on 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.

EDUCATIONAL RIGHTS AND PRIVACY ACT OF 1974 (BUCKLEY AMENDMENT)

The purpose of the Act is to require educational institutions and agencies to conform to fair information practices: that is, persons who are subjects of data systems must be informed of the existence of such systems, be able to learn what information about themselves is on record, be assured that it is used only for intended purposes, be able to correct or amend records, and be assured that those responsible for data systems take reasonable precautions to prevent misuse of the data.

More specifically, the law states that:

1. Educational agencies and institutions must provide students access to official records directly related to the students;
2. Students must be provided with the opportunity for a hearing to challenge such records on the grounds that their records may be inaccurate, misleading, or otherwise inappropriate;
3. Educational agencies and institutions must obtain the written consent of the students before releasing personally identifiable data about students from educational records to other than a specified list of exceptions; and
4. Students must be notified of these rights.

Students should be aware that these rights and privileges are available to them. Formal notification regarding the Act is provided annually in the Student Handbook. An announcement covering information designated as Public or Directory Information is included in the "Tech Times" each Fall Term, and prior to the publication of the annual University Directory. Students have the right to request that such information concerning them be withheld from the Directory. For a full description of the Act, information regarding the location of students' educational records, and procedures at SDSM&T for compliance with the law, please contact Academic and Enrollment Services.

ADMISSIONS REQUIREMENTS & REGULATIONS

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% 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.

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-half year of fine arts for students graduating from South Dakota high schools** - 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. Competency Criteria

a. Students who do not successfully complete four years of English may demonstrate English competency through one of the following:
   - i. An ACT English subtest score of 17 or above;
   - ii. An Advanced Placement Language and Composition, or Literature and Composition score of 2 or above.

b. Students who do not successfully complete three years of advanced mathematics may demonstrate mathematics proficiency through one of the following:
   - i. An ACT mathematics subtest score of 17 or above;
   - ii. An Advanced Placement Calculus AB or Calculus BC score of 2 or above;

c. Students who do not successfully complete three years of laboratory science may demonstrate science competencies 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 or Physics C score of 2 or above.

d. Students who do not successfully complete three years of social studies may demonstrate social studies competencies 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 2 or above.

e. Students who do not successfully complete one-half year of computer science may demonstrate computer science competencies through one of the following:
   - i. An Advanced Placement Computer Science A or AB score of 2 or above.

f. Students who do not successfully complete one-half year of fine arts may demonstrate fine arts knowledge or competency through one of the following:
   - i. An Advanced Placement History of Art, Studio Art drawing or general portfolio or Music Theory score of 2 or above.

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

An applicant who is not a high school graduate must obtain an ACT composite score of 18, ACT English, Mathematics, 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 at least 18 years of age, or the high school class of which the student was a member must have graduated from high school.

C. Non-Traditional Students

Each university shall establish appropriate admissions requirements for students who are at least twenty-one (21) years of age.

D. Exception Group

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

E. Regents Scholars

Effective Spring 1998, South Dakota high school graduates completing the following high school courses with no final grade below a "C" 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:

- 4 units of English
- 4 units of mathematics*
- 4 units of science*
- 3 units of social studies
- 2 units of a modern ** or classical language (Including American Sign Language)
- 1/2 unit of fine arts
- 1/2 unit of computer science

* 3 units of algebra or higher mathematics and 3 units of approved laboratory science.

** American Sign Language is considered a modern language.

ASSOCIATE DEGREE ADMISSIONS AND TRANSFERS

A. Associate Degree Admissions

A student who has not completed the core high school requirements as specified in BOR policy 2:3.2 may gain acceptance to an associate degree program by meeting any one of the following criteria:

- Ranking in the top 60% 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.

1. General Education Equivalency Diploma

Students who have completed the General Equivalency Diploma (GED) with a combined score of 225 and minimum of 40 on each test will be admitted.

2. Students Who Do Not Meet Baccalaureate Degree Admission Requirements

Students who do not meet the baccalaureate degree admission requirements and want to enter a baccalaureate degree program must:

- Complete at least 15 credit hours of the system-wide general education requirement with a 2.0 GPA

  AND
- Meet minimum progression standards.

3. Additional or Higher Admissions Requirements

Some associate degree programs may have additional or higher admissions requirements.

B. 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.

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.

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.

APPLICATIONS AND PROCEDURES

A. Application for Enrollment Form

Each university shall include on its application for enrollment form a section designed to identify persons who may be entitled to tuition and fee reductions and scholarships established by the Legislature. Such persons include:

- veterans (see SDCL § 13-55-2);
- children of residents who died from any cause while in the armed forces (see SDCL § 13-55-6);
- dependents of prisoners of war or persons missing in action (see SDCL § 13-55-9.2);
- children or spouses of members of the South Dakota national guard disabled or deceased in the line of duty (see SDCL § 13-55-10);
- visually impaired persons (see SDCL § 13-55-11);
- enrolled members of federally recognized Indian tribes whose reservation is located in South Dakota (see Policy 3:14 and SDCL § 13-55-14);
- surviving children of certain firefighters, certified law enforcement officers, and emergency medical technicians (see SDCL § 13-55-22);
- student incentive grant recipients (see SDCL § 13-55A);
- superior scholar award recipients (see Policy 3:14 and SDCL § 13-55C);
- educational excellence scholars (see SDCL § 13-55D);
- state employees (see SDCL § 3-20);
- members of the South Dakota national guard (see SDCL § 33-6-5).

The tuition and fee reductions and scholarships created by the Legislature for the benefit of South Dakota residents shall be administered as provided in the legislation.

B. Application Deadlines

An applicant for admission must submit the required application for admission and the necessary official transcript or transcripts and other required documents to the admissions officer at the appropriate college according to campus published deadlines. An application for admission from a student who is required to take an entrance examination shall not be considered unless the examination results can be obtained before the beginning of orientation.

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

- 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 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.
- 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.
- 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.
- 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.

ADDITIONAL ADMISSIONS POLICIES & 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.

MANDATORY MATHEMATICS PLACEMENT PROCEDURE

A mandatory mathematics placement procedure for incoming freshmen 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.

CHECKLIST FOR FRESHMAN ADMISSIONS/SCHOLARSHIP CONSIDERATION

- Submit application for admission.
- Enclose non-refundable application fee with application for admission. ($15.00)
- ACT or SAT scores must be on file in the Academic and Enrollment Services Office.
- Applicants must arrange to have an official copy of their high school transcript f forwarded to the Academic and Enrollment Services Office 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 15th.

UNDERGRADUATE TRANSFER ADMISSION

An applicant for admission to 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.

JUNIOR COLLEGE CREDITS

Transfer credit from a junior college will not be accepted for graduation in excess of two years credit or one-half of the number of hours needed for the earning of the baccalaureate degree.

CHECKLIST FOR TRANSFER APPLICANTS

- Application for admission.
- Non-refundable application fee, $15.00. 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 SDSM&T Office of Academic and Enrollment Services.)
- Transfer form completed by the institution from which the applicant is transferring.
- 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 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 coursework 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.

SPECIAL 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 admission, and submit the $15.00 non-refundable application fee. If a prospective student has previously attended a South Dakota state university and paid the application fee it is not assessed again. 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.

SDSM&T POLICY FOR THE ADMISSION OF HIGH SCHOOL STUDENTS ON A SPECIAL STUDENT BASIS

High school students who wish to take courses at SDSM&T should begin by contacting 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 and $15.00 application fee. 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."

UNDERGRADUATE FOREIGN STUDENT ADMISSION

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

- Rank in the upper half of secondary school graduation class.
- Have a 3.0 (B) grade average if transferring from a college or university.
- Be proficient in English.
- Be financially self-sustaining.

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 American Consulate will supply detailed information on student status and required visas.

- A completed application for admission to the SDSM&T Academic and Enrollment Services Office submitted prior to June 30 (Fall) or November 10 (Spring) and the State of South Dakota application fee of $15.00. (Your application will not be processed until the $15.00 fee is paid.)
- Affidavit of Financial Responsibility. The financial certificate/statement must be signed by the applicant and all other persons providing financial resources to the applicant and counter-signed by a bank official.
- 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.
- 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 Academic and Enrollment Services (AES) Office, South Dakota School of Mines & 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 undergraduates. For Norwegian students, we 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
- Recommendations from two professors or instructors familiar with the academic performance of the applicant.

International Students must attend the school specified on their visa or they may be refused admittance to the United States. Special permission must be obtained in order to work and is granted only under rare circumstances. A spouse or child may not work. A passport valid for at least 6 months must be maintained. Aliens are subject to deportation if they stop attending school, take less than a full course of study, or accept unauthorized employment. Prospective students must 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. Under no circumstances should a student enter the U.S. with a WT. The deadline for application is at least 60 days prior to the beginning of the terms for which admission is desired.

INTERCOLLEGIATE REGISTRATION

In order to increase the availability of courses to their students, South Dakota School of Mines and Technology and Black Hills State University cooperate in a program of intercollegiate registration which allows students seeking a degree from either institution to simultaneously enroll in classes at the other campus. For details on how to participate in this program, students should contact the Office of Academic and Enrollment Services at the campus from which they intend to graduate.

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 college in the Fall, 1989 semester, or later semesters, and are not residents of South Dakota, but who are legal residents of Alaska, 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, 700 Governors Drive, Pierre, SD 57501-2293, Telephone: (605) 773-3455; or from WICHE Student Exchange Program, P.O. Drawer P, Boulder, CO 80301-9752, Telephone: (303) 541-0124.

RESIDENT AND NONRESIDENT CLASSIFICATION OF STUDENTS

Purposes of Classification

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

Information, Burden of Establishing Residency, Reclassification

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

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

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

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

E. After twelve 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 an 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 twenty-one 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 twelve 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 twelve 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 twelve 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 twelve 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 §3(B) above.

E. Residence of International Students
   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.

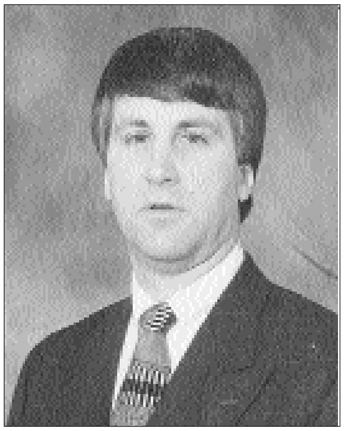
C. The fact that a person pays taxes and votes in the state does not in itself establish residence.

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.

.



Mr. Timothy G. Henderson,
Vice President of Business
and Administration

Tuition and Fees: The charges for tuition, fees, special charges, and room and board will be set each year by the Board of Regents.

Payment of Tuition and Fees: At each institution under the control of the Board of Regents, tuition and fees shall be due and payable at the time of registration for each semester.

Refunds: No refunds are to be made for courses dropped after the deadline set for payment of fees except under circumstances beyond the control of the student as determined by the Office of Academic and Enrollment Services of the institution. This is not to be interpreted to mean that courses may not be changed.

Military Service: A student required to withdraw from a state-supported institution before completing a semester may receive credit and refund privileges if: the individual is a regularly enrolled student, is a member of a military unit called for duty or is 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. An eligible student who is 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 seventy-five percent of an extension enrollment, shall be given full credit for all courses or lessons if the student has an average grade of "C" or better. An eligible student who receives credit for any course or lesson shall not be entitled to any refund of tuition or fees paid for the privilege of pursuing such course or lesson. An eligible student who does not receive credit for a course or lesson shall be entitled to a full refund of tuition and academic fees.

Tuition Rate Versus 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.

Graduate Fellows and Assistants: Graduate assistants and fellows who receive awards in the amount of $1,900 or more per semester and are full-time (9 or more credit hours) students may be eligible for reduced tuition on state supported courses at one-third the resident rate.

ROTC Tuition Reduction: ROTC members who meet established criteria are eligible to receive a fifty 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 fifty 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 S.D. National Guard Tuition Assistance.

National Guard Officers: Upon presentation of a completed DA2171, National Guard Officers will receive tuition assistance from the Army. This assistance applies to tuition only.

AIR FORCE TUITION ASSISTANCE: Air Force Tuition Assistance will be granted only when a completed AF 1227 is presented. This assistance is applied to tuition and appropriate fees.

STUDENTS SIXTY-FIVE YEARS OF AGE OR OLDER: The tuition for students sixty-five years of age or older during the calendar year in which they are enrolled shall be one-fourth of the cost of resident tuition, on a space available basis.

DELEGATION OF AUTHORITY TO COLLECT MONIES: The President of each institution shall delegate to the Vice President of Business and Administration of that institution authority to collect and receive all fees, charges, tuition, rents, and other monies due to the institution.

STUDENT REPRESENTATION ON GENERAL ACTIVITY FEE COMMITTEE: There shall be at least a simple majority of students on the committee that recommend to the President the establishment and allocation of General Activity Fees. The President of the institution is the approving authority.

TUITION AND FEES

Each course is assessed **tuition, university support fee, and a general activity fee,** based on the number of credit hours listed for the course. In addition, courses with credit for laboratory work are assessed a **laboratory fee** at a fixed rate per laboratory. All courses in engineering, physics, computer science, mathematics, chemistry, and geology which are acceptable for an engineering, physics, computer science, mathematics, chemistry, or geology degree are assessed a **program improvement fee** based on the total number of credit hours for each such course. All tuition and course fees, as well as any other applicable fees must be paid at the time of enrollment or no later than Registration Day. Refund of such tuition and fees is possible only as prescribed herein under Refunds. The Board of Regents reserves the right to make changes in any fee as and when it deems necessary.

Assessed tuition and fees must be paid as part of the registration procedures at the opening of each semester. A loan, deferred payment, or any other unusual financial arrangements must be approved by the Business Office prior to registration.

GRADUATE STUDENT TUITION AND FEES

Graduate students who hold a state contract for a teaching or research assistantship or fellowship may be entitled to special reduced tuition at one-third the resident graduate rate (see "College Costs"). Campus fees remain unchanged. To be eligible for reduced tuition, a candidate must be under contract for $1,900 or more per semester and must be carrying 9 credit hours (6 in summer)*. The assistantship offer or fellowship award letter will specify whether the award carries with it eligibility for reduced tuition. Hourly wages alone cannot be used to satisfy the current posted minimum stipend earnings for tuition reduction.

Reduced tuition is not available for extension 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 withdraws from one or more courses at any time during the semester for which reduced tuition has been assessed and if such action causes his or her credit-hour load to fall below the minimum requirement for reduced-tuition eligibility, then tuition will automatically be reassessed at the regular rate for the remaining credit hours and the student is responsible for reimbursing the institution for the difference between regular and reduced rates. A student who receives at any time after registration for a semester 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 tenth day of classes.

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 three-fourths time attendance if taking six, seven, or eight credit hours, and in half-time attendance if taking five credit hours.

* These credits must be required credits in the degree program of study (See Institutional Policy 11-C-07).

INTERNATIONAL STUDENT TUITION AND FEES

Policy Guidelines of Tuition and Fee Payments for international students at SDSM&T (holding F1-J1): In view of widespread and persistent failure of certain countries to pay tuition and fees and/or to transfer funds for other necessary living costs of students while attending SDSM&T, the college has implemented the following policy:

Students from such countries will not be granted certificates of eligibility "Form I-20" or "IAP-66" until advanced payment to SDSM&T for tuition and fees has been received by the Business Office and estimated tuition and fees for succeeding semesters must be placed on deposit with the SDSM&T Business Office in advance of registration each semester.

Those accepted undergraduate and graduate students who are offered financial assistance at a level which covers estimated tuition and fees are exempt from the advanced payment requirement. However, stipend payments may be withheld unless tuition and fees for any given semester are paid in full at the end of registration for that semester.

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 you are covered by your government's insurance. Documentation of this is necessary. If any of your dependents are with you in the United States, it is required that you purchase insurance coverage for them also. Again, the only acceptable policy for you and your dependents is SDSM&T's policy. Questions about health insurance should be directed to the Ivanhoe International Center.

Financial Assistance: South Dakota School of Mines and Technology is a state-supported institution governed by Regents of Education, State of South Dakota, and as such is unable to provide financial assistance to undergraduate and graduate students who are not U.S. citizens. The applicant must provide documentary evidence that he/she is financially able to cover the projected annual cost of education at this college and all living expenses incurred in the pursuit of the Bachelor of Science degrees.

TUITION RATES

The tuition rates listed below are effective May 8, 1999.

Tuition Category	Undergraduate Courses (cr. hr.)	Graduate Courses (cr. hr.)
Resident	$ 58.35	$ 88.60
Non-Resident	$ 185.65	$ 261.25
MN Reciprocity[1]	$ 64.88	$ 120.46
Child of S.D. Alumnus[2]	$ 58.35	$ 88.60
WUE[3]	$ 87.51	N/A
WICHE[4]	$ 58.35	$ 88.60
Graduate Assistant[5]	$ 29.53	$ 29.53
Nat'l Gd Member[6]	$ 29.18	N/A
ROTC[6]	$ 29.18	N/A
Resident, 65 & older	$ 14.59	$ 22.15
Extension	$ 125.45	$ 161.25

Audit-Same as for course taken for credit

[1] Will be revised in July, 1999.

[2] This rate is for students who were enrolled in the Fall 1995 term.

[3] Western Undergraduate Exchange (WUE) for students in eleven western states. Call the Academic and Enrollment Services Office for details.

[4] Western Interstate Commission for Higher Education (WICHE)/Western Regional Graduate Program.

[5] Carrying nine or more hours per semester, under contract and receiving a qualifying award. A teaching associate is required to be enrolled for at least six credit hours.

[6] Resident submitting proper documentation at time of registration.

DESCRIPTION OF FEES

Course Fees

UNIVERSITY SUPPORT FEE - $35.44/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, O&M costs, deferred maintenance, Student Information System software, and technological supplies and equipment. This fee is refundable only in those cases which produce a refund of the tuition of the course.

GENERAL ACTIVITY FEE - $12.83/ CREDIT HOUR: This fee is assessed for all on campus courses with a duration over two days. The amount is assessed on all credit hours, up to a maximum of twelve per semester. This fee is refundable only in those cases which produce a refund of the tuition for the course.

LABORATORY FEE - $20.25/LAB: A laboratory fee is charged for each laboratory course. This fee is refundable only in those cases which produce a refund of the tuition for the course.

PROGRAM IMPROVEMENT FEE - $13.70/CREDIT HOUR: Students enrolled in courses in engineering, physics, computer science, mathematics, chemistry, and geology which are acceptable for an engineering, physics, computer science, mathematics, chemistry, or geology degree are required to pay a program improvement fee for each credit hour of enrollment in such courses. This fee is refundable only in those cases which produce a refund of the tuition for the course.

OTHER FEES, DEPOSITS AND CHARGES

CREDIT-BY-EXAMINATION FEE: This fee is charged for each course in which a student seeks credit by examination.

PARKING CHARGE - $35.00/YEAR: All motor vehicles brought on campus must be registered with the Parking Office and must display the appropriate parking sticker. Parking stickers can be purchased at the Debit Card/Cashier Office. Unpatrolled (free) parking is provided south of the Physical Education Building and in a portion of the stadium parking areas.

TRANSCRIPTS: (Refer to Transcript of Credits under General Information.)

ADD/DROP CHARGE: This charge is levied on each occasion when a student adds or drops courses after classes have begun.

LATE REGISTRATION CHARGE: Late registration is charged each semester to those students who do not register at the time or in accordance with the plan provided for registration. Request for refund of this charge must be submitted in writing to Academic and Enrollment Services.

LATE PAYMENT CHARGE: 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.

APPLICATION FEE: The application fee is charged upon initial application for admission to a state college. This fee must accompany the application form.

FOREIGN STUDENT ENROLLMENT FEE: Foreign students will be assessed a one-time fee of $100 in addition to the usual application fee. This fee will be assessed at the time of enrollment for the student's first semester of attendance at SDSM&T. The revenues from this fee are used to offset additional administrative costs that are incurred while processing foreign student enrollments.

OPTIONAL HEALTH INSURANCE: The hospital-surgical medical plan is a year-round hospitalization plan consisting of basic and major medical insurance for those students not covered by any other insurance plan. Dependents may also be covered under this plan at an additional cost. This policy excludes accident or injury occurring while participating in intercollegiate sports, contests or competitions, or while participating in any practice or conditioning program of a preparatory nature for such sports, contests or competitions. Dental and vision insurance are also available at additional cost. Additional information may be obtained at the Debit Card/Cashier Office.

INTERNATIONAL STUDENT HEALTH INSURANCE: In accordance with South Dakota Board of Regents policy 3:14, dated 9/92, international students, their spouses and their dependents, enrolled in any Board of Regents university are required to purchase the South Dakota Board of Regents endorsed student health insurance plan. Exceptions may be granted for students with legal residence or those with a comparable, non-refundable, health insurance plan in effect.

Special Examination Charge: This special examination charge may be required each time a student fails to take a scheduled examination and requests a special examination to establish a grade.

Vocational Testing Charge: The vocational testing charge is charged to all who request special vocational testing service. Contact the Dean of Students Office for details.

Audit Fee: Audited courses and courses taken not-for-credit are assessed tuition and related fees.

Indebtedness: A student who is indebted to the college 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.

Dorm Deposit: A deposit must accompany all requests for dormitory assignments.

Food Service Contracts: (See the following page).

Schedule of Fees

Course Fees

Each course is assessed **tuition, university support fee, and a general activity fee,** based on the number of credit hours listed for the course. In addition, courses with credit for laboratory work are assessed a **laboratory fee** at a fixed rate per laboratory. All courses in engineering, physics, computer science, mathematics, chemistry, and geology which are acceptable for an engineering, physics, computer science, mathematics, chemistry, or geology degree are assessed a **program improvement fee** based on the total number of credit hours for each such course. All tuition and course fees, as well as any other applicable fees must be paid at the time of enrollment or on Registration Day. Refund of such tuition and fees is possible only as prescribed herein under Refunds. The Board of Regents reserves the right to make changes in any fee as and when it deems necessary.

University Support Fee	$35.44 cr. hr.
Program Improvement Fee	$13.70 cr. hr.
Laboratory Fee	$20.25 per lab
General Activities Fee	$12.83 cr. hr.

Other Fees, Deposits and Charges

Credit-by-Examination (per course)	$75.00
Reinstatement Fee	$10.00
Parking Charge (per academic year)	$35.00
Transcript Fee	$ 5.00
Late Registration	$10.00
Late Fee Payment (plus $1.00 per day)	$10.00
Application Fee	$15.00
Optional Health Insurance and Major Medical (per student per year) (1998-99 rate)	$559.00 (Additional charge for spouse and family)

Housing Charges

Deposit (applies to dormitory rent):	$100.00
Dormitory residency, All Residence Halls:	
double occupancy per semester	$698.00
single occupancy per semester	$931.00
Overcapacity Rate	$522.00

Rental rates include local telephone service and basic cable TV service. Computer network connections are also available in all rooms.

Food Service Contracts

A, B, C Freshman Plan	$863.00/sem.
E. Returning Student Plan	$618.00/sem.

D.	Returning Student Plan	$490.00/sem.
F.	Commuter Plan	$100.00/sem.

All new dormitory students will be required to purchase Plans A, B, or C. Plan D provides $490.00 in Plus Dollars. Plan F is a commuter plan offered only to students living off-campus at the rate of $100/semester.

REFUNDS

STANDARD REFUND: If no final grade has been awarded, tuition and fees will be refunded for those courses dropped before the close of business of the day listed as "last day to add or drop courses" in the academic calendar. If a student withdraws from college with permission, only the tuition, enrollment fees and general activities fee for the uncompleted courses remaining at the time of withdrawal will be refunded according to the following table:

Week of drop	**Refund**
First and second weeks of semester	100%
Third week of semester	50%
Fourth week of semester	25%
After fourth week of semester	none

PRO RATED REFUND FOR FIRST TIME STUDENTS RECEIVING TITLE IV ASSISTANCE: Any student, attending the university for the first time, whose date of withdrawal is at or before 60% of the term is completed and who received Federal Title IV assistance shall be eligible for a pro rated refund of tuition, fees, and other charges. The refund is equal to the portion of the period of enrollment for which the student has been charged that remains on the last recorded day of attendance by the student less any unpaid charges owed by the student for that period of enrollment.

Refund

Up to 2 weeks	100%
More than 2 weeks, up to 3 weeks	80%
More than 3 weeks, up to 4 weeks	70%
More than 4 weeks, up to 6 weeks	60%
More than 6 weeks, up to 7 weeks	50%
More than 7 weeks, up to 9 weeks	40%
More than 9 weeks	0%

DORMITORY REFUND: The amount refunded will be the amount assessed less ten percent per week of residence up to ten weeks. After ten weeks of residence there will be no refund. If any charges are pending the refund will be reduced by the amount not paid.

PRO RATED DORMITORY REFUND FOR FIRST TIME STUDENTS RECEIVING TITLE IV ASSISTANCE: The following schedule will be followed for refunding residence hall charges:

Refund

Up to 1 week	90%
More than 1 week, up to 3 weeks	80%
More than 3 weeks, up to 4 weeks	70%
More than 4 weeks, up to 6 weeks	60%
More than 6 weeks, up to 7 weeks	50%
More than 7 weeks, up to 9 weeks	40%
More than 9 weeks	0%

FOOD SERVICE CONTRACT REFUND: Amount of refund will be based on a 16-week semester. To receive this refund, the meal contract must be turned in at the Business Office at the time of withdrawal.

TEXTBOOK REFUND POLICY

FALL AND SPRING SEMESTERS: WITH RECEIPT, 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, 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 begin. It is recommended that students attend class before purchasing their textbooks.

SELLING TEXTBOOKS TO THE TECH BOOKSTORE: The Tech Bookstore will buy back textbooks each week of finals tests during the Fall and Spring semesters. Summer school buyback will be held the last two days of the last summer school session. Books will be purchased according to the official buyback policy.

The Tech Bookstore cannot guarantee that any of your textbooks will be bought back.

TECHFact: Tech has an active intramural athletic program. Among the intramural activities are tennis, golf, basketball, softball, volleyball, swimming, water polo, wallyball, bowling, and flag football.

FINANCIAL AID

Many college students have limited funds and find it necessary to supplement their personal and family financial resources for college. The School of Mines and Technology administers a comprehensive financial aid program which amounted to over $6,500,000 for 1997-98. Staff members are available in the Office of Academic and Enrollment Services to help students secure needed financial aid. Members of the staff make every effort to develop a financial aid package (some combination of the loan, job, grant and scholarship) which will make it possible for capable, qualified, and needy students to finance college and living costs. The student should 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. Financial aid applications received after April 1 will be processed to the extent remaining funds permit.

The following are brief descriptions of the major Financial Aid programs. More detailed descriptions of the program provisions are available from the Office of Academic and Enrollment Services upon request:

> Federal Pell Grants, Federal Supplemental Educational Opportunity Grants, Federal Perkins Loans, Federal College Work-Study Jobs, State Student Incentive Grants, and Subsidized Federal Stafford Loans

These sources of federally funded aid are awarded on the basis of need. U.S. citizenship or permanent residency is required by Federal law for eligibility for all of the Federally financed student aid programs. The student and his or her parents should process the Free Application for Federal Student Aid (FAFSA). The FAFSA can be obtained from the high school guidance office or the SDSM&T Office of Academic and Enrollment Services. The FAFSA process should be completed by March 15 in order to be considered for the most advantageous package for the aid year beginning in July. Students will usually receive notification of their award during the summer months.

PLUS LOAN AND UNSUBSIDIZED FEDERAL STAFFORD LOAN

The Federal PLUS loan program and the unsubsidized Federal Stafford Loan program are alternatives for students who either are not eligible for the previously mentioned aid programs or require additional funds for educational expenses.

The unsubsidized Federal Stafford Loan is a loan to both dependent and independent students. Under this program the student is responsible for paying all interest costs in addition to the principal. Parents may borrow from the PLUS loan program for the dependent undergraduate student. The forms usually required for an unsubsidized Federal Stafford loan and the PLUS loan are the Common Application and Promissory Note for Federal Stafford Loans and the PLUS Loan application, in addition to the FAFSA. Forms may be obtained from the Office of Academic and Enrollment Services.

The university must certify on the loan application that the student is enrolled and in good standing or has been accepted for enrollment. The university must also assign a student budget and report any financial assistance the student has or is likely to receive. U.S. citizenship or permanent residency is required by Federal law for eligibility for both of these federal programs.

SCHOLARSHIPS AND PRIZES

A substantial scholarship program is available at the School of Mines and Technology for incoming and currently enrolled students. The total aid from scholarships, grants, and prizes is in excess of $330,000. Incoming students should submit a scholarship application and must have completed all the requirements for admission to the South Dakota School of Mines and Technology, including the submitting of transcripts and ACT scores to be eligible. All previously enrolled students are considered by the scholarship committee after they have established scholastic records at the college. In making selections for scholarships and prizes, the committee considers the qualifications and expectations as specified by the sponsor of the scholarships as well as the students' academic attainment, promise for the future, and need. Department scholarship represenative are consulted when selecting recipients for specified departmental scholarships. Recipients of scholarships and prizes are notified by the committee when selections are complete and are given recognition in Honors Day activities scheduled during the spring semester.

Following is a listing of scholarships and prizes at SDSM&T. Eligibility requirements are also indicated.

FOUR YEAR SUPPORT SCHOLARSHIPS

The most prestigious scholarship assistance on campus provides assistance for incoming freshmen with guaranteed renewable support for four (4) years provided recipient maintains a minimum 3.0 grade point average (based upon a 4.0 scale) and is continuing progress towards completion of a degree.

PRESIDENTIAL - Minimum yearly award of $1,000.

NELS & ELISE AFDAHL MEMORIAL - 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 & GRACE BENNETT ACADEMIC - Established by Charles Bennett.

HELEN JENNIE & 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. & BEVERLY COLE - Established by Richard & Beverly Cole.

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

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

ROYAL CRAWLEY MEMORIAL - Established by Estate of Royal Crawley.

QUENTIN P. DYCE MEMORIAL - Established by Quentin & Lois Dyce upon the death of Quentin P. Dyce (MET '49).

BERTAL A. & MARGUERITE A. FLISNES MEMORIAL - Established by Estate of Bertal & Marguerite Flisnes.

PEGGY LEE HANSEN (Females) - Established by Walter G. Hansen (CE '53) to honor his wife.

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

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

GEORGE HOKENSTAD - Established by George R. (EE'52) & Phyllis J. Hokenstad.

WILLIAM & CECILE HUDSON - Established by William Hudson (CE '28).

GAIL MARCH (Females) - Established by Ervin Pietz (EE '34) to honor Gail March.

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

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

EVERETT & HELEN SIEGER - Established by Donal (ME '77) & 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. & VELMA ANDERSON MEMORIAL - Established from the Estate of Velma H. Anderson.

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

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

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

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

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

DEAN & 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 & Mary Liss and I.M. & Florence Wormser.

CRISTI & CARLYN PRYER - Established by Estate of Carlyn Pryer.

CHRIS & 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

The following is a description of eligibility for the scholarships mentioned below:

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
Grad	Graduate
( )	Preference given

The following award amounts depend upon income from investments and all students must be in good academic standing at SDSM&T

ABBOTT VERTEBRATE PALEONTOLOGY FUND - Grad in vertebrate paleontology.

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

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

AMAX - Unrestricted.

AMOCO - Unrestricted.

FRANK APLAN - Native American, MET.

ASCE CONCRETE CANOE SCHOLARSHIP - Awarded by the ASCE Chapter.

MACY BARESCH SCHOLARSHIP - GEOE & GEOL with financial need.

BARRICK - MINE.

JEFF L. BAUER MEMORIAL SCHOLARSHIP - So, Jr, or Sr in Geol or GeoE (non-academic campus activities).

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

GUS & ILA BEKA SCHOLARSHIP - Unrestricted.

MARILYN R. BELL MEMORIAL SCHOLARSHIP - Student who is active in extra curricula activities (Female).

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

DONALD D. 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 - GPA of 2.75 or above and have financial need.

DR. CONRAD F. J. BLUNCK MEMORIAL FELLOWSHIP - Grad in CE (support of research that can be applied to medical technology).

GARY BONER/SONNY COYLE ATHLETIC SCHOLARSHIP - Varsity football athlete (So, Jr, or Sr).

BRADLEY C. BORGEN MEMORIAL SCHOLARSHIP - Jr or Sr in Phys (Military Science).

ELDON A. & 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. Recommendations are required from the chair of the department and from the Director of United Campus Ministries. A one-page essay should be submitted (See Financial Aid).

ERNEST BOWERMAN MEMORIAL SCHOLARSHIP - Jr in CHE.

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

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

FRANK R. BRADY MEMORIAL SCHOLARSHIP - Jr or Sr in CE.

G. GREGORY & GERTRUDE S. BRYAN SCHOLARSHIP - Jr in GEOL, GEOE, MET or MINE with 3.0 GPA or above.

PAUL A. & MARY M. CECIL MEMORIAL ATHLETIC SCHOLARSHIP - Athlete from South Dakota with a 2.8 GPA or above.

JOHN J. CHISOLM MEMORIAL SCHOLARSHIP - Criteria to be established.

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

CLASS OF '40 SCHOLARSHIP - Unrestricted.

MAURICE L. CLELAND MEMORIAL SCHOLARSHIP - EE & CENG. South Dakota 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 (US Citizen).

HAROLD E. CORWIN SCHOLARSHIP - SCI or ENGR.

BILL COYLE - ATHLETIC/CIVIL ENGINEERING SCHOLARSHIPS - One to an athlete in ENGR and one to any student in CE.

BILL COYLE/DELTA SIGMA PHI

ATHLETIC SCHOLARSHIP - Male athlete and female athlete with 3.0 or above.

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

EARL D. DAKE MEMORIAL SCHOLARSHIP FUND - Residents of South Dakota enrolled in CE.

HOMER DAVIS MEMORIAL SCHOLARSHIP - So, Jr, or Sr in GEOE.

DALE & DIEDE SCHOLARSHIP FUND - One award to Jr or Sr in GEOL, GEOE, MINE, or MET with 3.0 GPA or above. One award to an EE or CENG with 3.0 GPA or above. One award to a female in Eng or Sci.

VIC DEJONG SCHOLARSHIP - Jr, Sr.

GERALDINE DELGER KRIER AND HENRY & FERN DELGER MEMORIAL SCHOLARSHIP - ENGR. (Residents of McCook or Hanson counties).

DELTA SIGMA PHI MEMORIAL SCHOLARSHIP - So, Jr, or Sr who is also 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 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, MINE.

R. E. DRISCOLL, SR. SCHOLARSHIP - Unrestricted.

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

DAVID J. & LESLIE R. ENGEBRETSON LEADERSHIP SCHOLARSHIP - Jr or Sr in MINE who has demonstrated leadership capability through elected and participatory student activities.

BENARD A. ENNENGA FUND - 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.

IRMA BEATRICE FLAIGG & 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 SCHOLARSHIPS - Unrestricted.

HARVEY R. FRASER SCHOLARSHIP - Unrestricted.

GREG FRENCH ECONOMIC GEOLOGY FELLOWSHIP - Economic GEOL grad student for study in hard rock area.

ERWIN, HAZEL & RICHARD FUERSTENAU SCHOLARSHIP - Jr or Sr in GEOL, GEOE, MET, or MINE. Graduate of a South Dakota high school.

MAURICE C. FUERSTENAU

SCHOLARSHIP - So, Jr, or Sr in MET with 3.0 GPA or above.

NOEL A. GAGSTETTER MEMORIAL SCHOLARSHIP - EE.

ED & PRISCILLA GAISER FUND - Yearly earnings from fund to provide support for the SDSM&T Athletic Program, which may include scholarships.

MARY JANE GIACOMETTO SCHOLARSHIP - Non-traditional student with financial need (female in IS).

BERNARD GIVOGRI MEMORIAL SCHOLARSHIP - Graduate of Lead, SD, high school who is a So, Jr, Sr in Eng.

PAUL G. GRIEBEL MEMORIAL SCHOLARSHIP - Unrestricted.

DR. PAUL & VIRGINIA GRIES FUND - Undergraduate or graduate fellowships for worthy students pursuing an education in minerals exploration.

WILLIAM A. GRIFFITH FELLOWSHIP - Grad in GEOL, GEOE, MET or MINE.

ROBERT J. GUNN MEMORIAL SCHOLARSHIP - So, Jr, or Sr in CHEM or CHE.

GUSTAFSON STUDENT LEADERSHIP SCHOLARSHIP - Jr or Sr.

DELLA M. HAFT MEMORIAL SCHOLARSHIP - Unrestricted.

MARY HALE SCHOLARSHIP FUND - Unrestricted.

DANIEL S. HAMWAY MEMORIAL - CHE.

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

WATER G. HANSEN SCHOLARSHIP - CE

JAMES O. HARDER MEMORIAL SCHOLARSHIP - Jr or Sr enrolled full time and working toward a Bachelor of Science Degree in GEOL, GEOE or MINE. Selection based upon initiative, good academic record, leadership qualities, and genuine interest in major field with apparent intent to pursue that field full time following graduation. Must be a U.S. citizen (resident of SD with need if all other candidate qualifications are equal).

HARDROCK CLUB MEMORIAL SCHOLARSHIP - Varsity athlete.

ALVIN & ALEITHA HAUGEN SCHOLARSHIP - So, Jr, or Sr in EE. (Student graduating from a South Dakota high school).

HARROLD H. HAYES ATHLETIC SCHOLARSHIP - Athlete. (Student from Jackson, MI, area).

BOB & BETTY HEIRIGS SCHOLARSHIP - So, Jr, Sr in CE. Assist student working their way thru school.

HERRINGTON - Unrestricted.

WILLIAM A. HIXSON MEMORIAL SCHOLARSHIP - EE major upon recommendation of the department.

FRANK MOORE HOWELL, JR. MEMORIAL SCHOLARSHIP FUND - MET (American born U.S. citizen).

HRACHOVEC FAMILY SCHOLARSHIP - Jr or Sr.

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

DARRELL OTTO HUWE MEMORIAL - PHYS, with a 3.5 GPA or above, 1st preference to graduates of Lemmon HS or students with a goal of teaching Physics.

INFORMATION HANDLING SERVICES GROUP, INC. - Unrestricted.

IS ADVISORS AWARD - IS.

IVANHOE EXCELLENCE AWARD - Needy

and deserving grad from any country or state for study towards a Master of Science degree in SCI or ENGR. Award shall go to a student who is not receiving other fellowship assistance.

IVANHOE FELLOWSHIP FUND - Assistance to be provided towards Master of Science (MS) degree for needy and deserving students from the less developed countries. These fellowships honor the following individuals: John Liss, Roderick F. Ivanhoe, M. King Hubert, Guy E. March, A.I. Levorsen, John A. Carver, Arthur A. Meyerhoff, Richard H. Vaughn, and Garrett Hardin.

CLARENCE & VINCENT IVERS MEMORIAL SCHOLARSHIP TRUST - Unrestricted.

SRINIVASA L. IYER SCHOLARSHIP - Sr or Grad in CE. The recipient shall be working 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 FUND - MET (So).

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

LOWELL JOBE CHEMICAL ENGINEERING SCHOLARSHIP - CHE.

ARTHUR (A.I.) & WILLMETA JOHNSON SCHOLARSHIP - Jr or Sr in GEOL, GEOE, MET or MINE.

ARTHUR LOUIS JOHNSON MEMORIAL SCHOLARSHIP - So or Jr.

CLINTON JOHNSON MEMORIAL - Jr in IE with leadership qualities.

JERALD L. JOHNSON SCHOLARSHIP - 1st preference incoming freshman from South Shore HS, MATH, ENGR, or SCI.

LINDSAY F. JOHNSON MEMORIAL SCHOLARSHIP FUND - MINE.

MERLE DELOS JONES MEMORIAL SCHOLARSHIP - ENGR with financial need. (Southeastern South Dakota resident).

WILLIAM & MARY JONES MEMORIAL SCHOLARSHIP - lst preference to resident assistants.

EARL & BLANCHE KELLER SCHOLARSHIP - Unrestricted.

GERRY KELLER ATHLETIC SCHOLARSHIP - Athlete.

MARK KENNER MEMORIAL SCHOLARSHIP FUND - Jr or Sr in CE (South Dakota native and athlete).

CHARLES N. KEOWN MEMORIAL SCHOLARSHIP - Unrestricted.

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

JOHN KNECHT ATHLETIC SCHOLARSHIP - Varsity Athlete.

GRANT A. KOPPELMAN MEMORIAL SCHOLARSHIP - So, Jr, or Sr in MET.

KRUSE EDUCATION TRUST - Native American

CHARLES KYRISS MEMORIAL SCHOLARSHIP - Entering freshman or transfer student who is a graduate of a Nebraska high school (Western Nebraska).

DANIEL & BARBARA LANDGUTH SCHOLARSHIP - Basketball player (Rapid City Stevens High School graduate. Second preference to Black Hills area high school graduates).

JOSEPH E. LARSON MEMORIAL

SCHOLARSHIP - (National Guard and U.S. or Canadian citizens).

RAY E. LEMLEY, M.D. MEMORIAL - Geol/GeoE student in Summer Field Camp who demonstrates financial need.

DANIEL E. LIPKIE SCIENCE SCHOLARSHIP - CSC, MATH, CHEM, PHYS, Fr - Sr, with a 3.4 GPA or above.

EDWARD W. LOGAR SCHOLARSHIP - lst preference Native American.

CLIFFORD B. LOWE SCHOLARSHIP - PHYS. (Students who demonstrate financial need.)

GUY E. MARCH SCHOLARSHIP - So, Jr, or Sr in MATH and CSC.

FLOYD L. MATTHEW MEMORIAL SCHOLARSHIP - Jr or Sr in CE with special consideration given to women and non-traditional students.

RUBY MAUCH MEMORIAL SCHOLARSHIP- Unrestricted.

UNA (BINKLEY) McGARVIE MEMORIAL SCHOLARSHIP - Incoming freshman from a South Dakota high school who shows financial need, good scholastic standing and leadership qualities. A GPA of 3.0 or above must be maintained in the fall semester to receive the second half of the award.

ALEXANDER E. McHUGH MEMORIAL SCHOLARSHIP - GEOL, GEOE, (MET), or MINE.

P DEFORREST & EDITH M. MCKEEL SCHOLARSHIP - EE, CENG, MATH, CSC.

JOHN McLEARIE TECHNICAL COMMUNICATIONS AWARD - Sponsored by Dr. L. Homer Surbeck. Outstanding student in Technical Communications II.

KIRK T. MEARS MEMORIAL SCHOLARSHIP - Graduate of Rapid City high school (Westhills Village worker).

GRACE MICKELSON & JOANN KLEIN SCHOLARSHIP FUND - Jr or Sr in MATH or CSC with 3.0 GPA or above. Funds may cover tuition, fees and books.

JOHN C. MICKELSON FELLOWSHIP FUND - Grad Teaching Assistant in GEOL or GEOE.

RONALD F. MILLER MEMORIAL SCHOLARSHIP - Graduates of a South Dakota high school (student from a small town).

DALE D. MODEN MEMORIAL - Unrestricted.

MONSANTO - Unrestricted.

MARLIN J. "MICK" MURTHA MEMORIAL SCHOLARSHIP - Second semester So in CHE with 2.7 GPA or above who has financial need.

JOSEPH F. NELSON OUTSTANDING SCHOLAR AWARD - Undergrad or Grad in CHEM, CHE, PHYS, GEOL, GEOE, MATH or Meteorology 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 Meteorology with 3.0 GPA or above or in the upper one-fourth of his/her class. (Financial need).

NEXT CENTURY SCHOLARSHIP FUND - To recruit and retain brightest and best students, Fr, So.

FRED N. OBERG MEMORIAL SCHOLARSHIP - MET.

ALDEEN AND ESTHER OCHSNER MEMORIAL SCHOLARSHIP - to an incoming freshman engineering student. 1st preference students from Mobridge HS and to students who have participated in high school athletics.

LEONARD & LUCILLE OHLSON

MEMORIAL SCHOLARSHIP - Criteria to be established.

RALPH S. O'NEILL - So - Sr CE (South Dakota student working part time).

HAROLD & LAURA ORVILLE GRADUATE FELLOWSHIP - 1st preference entering graduate student in Atmospheric Sci, then to current student. Environmental field also acceptable.

EDWIN OSHIER MEMORIAL SCHOLARSHIP - MINE.

LARRY OWEN ENDOWMENT - Master of Science degree in Technology Management.

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

RUSSELL PALMER MEMORIAL SCHOLARSHIP - Sr in CE with need a possible factor.

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

HOWARD C. PETERSON SCHOLARSHIP - Incoming freshmen in top 5% of their graduating class or upperclassmen with 3.0 GPA or above.

JAMES P. & MILDRED T. PETERSON SCHOLARSHIP - So, Jr, and Sr ENGR (CE).

EVA STENGER PHILLIPS FUND - Unrestricted.

KIRK G. PHILLIPS MEMORIAL SCHOLARSHIP - Unrestricted.

PIETZ INDUSTRIAL ENGINEERING SCHOLARSHIPS - An award each to a So, Jr, and Sr in IE.

TIM & LAURA PIKE SCHOLARSHIP - Jr or Sr in CSC or ENGR with financial need.

PAUL A. PORTER, JR. MEMORIAL SCHOLARSHIP - CHE (Student from Aberdeen, SD).

ROBERT POWELL MEMORIAL SCHOLARSHIP - Unrestricted.

MAYME T. REDMON SCHOLARSHIP - Unrestricted.

FRANK & MARILYN RICHARDSON SCHOLARS PROGRAM - Criteria to be established.

LESLIE & VALETA ROGGENTHEN SCHOLARSHIP - GEOL, GEOE, MET or MINE (residents of Spink County).

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

GLADYS ROSENBAUM MEMORIAL SCHOLARSHIP FUND - Undergraduate with financial need.

BERNARD J. "BUN" ROSKOS MEMORIAL ATHLETIC SCHOLARSHIP - Varsity football player.

DEAN R. ROUNDS MEMORIAL SCHOLARSHIP - Unrestricted.

JAMES, MAURICE, AND MARCIA SCANLAN FUND - Unrestricted.

SCHLUMBERGER SCHOLARSHIP - CE.

LARRY SIMONSON ATHLETIC SCHOLARSHIP - Varsity athletics.

MARLYS & LESLIE SIMONSON ELECTRICAL AND COMPUTER ENGINEERING SCHOLARSHIP - So, Jr, 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 (students from the Black Hills area of South Dakota).

SDSM&T MEMORIAL SCHOLARSHIP FUND - 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, SCOTT BURRILL, GLENN COATES, ROY K. & RUTH E. DEAN, PAT DIXON, PAUL B. DONALDSON, JON G. FLOWER, CHARLES HALLSTROM, DANIEL SAM HAMWAY, HAROLD R. HAYS, LEON & MAUDE HENRY, CHARLES F. HOFFMAN, LLOYD HOLMGREN, ARVO MATTHEW KORPI, CONSTANCE MARIE KORPI, HRONE S. MAKREDES, ANTHONY MASTROVICH, CHARLES G. MATHISON, FRANK MAYER, MAX MONHEIM, GODFREY LYON OAKLAND, WAYNE L. OLSON, ROBERT H. OSBORN, G.G. OSTERHOF, ROBERT A. QUINTAL, C.C. (WINNIE) ROUNDS, MYLO SCHNEIDER, ROBERT F. SHERMAN, DAN TUSCHER, ARNOLD ULMER, WALLACE DIXON WARD, and BOYD E. WILSON.

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

SDSM&T MUSIC SCHOLARSHIP - Awarded on basis of competitive audition, one instrumental, one choral.

JANE SPEICE MEMORIAL SCHOLARSHIP - So, Jr, or Sr in GEOL, GEOE, MET or MINE (participating in a university sanctioned activity).

STARR MEMORIAL SCHOLARSHIP - CE, 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 with 3.0 GPA or above.

SARAH STEVENS MEMORIAL SCHOLARSHIP - Athlete (Female in track and/or cross country at SDSM&T).

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

DR. CHARLES E. STUTENROTH MEMORIAL SCHOLARSHIPS - Unrestricted.

L. HOMER SURBECK ENDOWED SCHOLARSHIP FUND - Unrestricted.

L. HOMER SURBECK PHYSICS PRIZE - Jr in PHYS.

AGNES & HARRY TALICH MEMORIAL SCHOLARSHIP - (Student from Hermosa, SD).

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

GEORGE TLUSTOS MEMORIAL SCHOLARSHIP - Students from central SD (Student from Gregory, SD, major CE).

EDWARD L. TULLIS ACADEMIC AWARD - Brunton Compass on Honor's Day to top GeoE (based on GPA at the end of the fall semester of senior year). A fifty dollar cash award will be included with the award if earnings are sufficient.

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

FRANK & PORTIA VAN LEUVEN MEMORIAL TRUST - 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 FUND - Jr or Sr with 3.0 GPA or above. (Black Hills area student with financial need).

ALVIN WAGGONER MEMORIAL SCHOLARSHIP - Unrestricted.

CHARLES N. WATERMAN SCHOLARSHIP - Student with high academic standing.

HOWARD H. WELLS ATHLETIC SCHOLARSHIP - Athlete.

WEST RIVER FOUNDATION - Jr.

WHEELER MANUFACTURING COMPANY SCHOLARSHIP - Incoming freshman from Western SD (Employee of Wheeler MFG, Lemmon or NW, SD) with a 2.5 GPA or above, two year award.

JOHN & GWEN WILLARD MEMORIAL SCHOLARSHIP - Female Fr in ENGR or SCI.

WARREN D. WITHEE MEMORIAL SCHOLARSHIP - CE.

LEITH L. WYMAN MEMORIAL SCHOLARSHIP - CE.

The following award amounts depend upon current gifts and all students must be in good academic standing at SDSM&T

ALCOA SCHOLARSHIP - EE, ME, & MET.

ALPHA OMEGA EPSILON/SDSM&T WOMEN STUDENT SCHOLARSHIP - Member of AOE.

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.

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

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.

ASSOCIATED GENERAL CONTRACTORS OF SOUTH DAKOTA, HIGHWAY, HEAVY, UTILITIES CHAPTER SCHOLARSHIPS - CE.

KRISTI BARKL/ALPHA OMEGA EPSILON SCHOLARSHIP - So, Jr, or Sr engineering student who is an active member of Alpha Omega Epsilon and participates in school activities.

BHP MINERALS SCHOLARSHIP FUND - So, Jr, or Sr in MINE. Students who are committed to mining, desire to work internationally and are interested in work experience at a mine should apply through the Mining Engineering program.

BLACK HILLS POWER AND LIGHT COMPANY SCHOLARSHIP - Native American So, Jr, or Sr with 2.5 or above. (EE or ME). Summer employment opportunity also included.

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

E. LAWRENCE BREVIK MEMORIAL FUND - Jr, Sr in CHE. Min GPA=3.0.

MARSHALL & SALLY BURGESS SCHOLARSHIP FUND - Students graduating from Stevens High School, Rapid City, SD.

CARGILL FOUNDATION SCHOLARSHIPS - CHE and ME.

CATERPILLAR TRACTOR COMPANY SCHOLARSHIPS - EE, IE, ME, and MET.

CHEMICAL ENGINEERING ALUMNI SCHOLARSHIPS - ChE.

CHEMISTRY AND/OR CHEMICAL ENGINEERING SCHOLARSHIPS - CHEM or CHE. Supported by each of the following companies: CARGILL, DOW CHEMICAL, DOW CORNING, EXXON, MOBIL FOUNDATION, 3M, PHILLIPS PETROLEUM, SHELL OIL COMPANY, UNION CARBIDE.

CIVIL ENGINEERING SCHOLARSHIPS - CE.

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

CONSOLIDATION COAL COMPANY SCHOLARSHIPS - MINE.

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

CORPORATE MATCHING SCHOLARSHIPS - Corporate gifts to the SDSM&T Foundation from companies and organizations matching contributions to the college; amount of awards vary. Unrestricted.

CRAZY HORSE - SOCIETY OF EXPLOSIVE ENGINEERS - Native American student (GEOL, GEOE, and MET).

D.A.R. - BEAR BUTTE CHAPTER SCHOLARSHIP - Jr or Sr in ENGR, MATH or SCI. (DAR members, children or grandchildren of DAR members).

DACOTAH CEMENT UNDERGRADUATE SCHOLARSHIPS IN CIVIL ENGINEERING - Sr in CE who is resident of South Dakota. 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.

SUSAN DAVIDSON SCHOLARSHIP FUND - CHEM or CHE (Incoming freshman from Mitchell, SD).

BRIANT L. DAVIS SCHOLARSHIP - Grad in Atmospheric Sciences.

SIDNEY M. DENTON MEMORIAL SCHOLARSHIP - A participating member of American Indian Science and Engineering Society (AISES) with financial need. Must be recommended by SDSM&T Chapter of AISES.

FLORENCE DUNMIRE MEMORIAL - Fr from Custer High School (female.)

ENERGY LABORATORIES SCHOLARSHIP - Sr in CHEM with an interest in working in the environmental sciences field.

ERICSSON SHOLARSHIP AWARD - Incoming freshman from, McCook HS, Salem, SD, with a 3.0 GPA or above, MATH, SCI, ENGR.

EXXON EDUCATION FOUNDATION - Funds for CHE, CE, GEOL, and MINE, which may be used for scholarships.

GERALDEAN LYNN FLUKE MERIT AWARD - Undergraduate female So, Jr, or Sr in PHYS or CHE. Graduate female seeking doctorate in Environmental Engineering.

GEOLOGY/GEOLOGICAL ENGINEERING GENERAL SCHOLARSHIP FUND - GEOL or GEOE.

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

GARY R. & BARBARA E. HANSEN SCHOLARSHIP - Four year support to a Native American student in good academic standing with SDSM&T. First preference shall be given to Native American students majoring in Chemistry, second preference to those majoring in ChE, and third preference to those in Geology. Support from this fund is to be used for tuition, fees, books, room, and board.

HARDROCK CLUB ATHLETIC GRANTS - Athlete.

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

INSTITUTE OF NUCLEAR POWER OPERATIONS, (INPO) SCHOLARSHIPS - So, Jr, or Sr with demonstrated interest in nuclear utility industry.

ARTHUR F. JOHNSON MEMORIAL SCHOLARSHIP - Unrestricted (Dormitory resident).

KENNECOTT SCHOLARSHIP - Awards to four juniors, one to each in GEOL/GEOE, ME, MET, and MINE. Summer employment available between sophomore and junior year, and possibly between junior and senior year. Sophomores should contact their department for more information.

DAVE AND LORI LITZEN SCHOLARSHIP - one award to Jr, Sr women's basketball player - & one award to a Jr, Sr football player.

MARATHON CLUB - Athlete in cross country and/or track at SDSM&T.

MASTER BUILDERS RESEARCH FELLOWSHIP - graduate student in Civil and Environmental Engr.

MATH DEPARTMENT SCHOLARSHIP - MATH.

MAYTAG SCHOLARSHIP IN ENGINEERING - Sr in EE or ME. Selection based upon need, participation in extra-curricular activities, technical and administrative potential, and interest in entering private industry upon graduation.

VERNON A. MERRITT SCHOLARSHIP - Criteria to be established.

METALLURGICAL ENGINEERING DEPARTMENT SCHOLARSHIP - MET.

3M COMPANY SCHOLARSHIPS - CHE, EE and ME.

MINING ENGINEERING DEPARTMENT SCHOLARSHIPS - MINE.

MONTANA-DAKOTA UTILITIES CO. SCHOLARSHIPS - One to entering freshman (from Black Hills town) and one to upperclassman. Both from MDU service area.

CHARLES A MORSS MEMORIAL SCHOLARSHIP FROM CRAZY HORSE - Native American students. Unrestricted.

PAUL MUEHL FROM CRAZY HORSE - Financial need.

NATIONAL ASSOCIATION OF WOMEN IN CONSTRUCTION - So, Jr or Sr in construction industry. (Financial need).

"OLD JOCKS" ATHLETIC FUND - Athlete.

PALEONTOLOGY FELLOWSHIP FUNDS - Grads in Paleontology to support thesis research.

WALTER PAILING FROM CRAZY HORSE - Native American.

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 FUND - Jr or Sr in GEOL.

ROCKY MOUNTAIN COAL INSTITUTE SCHOLARSHIP - MINE.

ROLSCREEN HONORS PROGRAM - Sr in ME with 3.0 GPA or above.

ENRIQUE SAEZ SCHOLARSHIP - CHE.
SIOUX FALLS AREA ALUMNI SCHOLARSHIP - Sioux Falls area student

with financial need. (Athlete).

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

LOWERY & MARY ANN SMITH ATHLETIC SCHOLARSHIP - Athlete.

SDSM&T CAMPUS CAMPAIGN SCHOLARSHIP FUND - Contributions from SDSM&T employees to support general scholarships at the college. Unrestricted.

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

SOUTH DAKOTA ENGINEERING SOCIETY SCHOLARSHIP - BLACK HILLS CHAPTER - ENGR from eleven counties in the Black Hills Chapter area.

SOUTH DAKOTA WATER AND WASTEWATER ASSOCIATION SCHOLARSHIP - CE.

L. HOMER SURBECK SCHOLARSHIPS - Entering freshmen.

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

WOMAN'S AUXILIARY TO THE AMERICAN INSTITUTE OF MINING, METALLURGICAL, AND PETROLEUM ENGINEERS SCHOLARSHIPS - GEOL, GEOE, MET and MINE. Half of award to be repaid within ten years after graduation.

WOMEN OF THE MOOSE SCHOLARSHIP - Students whose parents are members of the Moose.

<u>THE SDSM&T STUDENT ASSISTANCE FUND</u>

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 & 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.

<u>SHORT TERM LOANS</u>

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 Mac Arthur Memorial
- Mayberry Memorial
- McLaury Memorial
- R.B. and Flora J. Neill
- H.A. Neilsen Memorial
- Marc Pitz Memorial
- Rapid City Lions Club-Swander Memorial
- Rapid City Rotary Club-Minty Seeley
- William E. Snyder Memorial
- R. Carl Stuelpnagel Memorial
- Betty J. Thomas Memorial
- Mel Willigman Memorial

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

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

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

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

Students who have completed at least one semester at 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.

PART-TIME EMPLOYMENT

Many students find it possible to defray a portion of their cost of attendance through earnings from part-time jobs during the academic year. The Office of Academic and Enrollment Services maintains a part-time-employment service. A number of job opportunities are available both on and off campus.

OTHER FINANCIAL AID

Students at the School of Mines and Technology have received financial assistance from various agencies, including the Department of Rehabilitation Services, Bureau of Indian Affairs, South Dakota Opportunities, and others. Many veterans will qualify for Veterans Benefits. For information on ROTC Scholarships, see Scholarships and Prizes.

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.
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.

The determination of a school-sponsored activity will rest with the Chair of the sponsoring department and/or the Dean of Students.

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 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 to the incident/s 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.

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 which is held detrimental to the college community (composed of students, faculty, and administration) may result in disciplinary action.

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

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

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 Handbook. 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 Handbook. This Handbook is published bi-annually and is available to students at registration or upon request. 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.

SOFTWARE COPYRIGHT POLICY

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 for review in the ITS Director's Office, Room 138, of the Electrical Engineering/Physics Building.

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 has been 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.

Additional pertinent information on this topic may be found at http://www.educom.edu/web/pubs/usingsoftware.html.

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 Instructional 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.

Guard your electronic identity. Choose secure passwords, and never reveal them to anyone. You could be held liable for activity carried out by others using your 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.
- 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 http://support.sdsmt.edu/policy.html.

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 Dean of Students Office is available to assist students in discussing circumstances which may or may not be grievable, and to advise students on steps under which grievances should be filed. Grievance forms are available at the 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 10 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.

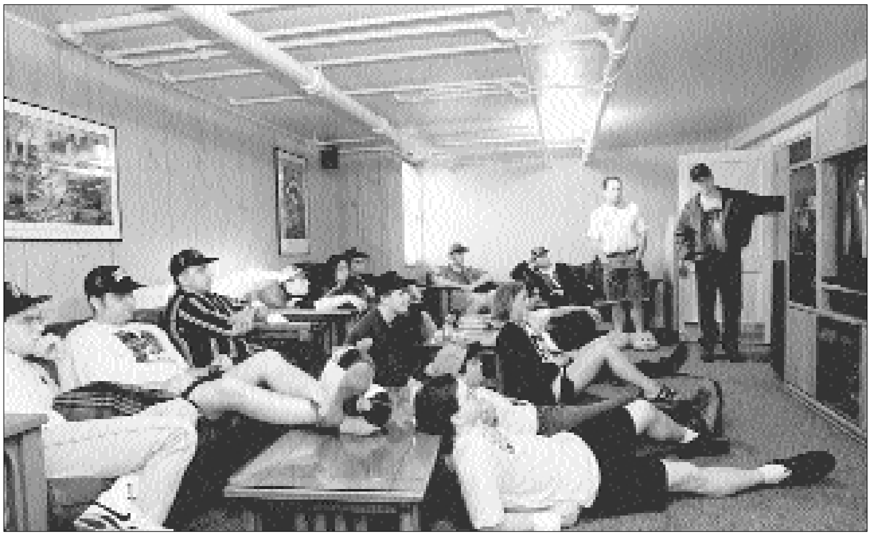
Step 3: If the grievance is not resolved at the Step 2 level, the grievant may formally grieve to the administrator at the Executive Council level who is the supervisor of the administrator receiving the grievance at the Step 2 Level. Grievant will use Grievance Form B.

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.

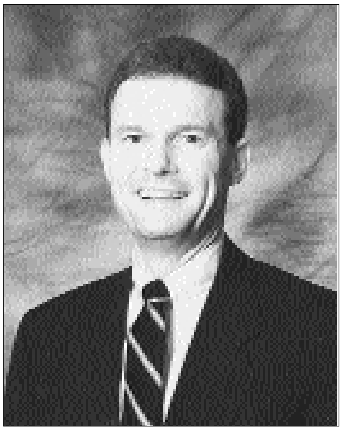
Step 4: If the grievance is not resolved at the Step 3 level, the grievant may formally grieve to the President of SDSM&T using grievance Form C.

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 10 working days following receipt of the Step 4 decision. The Board of Regents will review the grievance and render a final decision in accordance with Board procedures, policies, and guidelines.



TECHFact: Approximately 22 percent of Tech's body live in residence halls. Another 5 percent live in the 4 fraternity and 2 sorority houses clustered around the campus. The balance of the students live elsewhere off campus.



Dr. Douglas K. Lange,
Vice President of Student Affairs
& Dean of Students

STUDENT SERVICES

Counseling Services are offered free of charge to all SDSM&T students. The office is located in Surbeck Center. Individual, group and couples' counseling as well as wellness programming is available. Students may get counseling on stress, family problems, depression, substance abuse or other personal concerns and on school related problems. The office is open during most daytime and some evening hours. Call 605-394-1924 for information or an appointment.

CHILD CARE SERVICES

The 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 Little Miner's Clubhouse at 605-394-2586.

LIVING ACCOMMODATIONS AND REGULATIONS

Housing Policy

The South Dakota Board of Regents have established a policy which states that "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 twelve or more credits for four (4) semesters may be exempted from this agreement at the discretion of the institution."

Residence hall living contributes in a positive manner to the academic achievement of students and to the educational atmosphere of the university and assists underclassmen in adjusting to the overall university experience. Students who may choose their living arrangement are encouraged to choose on campus residency. In practice, the South Dakota School of Mines and Technology supports the South Dakota Board of Regents policy stated above and, at it's discretion, will approve exemptions to those students who (a) are two or more years past high school graduation as of registration day; or (b) will live for the full academic year with parent(s) or legal guardian(s); or (c) have a dependent child; or (d) are active members of, and living in, a college recognized fraternity or sorority; or (e) have completed four semesters of institutional enrollment with 12 or more credits; or (f) are 21 years of age or older as of registration day; or (g) are married; or (h) military veterans with one or more years of active service; or (i) are classified as special students (enrolled, but not admitted/non-degree seeking); or (j) are taking less than 6 credit hours.

Exemptions must be requested in writing by completion of the Residence Hall Exemption Information form provided to all new students or available from the Office of Residence Life. Such form is signed by the individual student certifying that he or she meets the conditions of an approved exemption as described in (a) through (j) above.

Any exceptions to the above policy must be supported by full 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 to graduate students because of undergraduate demands. No married student housing is available. Applications and information are not automatically provided to graduate level students, therefore, if you want such application/information, please contact the Department of Residence Life.

Information on accommodations in the Rapid City area may be obtained from the Director of Residence Life, realtors, local newspapers, current students, or the Ivanhoe International Center. Those new students who require housing are encouraged to arrive in Rapid City a few days prior to registration in order to get settled.

RESERVATIONS FOR A RESIDENCE HALL ROOM

Entering freshmen, transfer students, and returning former students will be provided information about residence halls and an application form by the Office of Residence Life. All currently enrolled students who will live in the residence halls for the coming year will be asked to complete an application form before leaving campus at the close of the spring semester. All students who live in a residence hall are required to abide by the policies, regulations, and guidelines of the residence halls. A Residence Hall Handbook covering all such policies, regulations, and guidelines will be issued to each student at the time of the occupancy. An advanced payment (to be applied to rent) of $100 must accompany each application for a residence hall room.

Cancellation of an application without notification to the Office of Residence Life by August 1 or December 15, depending upon the applicable semester, will result in forfeiture of the advance payment. After applications are processed and room assignments made, residents will be required to sign a residence hall contract upon occupancy.

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.

All residents are required to purchase a meal plan each semester.

RESIDENCE HALLS

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.

Campus network connections are available in all residence hall rooms. This service is provided to residents at an additional fee.

OFF-CAMPUS HOUSING

For students who wish to reside off campus, the Residence Life Office posts notices about available private rooms, apartments, motels, houses, etc. These postings are in the lobby of Palmerton Hall. You are encouraged to visit to review the postings if you are planning to reside off campus.

SDSM&T DINING SERVICES

The SDSM&T Dining Services would like to invite you 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. We offer a wide variety of meal plans that would fit any students needs. All students living on campus are required to purchase a meal plan. We are looking forward to having you dine with us. If you have any questions, please call us at 605-394-1953 or 605-394-2327.

TECH 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.

STUDENT HEALTH SERVICE

The Student Health Service is a two-part program which provides students the best medical care possible at reasonable cost.

Part I - Clinical Service

Each student 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.

A Medical Examination Form, signed by a physician, must be on file in the Student Health Office before medical service will be offered

An on-campus nurse and other health personnel are available during the hours posted. Procedures for emergency care are listed in the SDSM&T Student Handbook.

Under Part I the student receives routine medical treatment on campus or at the clinic. 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. Prescription drugs are provided through a multi-option plan. All students are required to pay the student health fee each semester, payable at registration. Part I covers only routine outpatient medical services, but excludes emergency room costs.

Part II - Optional Hospital-Surgical Medical Policy for Those Students Not Covered by Any Other Insurance Plan

SDSM&T also has available a hospital-surgical medical plan to supplement its on-campus clinical service. This coverage is mandatory for all foreign 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 and to provide financial assistance where serious or extremely expensive treatment is necessary. Students' dependents may also be covered under this policy. For complete information on this Hospital-Surgical Medical Policy, contact the SDSM&T Business Office.

GRADUATE HEALTH

Full-time graduate students are automatically included under the South Dakota School of Mines and Technology Student Health Service described in the General Catalog under "Student Services". (Part-time graduate students may obtain on-campus clinical services as an option.) Further, all foreign students and dependents are required to enroll in a Major Medical/Hospitalization/ Surgical Insurance Plan provided by SDSM&T. The only exceptions to this rule are those students who are sponsored by an external agency and the sponsor assumes responsibility for health insurance for the student in which case adequate, official documentation of equivalent coverage must be provided at registration for reassessment purposes.

All incoming full-time graduate students must present evidence of a physical examination to become eligible for health service. A physical examination form is supplied to the applicant when he or she is advised by the Graduate Office of acceptance for graduate study. The physical examination form should be filled out by the student and the physician of his or her choice and returned to the Office of Academic and Enrollment Services before registration. SDSM&T undergraduate students entering graduate study without a break in residence (except over the Summer) need not submit evidence of a physical examination. Those dropping out for two or more semesters will be regarded as newly entering students and must submit evidence of a recent physical examination in order to re-establish eligibility for health service.

To satisfy the physical examination requirement, foreign 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. All graduate students must provide proof of immunization against measles and rubella.

UNIVERSITY SCHEDULING AND CONFERENCES DEPARTMENT

The University Scheduling Center, USC, is located in the Surbeck Student Center. USC serves as a central coordinating office to assist with scheduling of all non-course work related activities, conferences, meetings, and other events held on campus. The USC office provides all necessary coordination of facilities, services, and equipment with the required servicing departments. USC also provides scheduling information to the campus and Rapid City communities. To assist us in this effort, we encourage you to register all your campus related events whether on or off campus. To answer your questions or assist you with your campus scheduling needs, contact the USC office at 605-394-6774.

SURBECK STUDENT CENTER

The Surbeck Student Center was built in 1961 in response to the growing need for students to have a facility to hold meetings, social and educational events, and recreational activities.

The Center is named in honor of Homer Surbeck, who graduated from SDSM&T in 1924 with Honors in Metallurgical Engineering. Mr. Surbeck was considered one of the dearest friends and a dedicated supporter to the Tech campus. Although Mr. Surbeck died in 1997, his legacy of leadership and service will be felt by generations of Tech students to come through the programs and services of the building that bears his name.

Current tenants of the Surbeck Student Center include the Bookstore, The Hardrocker Dining Hall, Miner’s Shack Convenience Store and Snack Bar, and Grubby's Game Room which offers bowling, pool, Ping-Pong, air hockey, video games, and a big screen TV.

Several campus offices are also located in the Surbeck Student Center, including Career Planning, Alumni, University Scheduling and Conferences, United Campus Ministries, Student Health Services, Counseling Center, Debit Card and Cashier, and Dining Services.

Many student organizations have offices located in the Surbeck Student Center as well. Student Association, TONITE, Student Leadership Development Team, Drama Club, The Tech Newspaper, SA Photo, Yearbook, Inter-Varsity Christian Fellowship, Circle K, Lutheran Campus Ministry, Tau Beta Pi, Tech Soccer Club, and Society of Women Engineers are all current tenants, although office space is assigned annually to student organizations.

The Student Activity Center provides office space for organizations that do not have offices. The Center offers a place to make phone calls, design flyers, type memos, and take care of any other administrative needs for student organizations.

In addition to providing office space, dining facilities and recreational activities, the Surbeck Student Center is a full service meeting and event facility. Student organizations have access to a variety of meeting rooms and event venues free of charge. For more information about activities at Tech, please refer to the Student Organization section.

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 over 50 organizations at Tech, 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 Surbeck Student 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
American Water Resources
Association for Computing Machinery
Drill & Crucible
Institute of Electrical & Electronic Engineers, Inc.
Institute of Industrial Engineers
Society of Automotive Engineers
Society of Women Engineers
Society of Petroleum Engineers
Solar Motion Team
TMS/ASM International Student Chapter

Tech Geological Association

Athletics
Badminton Club
Cross Country
Football
M-Club
Men's Basketball
Ski and Snowboard Club
Tech Soccer Club
Tech Mountain Bike Association
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
Eta Kappa Nu Association - Electrical Engineering Honor Society
Order of Omega - Greek Honor Society
Phi Eta Sigma - Freshman Honor Society
Pi Tau Sigma - Mechanical Engineering Honor Society
Sigma Pi Sigma - Society of Physics Students
Tau Beta Pi - Engineering Honor Society

Military Organizations
Pershing Rifles
Ranger Challenge

Multicultural Organizations
American Indian Science and Engineering Society (AISES)
Association of Norwegian Students Abroad
Cultural Expo Committee
India Club
International Students Association

Music Organizations
Concert Choir
Instrumental Ensemble
Jazz Band
Master Chorale
Pep Band
Symphonic Band

Religious Organizations
Baptist Campus Ministry
Fellowship of Christian Athletes
International Christian Fellowship
Inter-Varsity Christian Fellowship
Latter Day Saints Association
Lutheran Campus Ministry
Muslim Student Association
Newman Club
Tech Free Thought Society
United Campus Ministry

Special Interest Organizations
Circle K Club
College Republicans
Drama Club
Golden Z - Female Service Organization
Hardrocker Flying Club
Leadership Development Team
Speculative Society
Students Against Driving Drunk
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
The Engineer Yearbook
The Raver Tech Student Newspaper
K-TEQ Radio
SA Photo
Tech Educational Radio Council (TERC)

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 M-Week (Tech's Homecoming), Major Events, Coffeehouse, Recreation, Lecture, Public Relations, and Publicity. Membership is open to all Tech 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 whom 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 out-reach, 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 over 1600 square feet with adjoining music office, music library, music storage, and two smaller rehearsal areas of over 1000 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

SDSM&T Concerts are presented by the major ensembles every semester at venues around Rapid City and the Black Hills.

SDSM&T Recitals are presented by faculty and students throughout the academic year in the Rapid City area.

Concert Tours by music ensembles have included:

- Weekend 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
- Weeklong tours throughout the western states including Minnesota, Wisconsin, Nebraska, South Dakota, Wyoming, and Colorado
- Appearances at nationally recognized events such as the 1986 Music Educators

National Conference in California and the Washington National Cathedral dedication in 1991.
- Extended foreign tours every three years since 1990, resulting in critical acclaim and invitations to perform in such venues as the New Years Eve Mass in Vienna's Karlskirche (1990), Lindenholzhausen 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 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, and track.

The college is a member of the South Dakota-Iowa Conference and is NAIA affiliated. The SDIC awards championships in all conference sports each season. A double round robin in basketball plus post-season conference tournaments and a single round robin in football are scheduled each year and determine the conference championship. The championship in cross country 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.

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 have 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, golf, basketball, softball, volleyball, swimming, racquetball, and flag football. A Director of Intramural Activities is responsible for directing the Intramural Program.

COOPERATIVE EDUCATION PROGRAM

The Cooperative Education Program provides students with the opportunity to integrate their classroom learning with "real world" work experiences in industry. The Co-op Program is a partnership with business, industry, governmental agencies, and SDSM&T. 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 accepting a co-op position register and pay for a Cooperative Education (CP) class of two (2) hours of academic credit during the semester they are on co-op assignment. Cooperative education credits may be applied toward graduation in accordance with university and departmental policy.

CP 201, 301, 401, 601 (Fall Semesters)
Career Planning (CO-OP)
CP 202, 302, 402, 602 (Spring Semesters)
Career Planning (CO-OP)
CP 204, 304, 404, 604 (Summer Semesters)
Career Planning (CO-OP)

(2-0) 2 credits. Prerequisite: One full academic year of studies and a minimum 2.5/4.0 GPA. A single semester work experience at the employer's location.

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. Students must have the approval of the departmental Cooperative Education representative in order to enroll and are encouraged to notify the Career Planning Office when accepting an offer of a co-op position.

Administration

Each department appoints a Cooperative Education Coordinator who, along with the Vice President of Academic Affairs and the Director of Career Planning, Placement & Cooperative Education, comprise the Cooperative Education Steering Committee. 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.

CAREER PLANNING OFFICE

The Career Planning Office provides information, guidance and support to help students with career development and searches for full-time, summer and co-op opportunities in their respective career fields. Services offered by the Career Planning Office include the following:

Job Search Preparation

The office assists students with developing resumes, cover letters and interviewing skills. The Career Information Library contains company literature, videos, and other resources that can help students in their job searches and also be better prepared for interviews.

On-Campus Interviews

Each year many companies interview SDSM&T students for permanent, summer or co-op positions. The Career Planning Office coordinates the scheduling of these interviews on campus. All students registered with the office receive periodic Career Planning Bulletins that include company recruiting schedules and eligibility guidelines.

Career Fair

Each September the Career Planning Office hosts an Engineering and Science Career Fair that is FREE to SDSM&T students, staff, faculty and alumni. In 1998 over 1200 individuals and 55 companies participated. The 1999 Career Fair will be held Monday, September 13.

Summer Employment

Many companies hire SDSM&T students for summer jobs and/or internships that can help students confirm their career choices. Students should begin their search as early as September for jobs commencing the following May. The office posts summer job opportunities on a specially designated bulletin board.

Alumni Placement Assistance

The Career Planning Office offers job search and placement assistance to SDSM&T alumni for a nominal fee. Interested alumni are encouraged to call (605) 394-2667 for additional information.

Career Counseling

Individuals interested in information on career development are encouraged to contact the Career Planning Office, located in the South Lounge of Surbeck Student Center, (605) 394-2667, 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 testing, please contact Chuck Colombe, Office of Academic Services, MI 327, (605) 394-1287.

TECHFact: The trek up to 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 the M-Week, SDSM&T 's annual homecoming celebration which is held each fall. Other activities include the coronation of the homecoming royalty, the dance, and the M-Day parade and football game.

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 college. Each candidate for a degree is personally responsible for meeting all requirements for graduation. No college 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. Exceptions to this latter requirement for certain degree programs are currently under consideration. 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
8. Use computer technology for basic communication-related tasks such as word processing and research

Credit Hours: 6 hours

Courses:

ENGL 101	Composition I
ENGL 279/289	Technical Communications I & II

ENGL 279/289 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
3. Develop listening competencies including listening with literal and critical comprehensive to ideas, perspectives, and emotions in messages

Credit Hours: 3 hours

Courses:

ENGL 279/289	Technical Communications I & II
SPCM 101	Fundamentals of Speech

ENGL 279/289 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 student 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
5. Apply social science concepts and theories to contemporary issues in a responsible manner

Credit Hours: 6 hours (in disciplines)

Courses:

*ANTH 210	Cultural Anthropology
*ANTH 220	Physical Anthropology
ECON 201	Principles of Microeconomics
ECON 202	Principles of Macroeconomics
*GEOG 101	Introduction to Geography
*HIST 151/152	American History
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
SOC 250	Marriage and the Family

*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
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: 6 hours (in 2 disciplines or in a sequence of foreign language courses)

Courses:

ART 111/112	Drawing and Perception I & II
ARTH 211	Art History
+ARTH 151	Indian Art History
*ENGL 221/222	British Literature I & II
*ENGL 241/242	American Literature I & II
ENGL 250	Science Fiction
*FREN 101/102	Introductory French I & II
*GERM 101/102	Introductory German I & II
HIST 121/122	History of Western Civilization I & II
*HUM 100	Introduction to Humanities
*HUM 101/102	Japanese Culture & Language I & II
*HUM 200	Connections: Humanities & Technology
*HUM 211/212	Development of Western Thought
HUM 230	Introduction to the Bible
HUM 234	History of Christianity
*HUM 250	World Religions
+LAK 101/102	Introductory Lakota I & II
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
*SPAN 101/102	Introductory Spanish I & II

*Course meets requirement for Goal #7 Cultural Diversity

+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 the goal will require students to:

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

Credit Hours: 3 hours

Courses:

MATH 1021/ 1022/1023	College Algebra

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
5. Understand the implications science has for the modern world

Credit Hours: 6 hours

Courses:

BIOL 151/152	General Biology I & Laboratory
BIOL 153/154	General Biology II & Laboratory
CHEM 106/107	Chemistry/Laboratory
CHEM 108/109	Organic Chemistry/Laboratory
CHEM 112/113	General Chemistry I & Laboratory
CHEM 114/115	General Chemistry II & Laboratory
GEOL 201/205	Physical Geology/Laboratory
PHYS 111/112	Introduction to Physics I & Laboratory
PHYS 113	Introduction to Physics II & Laboratory
PHYS 211	University Physics I
PHYS 213/214	University Physics II & 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
3. Examine the contributions of different cultures from a historical perspective

Credit Hours: Students are required to select 6 credit hours that provide a global and/or cultural diversity perspective. These 6 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. Courses in the social sciences and humanities/arts meeting this goal are indicated by an asterisk.

Information Technology Goal

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

Criteria: Course 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;
2. utilize computers and emerging technologies to seek knowledge, solve problems, gather information, and interpret the world.

Credits Hours: 2 (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

CAAP PROFICIENCY EXAMS

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. Criteria for exam eligibility:

1. Degree-seeking students registered for credit.
2. Completion of 48 passed credit hours in courses at or above the 100 level.
3. Completed or currently enrolled in 15 credit hours of lower division general education courses, as specified in the Board of Regents Policy 2:28.

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. Students should work closely with their academic advisor to insure that they complete or are currently enrolled in the general education classes by the time they complete the 48 credit hours.

Additional information about the CAAP Proficiency Exam may be obtained from Chuck Colombe, Coordinator of Student Academic Development, in the Office of Academic Services.

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 college property to the appropriate departments prior to graduation or their last day of enrollment. All financial obligations to the college 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 college reserves the right to withhold a student's diploma and/or transcript of grades for failure to meet any of the above specified requirements.

Diploma Requests: Prior to graduation, all graduating seniors must complete a Diploma Request Form, available at the Office of Academic and Enrollment Services.

Curricular Requirements

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

General requirements for each curriculum 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 (3) 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 Science** - minimum of 16 credit hours - CHEM 112, 113, 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 (6) credits in humanities and six (6) credits in social sciences. Students majoring in engineering must complete at least three (3) of these credits at an advanced level. (Advanced-level courses are in bold face.) See p. 80 for courses which also meet general education core requirements.

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 2 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.

HUMANITIES

Art:

ART 111, 112, ARTH 151, 211, **320**, **490**, **494**

English:

ENGL 250, 221, 222, 241, 242, **300**, **325**, **333**, **350**, **360**, **366**, **374**, **383**, **390**

European Studies (Culture):

EURS **301**

Foreign Language:

FREN 101, 102, 201, 202, GERM 101, 102, LAK 101, 102, SPAN 101, 102,

(All foreign language credit may be used as 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 where a social science.)

Humanities:
HUM 100, 101, 102, 200, 211, 212, 230, 234, 250, 290, **300**, **350**, **375**, **410**, **490**, **494**

Interdisciplinary Sciences:
IS 299
(May count as either humanities or social science credit, depending on content of course)

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

Philosophy:
PHIL 100, 200, 220, 233

SOCIAL SCIENCES

Anthropology:
ANTH 210, 220, **421**

Business Administration
BAD **350**, **360**

Economics:
ECON 201, 202

Geography:
GEOG 101, 297, 298, 299

History:
HIST 151, 152, **360**

Interdisciplinary Sciences:
IS 299
(May count as either humanities or social science credit, depending on content of course)

Law:
LAW **457**

Political Science:
POLS 100, 210, **330**, **340**, **350**, **353**, **412**

Psychology:
PSYC 101, 251, **327**, **331**, **341**, **361**, **390**, **451**

Sociology:
SOC 100, 150, 250, **320**, **390**, **394**, **399**, **410**, **420**, **459**, **510**, **520**

Social Work:
SOCW 200, 210

CIVIL ENGINEERING

ATMOSPHERIC SCIENCES

GEOLOGY

MINING ENGINEERING

GEOLOGICAL ENGINEERING

The College of Earth Systems consists of four departments: Departments of Civil and Environmental Engineering, Geology and Geological Engineering, Atmospheric Sciences, and Mining Engineering. Four bachelors of science degrees and six masters of science degrees are currently being offered in the college. The college also offers Ph.D. programs in Geology and Geological Engineering. In addition, the college provides extensive support for the newly established Ph.D. program of Atmospheric, Environmental, and Water Resources which is a joint program with the South Dakota State University and also participates in the Materials Engineering and Science Ph.D. program on campus.

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 four 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, and Mining Engineering. 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 which 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
Dean, College of Earth Systems

Patrick R. Zimmerman, Ph.D.
Chair and Professor, Department of Atmospheric Sciences; Director, Institute of Atmospheric Sciences

Professor
Andrew G. Detwiler, Ph.D.
John H. Helsdon, Jr., Ph.D.
Mark R. Hjelmfelt, Ph. D.

Associate Professor
L. Ronald Johnson, M.S

Assistant Professor
William J. Capehart, Ph.D.
Lee A. Vierling, Ph.D.

Distinguished Professor Emeritus
Harold D. Orville, Ph.D.

Professor Emeritus
Briant L. Davis, Ph.D.
James R. Miller, Jr., M.S.
Paul L. Smith, Jr., Ph.D.

Associate Professor Emeritus
John H. Hirsch, M.S.

Research Associate Professor Emeritus
Dennis J. Musil, M.S.

ATMOSPHERIC SCIENCES CURRICULUM/CHECKLIST

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 chemical and physical processes in the atmosphere.

A minor in atmospheric sciences is offered to any student enrolled in any undergraduate degree program which allows minors at SDSM&T. For some majors this would require an additional semester or more of study beyond the normal 4 years. A minimum of 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.

A sample program is shown below.

JUNIOR YEAR

Fall

ATM 301	Intro. to Atmos. Sci. (could be taken in soph. yr.)	3
ATM 501*	Atmospheric Physics	3
TOTAL		**6**

SENIOR YEAR

Fall

ATM 450*	Synoptic Meteorology I	3
ATM 660*	Atmospheric Dynamics	3
TOTAL		**6**

Spring

ATM 605	Air Pollution	3
ATM 650*	Synoptic Meteorology II	3
TOTAL		**6**

* Courses required for federal service qualification - National Weather Service, in addition to a course in Radar Meteorology or remote sensing.

The addition of 6 hours in physical meteorology (e.g., ATM 640, Atmospheric Electricity; ATM 630, Radar Meteorology; or ATM 320, Introductory Satellite Meteorology) 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.

FRESHMAN YEAR

Fall

*MATH 123	Calculus I	4
*CHEM 112	General Chemistry I	3
*CHEM 113	Exper. Gen. Chemistry I	1
ENGL 101	Freshman English I	3
GEOL 201	Physical Geology	3
GEOL 205	Physical Geology Lab	1
PE	Physical Education	1
TOTAL		**16**

Spring

*MATH 124	Calculus II	4
*PHYS 211	University Physics I	3
*CHEM 114	General Chemistry II	3
*CHEM 115	Exper. Gen. Chemistry II	1
*CSC 150	Computer Science I	3
PE	Physical Education	1
Free Elective		3
TOTAL		**18**

SOPHOMORE YEAR

Fall

*MATH 225	Calculus III	4
*PHYS 213	University Physics II	3
PHYS 214	University Physics II Lab	1
*ATM 301	Intro. to Atmos. Sci.	3
ENGL 279	Technical Comm. I	3
Hum., F.A., or S.S. Elective		3
TOTAL		**17**

Spring

*ATM 302	Climate & Global Change	3
*MATH 231	Ord. Diff. Equations	4
CSC 250	Computer Science II	4
Hum. or F.A. Elective		3
S.S. Elective		3
TOTAL		**17**

JUNIOR YEAR

Fall

*MATH 481	Eng. Statistics	4
*ATM 501	Atmospheric Physics	3
PHYS 341	Thermodynamics OR	
CHEM 340	Physical Chemistry	3
Free Elective		3
Hum. or F.A. Elective		3
TOTAL		**16**

Spring

ATM 605	Air Pollution	3
ATM 640	Atmospheric Electricity	3
ENGL 289	Technical Comm. II	3
Free Elective		3
S.S. Elective		3
TOTAL		**15**

SENIOR YEAR

Fall

*ATM 450	Synoptic Meteorology I	3
*ATM 660	Atmospheric Dynamics	3
ATM 630	Radar Meteorology	3
Biology Elective		3

Hum., F.A., or S.S. Elective		3
Free Elective		3
TOTAL		**18**

Spring

*ATM 650	Synoptic Meteorology II	3
Science Elective		3
Hum., F.A., or S.S. Elective		6
IS 490	Senior Project	3
TOTAL		**15**

* Required by Atmospheric Sciences Department

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 24 credit hours of course work plus a thesis for an additional 6 semester hours of credit.

The Atmospheric, Environmental, and Wter Resources Program is a joint doctoral program in atmospheric, environmental, and water resources offered by the South Dakota School of Mines and Technology and the 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 programs please refer to the graduate school bulletin.

The graduating student is expected to be capable of independent and critical thinking in the areas of physical, synoptic, and dynamic meteorology. 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 research both individually and as a member of a team.

TECHFact: Tech's 1998 fall enrollment was 2265, 2020 undergraduate and 245 graduate students.

Terje Preber, Ph.D., P.E.
Chair and Professor, Department of Civil and Environmental Engineering

Distinguished Professor
Venkataswamy Ramakrishnan, Ph.D.

Professor
Sangchul Bang, Ph.D., P.E.
Wendell H. Hovey, Ph.D., P.E.
Srinivasa L. Iyer, Ph.D., P.E.
Director of Industry Programs, Center of Excellence for Advanced Manufacturing and Production

Associate Professor
Marion R. Hansen, Ph.D., P.E., S.E., L.S.
Scott J. Kenner, Ph.D., P.E.
Melvin L. Klasi, Ph.D., P.E.
Henry V. Mott, Ph.D., P.E.

Assistant Professor
Bruce W. Berdanier, Ph.D., P.E., L.S.
Thomas A. Fontaine, Ph.D., P.E.

Instructor
Lois L. Arneson-Meyer, BSCE, MSTM

Professor Emeritus
William V. Coyle, M.S., P.E., L.S.
Thomas P. Propson, B.S.E., M.S.E., Ph.D.
Donald A. Thorson, M.S., P.E., L.S.

Associate Professor Emeritus
Francis D. Bosworth, M.S., P.E.
Richard L. Fedell, M.S., P.E.
Lavern R. Stevens, M.S., P.E.

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 coursework 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.
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 specialized areas of environmental, geotechnical, hydraulic, structural, materials and water resource engineering. Each student is asked to choose one or more of these areas as a specialization from which specialty or "track" elective courses are selected at the senior level. 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 four Civil Engineering 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 coursework. 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.

MINOR IN CIVIL ENGINEERING

A minor in civil engineering is not available.

CIVIL ENGINEERING CURRICULUM/CHECKLIST

FRESHMAN YEAR

First Semester

Engl 101	Freshman English	3
CHEM 112	General Chem.	3
MATH 123	Calculus I	4
GE 115	Professionalism in Engr & Sci	2
PE	Physical Education	1
Gen Ed Humanities elective		3
TOTAL		**16**

Second Semester

CHEM 113	Experimental General Chem	1
CHEM 114	General Chem. II	3
PHYS 211	University Physics I	3
MATH 124	Calculus II	4
GE 117	Professionalism in Engr & Sci	2
PE	Physical Education	1
Gen Ed Social Science Elective		3
TOTAL		**17**

SOPHOMORE YEAR

First Semester

MATH 225	Calculus III	4
EM 214	Statics	3
CEE 284	Digital Comp. in CEE	3
CEE 206	CEE Pract. & Eng. Surveys I	4
Gen Ed Humanities Elective		3
TOTAL		**17**

Second Semester

ENGL 279	Technical Communications I	3
MATH 231	Ordinary Diff. Equations	4
EM 223	Fluid Mechanics	3
EM 216	Mechanics of Materials	3
CEE 285	Micro. App. in CEE	2
Gen Ed Social Science Elective		3
TOTAL		**18**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II	3
CEE 316	Eng. & Construct. Matls.	3
CEE 326	Environmental Engineering I	3
CEE 336	Hyd. Systems Des.	3
CEE 346	Geotechnical Engineering I	3
CEE 356	Theory of Structures I	3
TOTAL		**18**

Second Semester

PHYS 213	University Physics II	3
EM 215	Engr Mechanics or	
ME 221	Dynamics	3
Science elective		3
Three of the following courses:		9
CEE 327 (1a)	Environ. Eng. II	
CEE 337 (1b)	Eng. Hydrology	
CEE 347 (1c)	Geotechnical Eng. II	
CEE 357 (1d)	Metal Structures I	
CEE 358 (1d)	Applied Structural. Design	
TOTAL		**18**

SENIOR YEAR

First Semester

IENG 301	Basic Engineer. Economics	2
EE 211	Intro to Electrical Engineering	4
CEE 474	Civil Engr Project Management	3
CEE	(2) Track Elective	3
CEE	(3) Approved Elective	3
Humanities or Social Science Elective		1
TOTAL		**16**

Second Semester

CEE 492	CEE Profession	1
ME 211	Intro to Thermodynamics	3
CEE 466	Civil Eng. Capstone Design	3
CEE	(2) Track Elective	3
CEE	(3) Approved Elective	3
Humanities or Social Science Elective		3
TOTAL		**16**

A total of 136 semester credits is required.

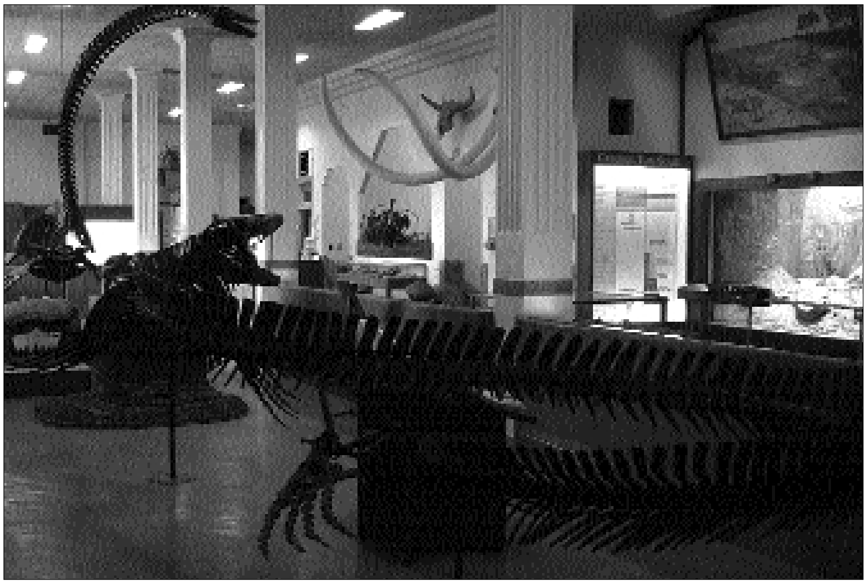
Curriculum Notes

(1) Each student must choose a minimum of one course from three of the four divisions (a-d).

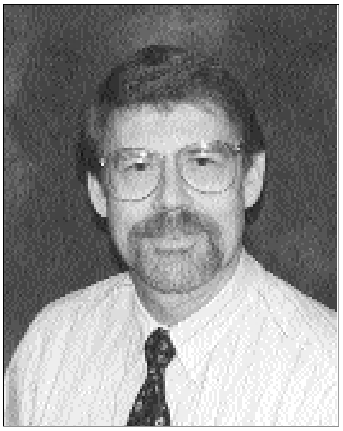
(1d) Structural Engineering track students must choose CEE 357 while students of other tracks desiring a terminal structural design course may choose CEE 358.

(2) Must be two or more approved courses in one area selected from either Environmental Engineering, Geotechnical Engineering, Structural Engineering, or Water Resources Engineering.

(3) Must be two or more courses approved by the Department of Civil and Environmental Engineering.



TECHFact: The SDSM&T Museum of Geology houses more than 300,000 specimens. Of general interest are skeletons from the Oligocene of the Big Badlands and the Upper Cretaceous of Western South Dakota, giving a vivid impression of Dakota life long ago. Other special exhibits feature fluorescent minerals, lapidary specimens of local agates, and native gold.



James E. Fox, Ph.D.
Chair and Professor, Department of Geology
and Geological Engineering

Mickelson Professor
Arden D. Davis, Ph.D., P.E.

Professor
William M. Roggenthen, Ph.D.

Assistant Professor
Larry D. Stetler, Ph.D.

Supporting Faculty

Professor
Edward F. Duke, Ph.D.
Manager, Analytical Services, Engineering and Mining Experiment Station
Alvis L. Lisenbee, Ph.D.
Colin J. Paterson, Ph.D.

Assistant Professor
Maribeth H. Price, Ph.D.

Professor Emeritus
John Paul Gries, Ph.D.
John C. Mickelson, Ph.D.
Perry H. Rahn, Ph.D., P.E.
Director, Black Hills Natural Sciences Field Station

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.

The objective of the program in geological engineering is to provide an educational experience in which students obtain 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 ground water, geotechnics, petroleum, and minerals. In the senior year, students select two of these four main areas in which to specialize, 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.

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. 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.

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 instrumentation. Equipment includes ground-probing radar, a hydrologic analysis system, a portable wind tunnel, a mobile drilling rig, and petroleum engineering equipment. The computer laboratory contains Macintosh and Pentium 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

FRESHMAN YEAR

First Semester

CHEM 112	General Chem. I	3
MATH 123	Calculus I	4
ENGL 101	Freshman English	3
GE 115	Professionalism in Eng. & Sci,	2
Gen Ed Humanities Elective**		3
Gen Ed Social Science Elective**		3
TOTAL		**18**

Second Semester

CHEM 113	Exp. Gen. Chem.	1
CHEM 114	General Chem. II	3
MATH 124	Calculus II	4
PHYS 211	University Physics I	3
GEOE 298	Geology for Engineers	3
GE 117	Professionalism in Eng. & Sci.	2
TOTAL		**16**

SOPHOMORE YEAR

First Semester

EM 214	Eng. Mechanics (Statics)	3
MATH 225	Calculus III	4
MINE 301	Mine Surveying	3
PE	Physical Education	1
PHYS 213	University Physics II	3
Gen Ed Humanities or Social Science Elective		3
TOTAL		**17**

Second Semester

ENGL 279	Technical Communications I	3
EM 216	Mechanics of Materials	3
GEOL 212	Mineral. and Crystal.	3
GEOL 231	Historical Geology	3
PE	Physical Education	1
Gen Ed Humanities or Social Science Elective		3
TOTAL		**16**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II	3
GEOL 331	Stratig. and Sed.	3
GEOL 341	Elementary Petrology	3
CEE 346	Geotechnical Engineering	3
MATH 231	Ord. Diff. Equations	4
TOTAL		**16**

Second Semester

GEOE 322	Structural Geology	3
GEOE 324	Eng. Geophysics	3
EM 327	Applied Fluid Mechanics	4
GEOL 416	Intro. to GIS	3
IENG 301	Basic Eng. Economics **OR**	2
MINE 441	Economics of Mining	
TOTAL		**15**

Summer

GEOE 410	Eng. Field Geology	6
TOTAL		**6**

SENIOR YEAR

First Semester

GEOE 466	Eng. and Envt. Geology	3
GEOE 475	Ground Water	3
GEOE 464	Petroleum Production	3
GEOE 491	Geol. Eng. Des. Project I	3
MET 320	Met. Thermo.	4
TOTAL		**16**

Second Semester

MINE 411	Rock Mechanics I	4
GEOE 451	Economic Geology	3
GEOE 492	Geol. Eng. Des. Project II	3
Geological Engineering Elective*		3
Humanities or Social Science Elective		3
TOTAL		**16**

136 semester credits required.

Curriculum Notes

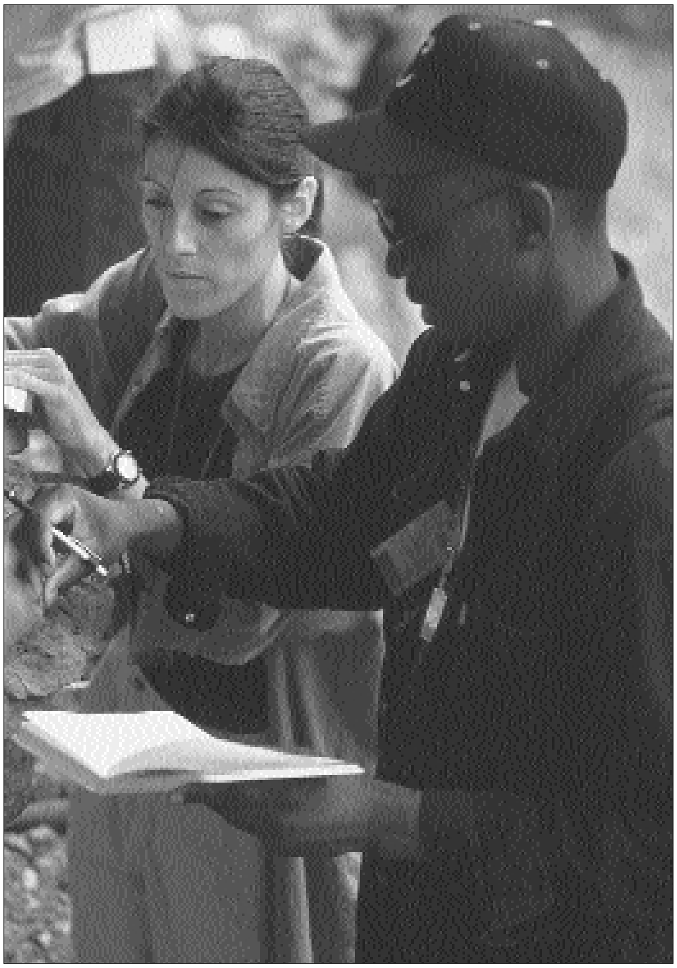
* Geological Engineering Electives: Students must take one of the following courses:

GEOE 425	Engineering Geophysics II	3
GEOE 462	Drilling Engineering	3
GEOE 482	Applied Geomorphology	3

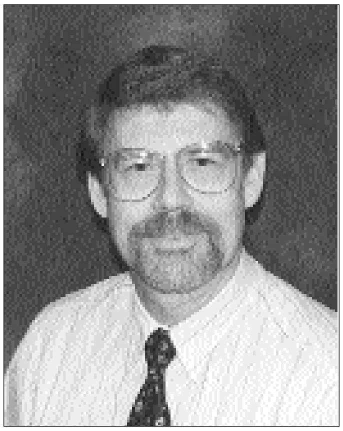
* Suitable engineering courses, including 600-level courses, may be substituted for this elective with the approval of the advisor and department chairman. NOTE: All courses must have at least 3 hr. of engineering topics to be considered for this elective.

** Students must complete 3 credits of humanities and 3 credits of social science by the end of the freshman year.

Additional coursework in mathematics and statistics is encouraged. MATH 281 and MATH 282 are recommended statistics courses; MATH 332 is recommended for students interested in numerical modeling of partial differential equations.



TECHFact: SDSM&T has the best in modern facilities, as well as the unusual advantage of proximity to natural laboratories of the Black Hills and Badlands.



James E. Fox, Ph.D.
Chair and Professor, Department of Geology
and Geological Engineering

Faculty

Professor
Philip R. Bjork, Ph.D.,
Paleontologist and Director, Museum of Geology at the Journey Museum
Edward F. Duke, Ph.D.
Manager, Analytical Services, Engineering and Mining Experiment Station
Alvis L. Lisenbee, Ph.D.
James E. Martin, Ph.D.
Curator of Vertebrate Paleontology, Museum of Geology
Colin J. Paterson, Ph.D.

Assistant Professor
Maribeth H. Price, Ph.D.

Haslem Post-doctoral Fellow in Paleontology
Julia T. Sankey, Ph.D.

Supporting Faculty

Mickelson Professor
Arden D. Davis, Ph.D., P.E.

Professor
William M. Roggenthen, Ph.D.

Assistant Professor
Larry D. Stetler, Ph.D.

Professor Emeritus
John Paul Gries, Ph.D.
John C. Mickelson, Ph.D.
Jack A. Redden, Ph.D.,
Perry H. Rahn, Ph.D., P.E.
Director, Black Hills Natural Sciences Field Station

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 tracks of Geology/Geoenvironmental, Paleontology, and GIS/Remote Sensing. The senior year culminates in an individual research project.

For specializations such as earth science teaching, students should consult teaching programs at other colleges for auxiliary education courses that would be needed for teacher certification. The basic program also prepares the individual for graduate study in geology or related areas.

The graduate programs, both Masters and Doctoral, involve additional specialization in geology and paleontology and commonly include research on regional or local problems. Analytical and computational facilities in the Department and related departments include the electron microprobe, heating-cooling fluid inclusion stage, AA-ICP, XRD, SEM, TEM, microcomputers, and two IBM RS6000 and three Silicon Graphic Indy 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 18 credit hours of Geology courses including the following: GEOL 201, 205, 212, 231, 341, and GEOE 322. GEOL 331 may be substituted for GEOL 231 with the permission of the Chair of the Department of Geology and Geological Engineering. Such degrees are commonly well received by employers and provide choices for future graduate fields.

GEOLOGY CURRICULUM/CHECKLIST

FRESHMAN YEAR

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry	3
ENGL 101	Freshman Composition	3
GEOL 201	Physical Geology	3
GEOL 205	Physical Geology Lab	1
Gen Ed Humanities Elective		3
TOTAL		**17**

Second Semester

CHEM 114	General Chemistry II	3
CHEM 113	Exper. Gen. Chemistry I	1
GEOL 231	Historical Geology	3
Geology Track Requirements		7/8
PE	Physical Education	1
TOTAL		**15/16**

SOPHOMORE YEAR

First Semester

CHEM 115	Exper. Gen. Chemistry II	1
GEOL 331	Stratig. and Sedimentation	3
Geology Track Requirements		7/10
Gen Ed Social Science Elective		3
TOTAL		**14/17**

Second Semester

ENGL 279	Technical Communications I	3
GEOL 212	Mineral. and Crystallog.	3
GEOE 211	Erth Sys. Eng. Anal.	3
Geology Track Requirements		0/3
Gen Ed Humanities or Social Science Elective		6
PE	Physical Education	1
TOTAL		**16/19**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II	3
GEOL 341	Elementary Petrology	3
Geology Track Requirements/electives		6
Humanities or Social Science Electives		1
TOTAL		**13**

Second Semester

GEOE 322	Structural Geology	3
GEOL 403	Regional Field Geology	1
GEOL 416	Intro. to GIS	3
Geology Track Requirements/electives		6
TOTAL		**13**

Summer

GEOL 410	Field Geology	6
TOTAL		**6**

SENIOR YEAR

First Semester

GEOL 491	Senior Research I	3
Humanities or Social Science Elective		3
Geology Track Requirements/electives		9
TOTAL		**15**

Second Semester

GEOL 492	Senior Research II3	3
GeologyTrack requirements/electives		12/13
TOTAL		**15**

128 semester credits are required.

GEOLOGY TRACKS COURSE CHECKLIST

GEOLOGY/GEOENVIRONMENTAL

Freshman Spring		
MATH 124	Calculus II	4
PHYS 211	Univ. Physics I	3
Sophomore Fall		
MATH 225	Calculus III	4
PHYS 213	Univ. Physics II	3
MINE 301	Mine Surveying	3
Sophomore Spring		
Junior Fall		
GEOL 471	Invert. Paleo*	3
	Track elective	3
Junior Spring		
GEOE 324	Engr. Geophysics I	3
GEOL 442	Optical Petrology*	3
Senior Fall		
GEOL 475	Ground Water	3
	Track electives	6
Senior Spring		
GEOE 482	Applied Geomorph*	3
GEOE 451	Economic Geology	3
	Track electives	7
TOTAL		**128**

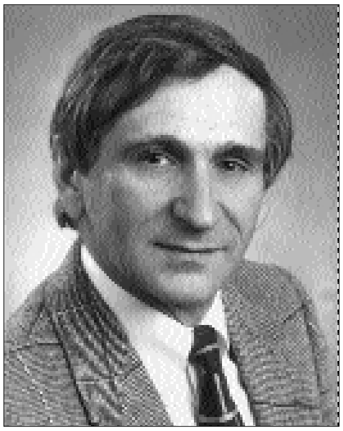
PALEONTOLOGY

Freshman Spring		
BIOL 121	Basic Anatomy	3
BIOL 122	Anatomy Lab	1
PHYS 111	Intro. Physics I	3
PHYS 112	Intro. Physics Lab	1
Sophomore Fall		
BIOL 151	Gen. Biology I	3
BIOL 152	Gen. Biology Lab	1
GEOL 271	Search for the Past	3
Sophomore Spring		
GEOL 276	Dinosaurs	3
Junior Fall		
GEOL 471	Invert. Paleo*	3
BIOL 211	Principles of Ecology	3
Junior Spring		
GEOL 496	Museum Cons. Cur.	3
MATH 181	Intro. to Statistics	3
Senior Fall		
GEOL 396	Vert. Tech. Exhib.	3
	Math elective	3
	Track electives	3
Senior Spring		
Track electives		12
TOTAL		**128**

GIS/REMOTE SENSING

Freshman Spring		
MATH 124	Calculus II	4
PHYS 211	Univ. Physics I	3
Sophomore Fall		
MATH 225	Calculus III	4
PHYS 213	Univ. Physics II	3
MINE 301	Mine Surveying	3
Sophomore Spring		
Junior Fall		
GEOL 351	Earth Resources	3
BIOL 211	Principles of Ecology	3
Junior Spring		
GEOE 324	Engr. Geophysics I	3
ATM 320	Int. Remote Sensing	3
Senior Fall		
GIS/Remote Sensing elective		3
	Track electives	6
Senior Spring		
GEOE 482	Applied Geomorph*	3
GEOE 451	Economic Geology	3
MATH 498	Eng. Statistics I	2
	Track electives	5
TOTAL		**128**

*Courses offered alternate years.



Zbigniew Hladysz, Ph.D.
Professor and Mining Engineering Program Coordinator

Professor
E. Ashworth, Ph.D.

Associate Professor
Charles A. Kliche, Ph.D., P.E.

Professor Emeritus
John Duff Erickson, M.S.

MINING ENGINEERING

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 management receive special emphasis.

Students are expected: to be proficient in the use of the computer, to develop problem-solving skills, and to be proficient in communication skills. 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 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 the campus fileservers through the network. Available software packages are routinely used by undergraduate and graduate students for the solution of problems in rock mechanics, geostatistics, management, mineral economics, ventilation, blasting, mapping, and mine design. State-of-the-art geoscience modeling and mine planning Vulcan software, and Silicon Graphics workstations are used by students in surface and underground mine design.

MINING ENGINEERING CURRICULUM/CHECKLIST

FRESHMAN YEAR

First Semester

CHEM 112	General Chem.	3
CHEM 113	Exp. Gen. Chem. I	1
MATH 123	Calculus I	4
Gen Ed Humanities or Social Science Elective		3
GE 112	Personal Comp. Programming	2
EG 111	Engr. Graphics	2
PE	Physical Education	1
TOTAL		**16**

Second Semester

CHEM 114	General Chemistry II	3
MATH 124	Calculus II	4
PHYS 211	University Physics I	3
ENGL 101	Freshman English I	3
PE	Physical Education	1
Gen Ed Humanities or Social Science Elective		3
TOTAL		**17**

SOPHOMORE YEAR

First Semester

MINE 201	Introduction to Mining	3
GEOL 201	Physical Geology	3
GEOL 205	Physical Geology Lab	1
MATH 225	Calculus III	4
PHYS 213	University Physics II	3
ECON 201	Principles of Microecon	3
TOTAL		**17**

Second Semester

MINE 202	Underground Mining	3
GEOL 212	Mineral. & Crystal.	3
MATH 231	Ord. Diff. Equations	4
ENGL 279	Technical Communications I	3
Gen Ed Humanities or Social Science Elective		3
TOTAL		**16**

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 Mech. of Mat.	3
ME 211	Thermodynamics	3
TOTAL		**18**

Second Semester

MINE 441	Mineral Economics	3
MINE 411	Rock Mechanics I	4
GEOE 322	Structural Geology	3
EM 215	Dynamics	3
EM 327	Applied Fluid Mechanics	4
TOTAL		**17**

SENIOR YEAR

First Semester

MINE 431	Underground Mine Design	4
MINE	Mining Elective	3
MINE 461	Mine Ventilation	3
MINE 493	Undergraduate Seminar	1
EE 301	Circuits & Machines	4
Free Elective		3
TOTAL		**18**

Second Semester

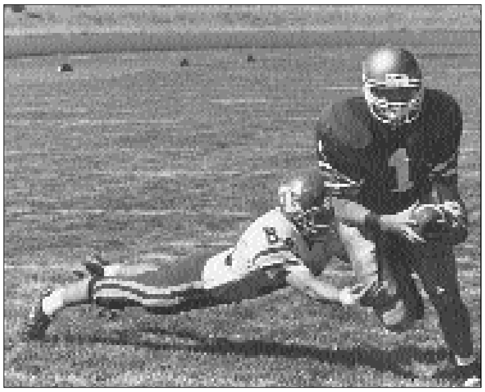
MINE 432	Surface Mine Design	4
MINE	Mining Elective	3
MET 220	Mineral Processing	4
Humanities or Social Science Electives		4
Free Elective		2
TOTAL		**17**

136 semester credits required.

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.

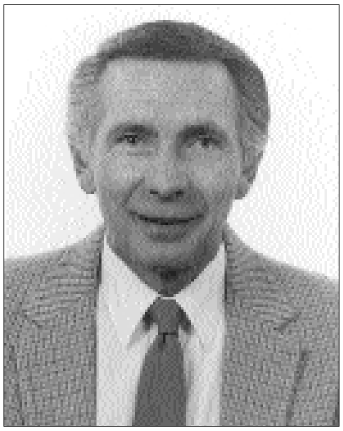
Military Science



Physical Education

Humanities

Social Sciences



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 to prepare 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 consulting with leaders in business and industry, the faculty delivers a curriculum of courses and experiences to equip students to 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 to specifically 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 management, medicine and health technology, military service, personnel, science industries, technology managers, 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, teaching, and the natural sciences.

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,

Dean Bryson

Dr. Dean Bryson
Dean, College of Interdisciplinary Studies

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, 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.
5. Students in pre-professional careers: law, medicine, physical therapy, atmospheric sciences, etc.

The benefits of this degree include:

1. Flexibility in a wide range of study.
2. Individual design allowing the student to influence the content of the degree.
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 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

I.	English Sequence (ENGL 101, 279, 289)	9 cr.
II.	Sciences*	
	Math & Computer Science	12 cr. min.
	Biology	3 cr. min.
	Chemistry	3 cr. min.
	These or other sciences	24 addit. cr.
	SUBTOTAL	**42 cr.**
III.	Humanities, Soc. Sciences	
	Soc. Sciences (with 3 cr. being upper division)	6 cr. min.
	Humanities (with 3 cr. being upper division)	6 cr. min.
	Social Sciences, Humanities, or Fine Arts	12 addit. cr.
	SUBTOTAL	**24 cr.**
IV.	Physical Education	2 cr.
V.	Electives	
VI.	IS 490 Senior Project	1-3 cr.
	TOTAL	**128 cr.**

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

* Of the 42 credits required in sciences, 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.

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 which IS graduates have entered or are pursuing.

Health Science

- Pre-Med: The IS Degree allows you to complete a program of courses to prepare you for entrance into a medical school. The faculty, by staying knowledgeable of what schools of medicine require for admission, will help you select the courses these schools require and recommend.
- Pre-Physicians Assistant: Working with your advisor, you can select the courses which will fulfill the IS Degree requirements and admission requirements of those universities which offer the P.A. degrees.
- Medical Technology/Radiologic Technology: The SD 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 you complete in the MT or RT program count towards your IS Degree. Many students then graduate with both a Bachelor 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, 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 you 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 for you to study special topics of your 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.

If you are planning to attend graduate schools in Psychology, Sociology, and Social Work the IS Degree provides an excellent opportunity for preparation for these advanced degrees.

Additional Programs of Study

- Atmospheric Sciences: If your interest is in this area, you have the opportunity to concentrate your courses in the Department of Atmospheric Sciences. With this concentration within your IS Degree you will study and do research with faculty from our 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 you to develop a program of study within your IS Degree. They will help prepare you with such skills as oral and written communications, critical thinking, and the broad education required by law schools.
- Environmental Science: If you have an interest in this area you will have the opportunity within your 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 your IS Degree you have the opportunity to prepare yourself 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 170[1], 299[2], **370**[1], **399**[1], **490**, **499/599**[1], **690**, **694**

[1] May be used as free elective for the IS Degree.

[2] May be used as humanities, social sciences, or free elective credit in the IS Degree.

Dr. Sue Shirley, Ph.D.
Chair and Associate Professor, Department of Humanities

Professor
Alfred R. Boysen, Ed.D.
James D. Feiszli, D.M.A.
    Director, Music
Bradford A. Morgan, Ph.D.

Associate Professor
Kathy Antonen, Ph.D.
Josephine M. Lee, M.A.
Rodney P. Rice, Ph.D.
Judy E. Sneller, Ph.D.

Assistant Professor
Michael T. Hudgens, Ph.D.
Deborah Mitchell, M.F.A.
    Director, APEX Gallery
Sally B. Palmer, Ph.D.
Susan L. Reid, D.M.A.

Professor Emeritus
John J. Dunn, Ph.D.
George R. Moe, Ph.D.

Professor Emerita
Jeannette E. Kinyon, M.A.
Audrey G. Whitehead, M.A.

Associate Professor Emerita
Boots Newstrom, M.Ed., M.A.
Cathryn A. Spelts, Ed.D.

Associate Professor Emeritus
Leslie M. Baylor, M.A.

HUMANITIES

The Department of Humanities provides study in the fields of communication, fine arts, literature, religion, 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 24 semester hours of humanities and social science courses. Other science and engineering degree candidates are required to complete 16 semester hours of humanities and social sciences courses - at least six 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 credit hours).

All IS degree candidates must complete ENGL 101, ENGL 279, ENGL 289 and IS 490, which cannot be used to meet the humanities and social sciences requirements.

HUMANITIES

(Upper level courses are in bold print)

Art:
ART 111, 112, ARTH 151, 211, **320**, **490**, **494**

English:
ENGL 101[1],102[2], 221, 222, 241, 242, 250, 279[1], 289[1], **300**, **325**, **333**, **350**, **360**, **366**, **374**, **383**, **390**, **394**[1]

European Studies (Culture):
EURS **301**

Foreign Language:
FREN 101, 102, 201, 202, GERM 101, 102, LAK 101, 102, SPAN 101, 102

Humanities:
HUM 100, 101, 102, 200, 211, 212, 230, 234, 250, 290, **300**, **350**, **375**, **410**, **490**, **494**

Interdisciplinary Sciences:
IS 299 (Counts as either Humanities OR Social Sciences, depending on content of course).

Music:
MUAP 150, MUEN 150[2], 160[2], 250[2], 260, **330**, MUS 100, 201, 250,

Philosophy:
PHIL 100, 200, 220, 233

Speech Communications:
SPCM 101[2]

[1] Meets general requirements for graduation, but not for humanities credits.

[2] May not be used as humanities credits, but may be used for free elective credit. (Consult advisor for further details).

Lieutenant Colonel Richard J. Murrell, M.S.
Chair and Professor, Department of Military Science, ROTC

Assistant Professor
Captain Randall P. Kramer, M.S.
Captain Scott W. Redd, M.Ed.

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 Basic ROTC Course incurs no military obligation.

CURRICULUM

ROTC provides leadership training and experience demanded by both corporations and the 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, US 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 credit hours each semester the first two years, and four 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 Basic Camp conducted 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.

FINANCIAL INFORMATION

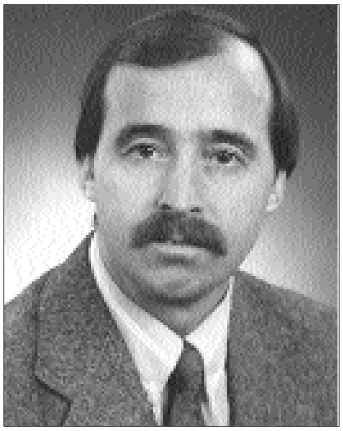
Financial support of $150 subsistence per month for up to 10 months of the academic school year is paid to those students enrolled in the ROTC Advanced Course. Students attending the five-week ROTC Basic Camp or the five-week ROTC Advanced Camp receive approximately $700 plus room, board, and travel expenses.

Additional financial aid is available to eligible freshman and sophomore students in the form of three-year and two-year Army ROTC scholarships. The scholarship provides tuition, fees, and a textbook allowance, in addition to the $150 per month in subsistence paid during the school year. In addition, all non-scholarship advanced course cadets receive a 50% reduction in tuition costs.

EXTRACURRICULAR ACTIVITIES

Military-related extracurricular activities and organizations available to the ROTC student include Scabbard & Blade, Pershing Rifles, SDSM&T Rangers, and the SDSM&T Drill 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.

TECHFact: Tech has an active varsity athletic program. The university is a member of the South Dakota/Iowa Conference (SDIC) and is associated with the National Association of Intercollegiate Athletics (NAIA). Varsity sports include basketball, football, volleyball, track, and cross country.



Jerry R. Schafer, M.A.
Chair and Associate Professor, Department of Physical Education; Assistant Director, Intercollegiate Athletics; Head Men's Cross Country and Track Coach

Professor
Barbara A. Felderman, M.S.
Head Women's Basketball Coach

Associate Professor
D. Hugh Welsh, M.Ed.
Director, Intercollegiate Athletics; Head Men's Basketball Coach

Assistant Professor
Ronald J. Richards, M.A.
Head Football Coach

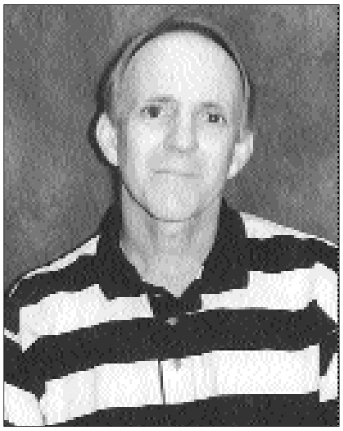
Instructor
Connie A. Mettille, M.S.
Intramural Director; Head Women's Volleyball Coach

Professor Emeritus
Robert P. Hunt, M.A.

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.



Dr. Stephen R. Pratt, Ph.D.
Chair and Associate Professor, Department of Social Sciences

Professor
Dean A. Bryson, Ed.D.
Dean, College of Interdisciplinary Studies
Sidney G. Goss, Ph.D.

Associate Professor
James K. McReynolds, Ph.D.

Assistant Professor
Roger E. Dendinger, Ph.D.
Robin J. Lipke, Ph.D.

Director, Devereaux Library
Patricia M. Andersen, M.L.I.S.

Associate Librarian Cataloger
Cindy L. Davies, M.L.I.S.

Associate Librarian
Margaret Sandine, M.A.

Professor Emerita
Stella P. Hughes, Ph.D.

Professor Emeritus
John R. Arneson, Ph.D.
George R. Moe, Ph.D.
A. Charles Thielen, Ed.D.

SOCIAL SCIENCES

The Department of Social Sciences provides study and understanding of that branch of science which 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 24 semester hours of humanities and social sciences courses. Other science and engineering degree candidates are required to complete 16 semester hours of humanities and social sciences courses - at least six credits in each area. Engineering majors are required to enroll in at least one upper-level humanities or social science course course (of at least three credit hours).

SOCIAL SCIENCES

(Upper level courses are in bold print)

Anthropology:
ANTH 210, 220, **421**

Business Administration:
ACCT 210[1], 211[1], BAD 101[1], 299[1], **345**[1], **350**, **360**, **370**[1], **399**[1]

Economics:
ECON 201, 202

Geography:
GEOG 101, 297, 298, 299

History:
HIST 121, 122 (For students enrolling in Fall 1999 or later these courses are a humanities, prior to Fall 1999 these courses where a social science.)
HIST 151, 152, **360**

Interdisciplinary Sciences:
IS 299 (Counts as either Humanities OR Social Sciences, depending on content of course.)

Law:
LAW **457**

Political Science:
POLS 100, 210, **330**, **340**, **350**, **353**, **412**

Psychology:
PSYC 101, 251, **327**, **331**, **341**, **361**, **390**, **451**

Sociology:
SOC 100, 150, 250, **320**, **390**, **394**, **399**, **410/510**, **420/520**, **459**

Social Work:
SOCW 200, 210

[1] May not be used as social sciences credits, but may be used for free elective credit. (Consult advisor for further details.)

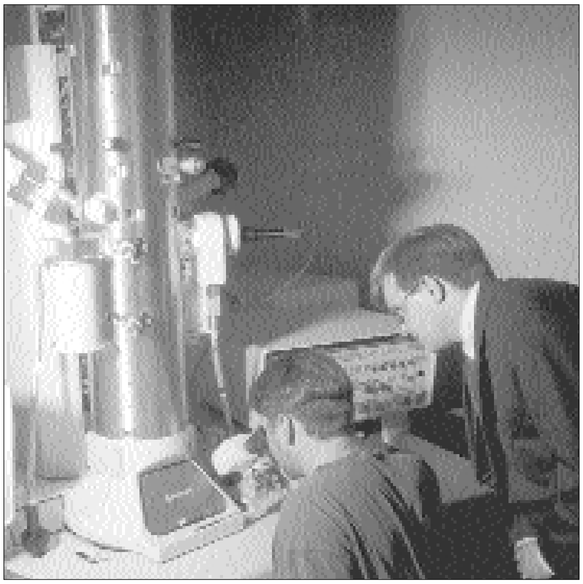
TECHFact: Although far from home, Tech's 60 Norwegian students celebrated Norwegian Independence Day on May 17 with a parade and other festivities. Seven and a half percent of Tech's enrollment in the fall of 1998 was international students. Norwegian students comprised the largest group. Students represented more than 20 other countries including the People's Republic of China, Zambia, and India.

BIOLOGY

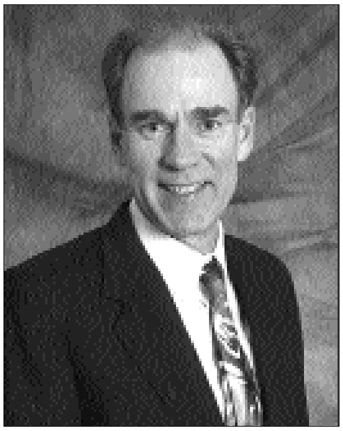
CHEMICAL ENGINEERING

CHEMISTRY

METALLURGICAL ENGINEERING



PHYSICS



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 biology program of the university also resides in the College.

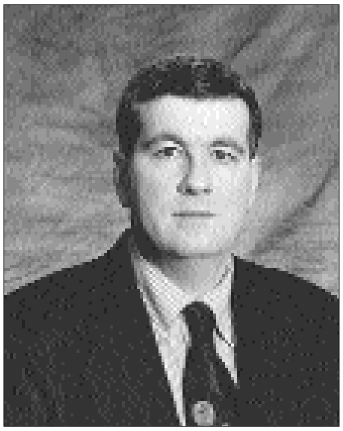
Nearly all students at the university will take some basic science courses within the College. Graduates of the College's programs find exciting and rewarding opportunities for careers in industrial or government employment, private practice, or consulting. Faculty members of the College are active in research, from developing practical new materials that can withstand extreme conditions to studying the theoretical behavior of the atom. The faculty of the College has taken a lead role in the university's Ph.D. program in Materials Engineering and Science.

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,

James M. Munro

Dr. James M. Munro
Interim Dean,
College of Materials Science and Engineering



M. Steven McDowell, Ph.D.
Chair and Associate Professor, Department of Chemistry
& Chemical Engineering

Associate Professor
Sookie S. Bang, Ph.D.

Assistant Professor
Karri T. Vierling, Ph.D.

Professor Emerita
Sister Marmion Howe, Ph.D.

Professor Emeritus
Morton Green, Ph.D.
Curator Emeritus of Vertebrate Paleontology

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 18 credits are recommended with 8 of those credits being BIOL 151-152; BIOL 153-154 or equivalent. At least 6 credits should be at the 300 level or above.

Recommended Options:

A. General Biology Sequence
8 core credits: BIOL 151, 152, 153, 154
10 additional credits from:

BIOL 231	General Microbiology	3
BIOL 232	General Microbiology Lab	1
BIOL 370	Genetics	3
BIOL 494	Independent Studies	1/3

B. Health Science Sequence
8 core credits: BIOL 151, 152; 153, 154
10 additional credits from:

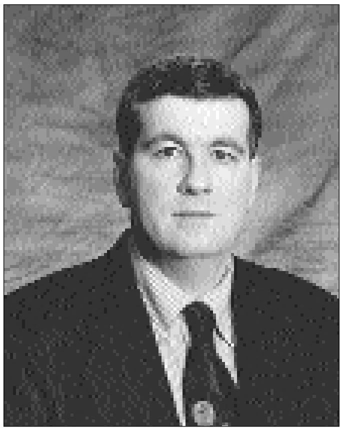
BIOL 121	Basic Anatomy	3
BIOL 122	Basic Anatomy Lab	1
BIOL 123	Basic Physiology	3
BIOL 124	Basic Physiology Lab	1
BIOL 231	General Microbiology	3
BIOL 232	General Microbiology Lab	1
BIOL 370	Genetics	3
BIOL 423	Pathogenic Microbiology	3
BIOL 424	Pathogenic Micro Lab	1
BIOL 494	Independent Studies	1/3

C. Environmental Science Sequence
8 core credits: BIOL 151, 152; 153, 154
10 additional credits from:

BIOL 211	Principles of Ecology	3
BIOL 370	Genetics	2
BIOL 431	Industrial Microbiology	3
BIOL 432	Industrial Micro Lab	1
BIOL 485	Technology & Enviro	3
BIOL 490	Special Topics	1/3

LABORATORIES

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.



M. Steven McDowell, Ph.D.
Chair and Associate Professor, Department of Chemistry & Chemical Engineering

Professor
Larry G. Bauer, Ph.D.
James M. Munro, Ph.D., P.E.
Interim Dean, College of Materials Science and Engineering
Jan A. Puszynski, Ph.D.

R. L. Sandvig Professor
Robb M. Winter, Ph.D.

Associate Professor
David J. Dixon, Ph.D.

Professor Emeritus
William A. Klemm, Sc.D.
Robert L. Sandvig, Ph.D.

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, energy, food, fibers, 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. The course curriculum is listed on a following page. Opportunities also exist for students to participate in on-the-job training in the form of cooperative education (Coops) and summer internships. These employment opportunities may be included as an integral part of the student's studies and are discussed in greater detail below.

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, 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 or materials areas.

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.

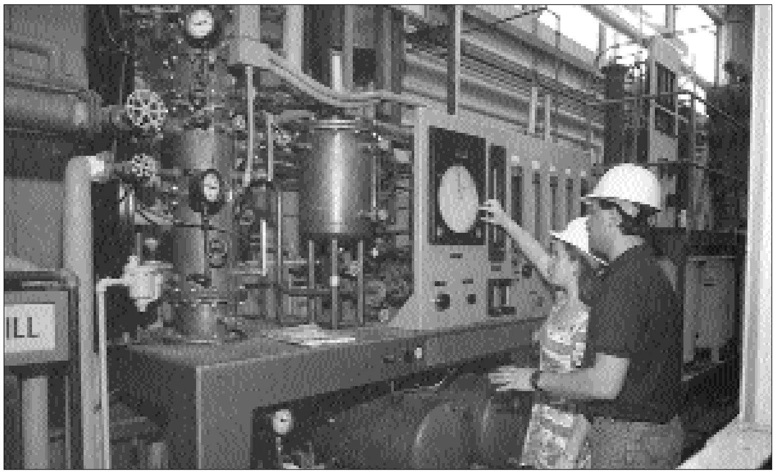
The Chemical Engineering Department has laboratory facilities that are used to supplement the basic information presented in the classroom. These facilities include the main laboratory that houses miniplant equipment such as a distillation column, evaporators, heat exchangers, a gas absorber, etc. Other 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.

SPECIALIZATION TRACKS IN CHEMICAL ENGINEERING

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 into a specialization track.

COOP OPPORTUNITIES IN CHEMICAL ENGINEERING

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 coop position, students register for 2 credits of a Cooperative Education (CP) course. Students wishing to register for coop credit must complete a departmental coop application form, available from their advisor. Students pursuing alternating term coop positions are advised to take their first two coop work terms as a Spring semester followed by a Fall semester in order to optimize the scheduling of courses for their degree.



CHEMICAL ENGINEERING CURRICULUM/CHECKLIST

FRESHMAN YEAR

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry	3
GE 113	Intro. to Personal Computer	3
ENGL 101	Freshman English I	3
CHEM 113	Exp. Gen. Chem.	1
PE	Physical Education	1
Gen Ed Humanities or Social Science Elective		3
TOTAL		**18**

Second Semester

MATH 124	Calculus II	4
CHEM 114	General Chemistry II	3
CHEM 115	Exp. Gen. Chem.	1
PHYS 211	University Physics I	3
CHE 111	Intro. Engineering Modeling	1
Gen Ed Humanities or Social Science Elective		6
TOTAL		**18**

SOPHOMORE YEAR

First Semester

CHE 217	Chem. Engr. I	3
CHE 233	Process Meas. and Control	1
CHEM 230	Analytical Chem. IA	2
CHEM 233	Exp. Anal. Chem.	1
MATH 225	Calculus III	4
PHYS 213	University Physics II	3
PHYS 214	University Physics II Lab	1
Gen Ed Humanities or Social Science Elective		3
TOTAL		**18**

Second Semester

ENGL 279	Technical Communications I	3
CHE 218	Chem. Eng. II	3
CHE 222	Chem. Engr. Thermo. I	3
CHE 262	Process Meas. Lab.	1
CHE 350	Comp. Appl. in Ch.E.	3
MATH 231	Ordinary Diff. Equations	4
PE	Physical Education	1
TOTAL		**18**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II	3
CHE 317	Chem. Engr. III	3
CHE 321	Chem. Engr. Thermo II	3
CHE 361	Chem. Engr. Lab II	1
CHEM 326	Organic Chemistry I	3
CHEM 342	Physical Chemistry I	2
CHEM 220	Exp. Org. Chem. I	1
TOTAL		**16**

Second Semester

CHE 318	Chem. Engr. IV	3
CHE 362	Chem. Engr. Lab III	1
CHEM 328	Organic Chemistry II	3
CHE 443	Chem. Kin. & Reac. Des.	3
CHEM 343	Exp. Phys. Chem. I	1
CHEM 344	Physical Chemistry II	2
Humanities or Social Science Elective		3
TOTAL		**16**

SENIOR YEAR

First Semester

CHE 417	Chem. Eng. V	2
CHE 461	Chem. Engr. Lab IV	1
CHE 431	Ch.E. Design I	4
CHE 433	Process Control	3
Design or Track Elective		3
Engr. Science or Track Elective		4
TOTAL		**17**

Second Semester

CHE 432	Ch.E. Design II	3
Design or Track Elective		2
Dept. Approved or Track Electives		6
Humanities or Social Science Elective		4
TOTAL		**15**

136 semester credits required.

Curriculum Notes:

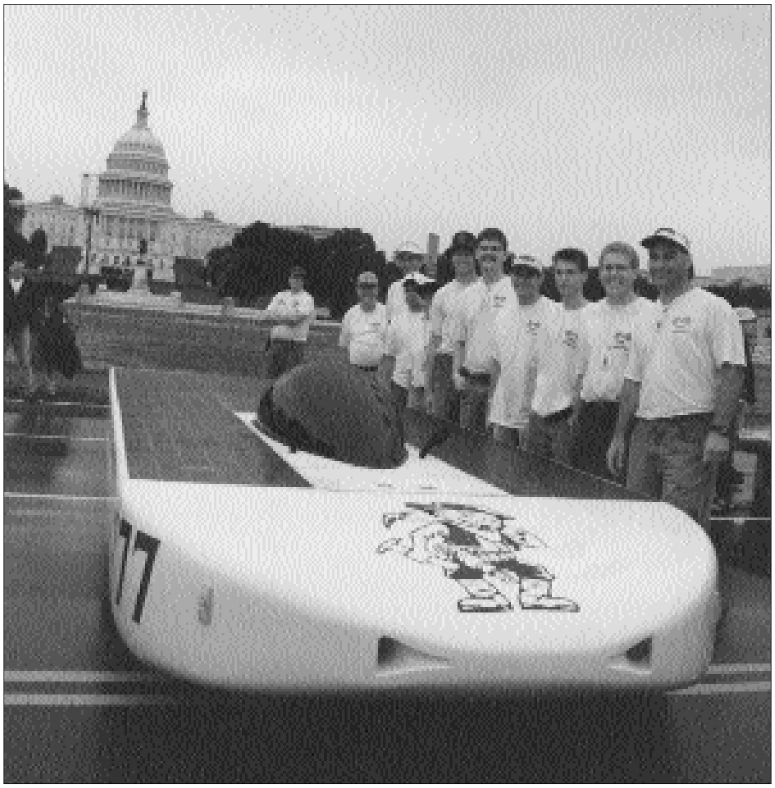
Optional specialization tracks. The following optional tracks for specialization are available. See your advisor for recommendation and approval of courses to take if you are interested in emphasis in one of these areas.

- Biochemical engineering track
- Environmental engineering track
- Materials track
  - Polymer emphasis
  - Solid state/semi-conductor emphasis
  - Ceramic emphasis
  - Corrosion emphasis
  - Materials processing emphasis

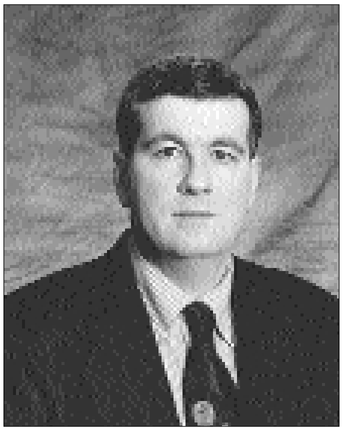
Music Ensemble courses may be substituted for physical education courses for qualified students. Any other substitutions must be approved in advance by the Physical Education Department Chair. Design Electives: CHE 400, 434, 444, 450, 474, 475, 484, 490, 655, 690.

Department approved electives may include up to 3 credits of advanced Military Science, up to 6 credits of co-op, or other approved courses.

The engineering science elective must include a minimum of 3 credits of an out-of-department engineering science course; requires advisor approval.



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.



M. Steven McDowell, Ph.D.
Chair and Associate Professor, Department of Chemistry & Chemical Engineering

Professor
Dale E. Arrington, Ph.D.

Associate Professor
John T. Bendler, Ph.D.
David A. Boyles, Ph.D.
Cathleen J. Webb, Ph.D.

Assistant Professor
Daniel L. Heglund, Ph.D

Professor Emeritus
Jack R. Gaines, Ph.D.
J. Haworth Jonte, Ph.D.
Robert W. Looyenga, Ph.D.
Carl E. Schilz, M.S.

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 128 semester credits.

Upon graduation with a bachelor's degree in chemistry, students have knowledge of chemical and physical phenomena at the molecular level. They are expected to possess the skills of critical thinking in chemical problem-solving, such as instrumental data interpretation for molecular structure characterization. Students are expected to have a command of the four major subdisciplines of chemistry, namely, analytical, inorganic, organic, and physical chemistry, as well as to be familiar with the chemical literature.

Chemistry graduates of the department distinguish themselves in that the chemistry curriculum gives them ample opportunity to supplement their chemical knowledge with a breadth of other courses which may be elected from diverse offerings on campus including the humanities, social sciences, biological and physical sciences, mathematics, engineering, and others. This unique latitude inherent within the chemistry curriculum allows students to develop as well-rounded individuals who are able to face and meet the challenges they may anticipate in their chosen careers.

Chemistry, by its very nature, is the central science in today's world, and many graduates use their degrees as a solid foundation for advanced study in chemistry as well as for study in medicine, pharmacy, veterinary medicine, forensic science, materials science, environmental science, medical technology, physical therapy, patent or environmental law, education-all are possibilities for students with a chemistry education. Likewise, students who opt not to further their education beyond their B.S. degrees in chemistry are also prepared for a wide variety of employment opportunities. Among former chemistry graduates these have included research and quality assurance positions in academic, industrial, governmental, and private sectors of the economy.

The department also participates in the Master of Science in Materials and Engineering Science, and the Doctor of Philosophy degrees in Materials and Engineering Science (MES), and Atmospheric, Environmental, and Water Resources (AEWR). Students seeking these degrees may choose to emphasize any of the representative subdisciplines of chemistry in addition to interdisciplinary research specialties as an integral part of their graduate program of study.

The department prides itself in having state-of-the-art instrumentation available not only for research but as an integral part of undergraduate education. The instrumentation within the department currently includes an FT-IR spectrometer, a 300 MHz superconducting heteronuclear nuclear magnetic resonance spectrometer, a spectrofluorometer, diode-ray electronic spectrophotometers, voltammograph, atomic absorption spectrometer, as well as gas, liquid, and ion chromatographs.

In order to ensure that chemistry majors will complete all degree requirements in a timely manner, will meet prerequisites for further education such as medical school, and will be knowledgeable about post-graduation options and employment opportunities, advisors work closely with their assigned students.

MINOR IN CHEMISTRY

A minor in chemistry must meet all of the general criteria for a minor as described in this catalog. The specific courses required for a minor in Chemistry are:

CHEM 112	General Chemistry I	3
CHEM 113	Exp. General Chemistry	1
CHEM 114	General Chemistry II	3
CHEM 115	Exp. General Chemistry II	1
CHEM 232	Analytical Chemistry I	3
CHEM 233	Exp. Analytical Chemistry I	1
CHEM 252	Systematic Inorganic Chemistry	3
CHEM 216 or 326	Organic Chemistry	3
CHEM 292	Chemistry Outreach	1
CHEM 340 or 342	Physical Chemistry	3

*Adv. Elective	3
TOTAL	**25**

*Departmentally approved elective in chemistry or chemistry-related discipline, 400-level or higher.

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

Freshman Year

First Semester

CHEM 112	General Chemistry	3
CHEM 113	Exp. General Chemistry I	1
ENGL 101	Freshman English	3
MATH 123	Calculus I	4
Gen Ed Social Science Elective		3
Gen Ed Humanities Elective		3
TOTAL		**17**

Second Semester

CHEM 114	General Chemistry II	3
CHEM 115	Exp. General Chemistry II	1
MATH 124	Calculus II	4
PHYS 211	University Physics I	3
PE	Physical Education	1
Gen Ed Social Science Elective		3
TOTAL		**15**

Sophomore Year

First Semester

CHEM 232	Analytical Chemistry I	3
CHEM 233	Exp. Analytical Chemistry	1
CHEM 292	Chemistry Outreach	1
CHEM 326	Organic Chemistry I	3
CHEM 327	Exp. Organic Chemistry I	2
MATH 225	Calculus III	4
PHYS 213	University Physics II	3
PHYS 214	University Physics II Lab	1
TOTAL		**18**

Second Semester

CHEM 182	Chemical Computations	2
CHEM 252	System. Inorganic Chemistry	3
CHEM 328	Organic Chemistry II	3
CHEM 329	Exp. Organic Chemistry II	2
ENGL 279	Technical Communications I	3
PE	Physical Education	1
Humanities Elective		3
TOTAL		**17**

Junior Year

First Semester

ENGL 289	Technical Communications II	3
CHEM 292	Chemistry Outreach	1
CHEM 342	Physical Chemistry I	3
Humanities or Social Science Electives[1]		5
Elective		3
TOTAL		**15**

Second Semester

CHEM 343	Exp. Physical Chemistry	2
CHEM 344	Physical Chemistry II	3
CHEM 370	Chemical Literature	1
Elective		4
Adv. Chem. Requirement		5
TOTAL		**15**

Senior Year

First Semester

Electives	6
Adv. Chem. Requirement[2]	10
TOTAL	**16**

Second Semester

Electives	9
Adv. Chem. Requirement[2]	6
TOTAL	**15**

---

[1] A minimum of sixteen (16) credit hours of university-approved humanities and social sciences are required, with a minimum of six (6) hours in humanities and six (6) hours in social sciences.

[2] Twenty-one (21) advanced chemistry credits must be taken from the following chemistry (CHEM) courses: either 480 or 482; either 420 or 426; and 424, 434, 435, 452, 453 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.

Freshman Year

First Semester

ENGL 101	Freshman English	3
CHEM 112	General Chemistry	3
CHEM 113	Exp. General Chemistry I	1
PE	Physical Education	1
MATH	Math Elective (Math102 or higher)	3
Gen Ed Social Science Elective		3
Gen Ed Humanities Elective		3
TOTAL		**17**

Second Semester

CHEM 114	General Chemistry II	3
CHEM 115	Exp. General Chemistry II	1
PE	Physical Education	1
MATH	Math Elective	3
Gen Ed Humanities Elective[1]		3
Gen Ed Social Science Elective		3
TOTAL		**14**

Sophomore Year

First Semester

CHEM 232	Analytical Chemistry I	3
CHEM 233	Exp. Analytical Chemistry	1
CHEM 292	Chemistry Outreach	1
CHEM 326	Organic Chemistry I	3
CHEM 327	Exp. Organic Chemistry I	2
ENGL 279	Technical Communications I	3
PHYS 111	Introductions to Physics I	3
PHYS 112	Intro. To Physics I Lab	1
TOTAL		**17**

Second Semester

CHEM 182	Chemical Computations	2
CHEM 252	System. Inorganic Chemistry	3
CHEM 328	Organic Chemistry II	3
CHEM 329	Exp. Organic Chemistry II	2
PHYS 113	Introduction to Physics II	3
Elective		4
TOTAL		**17**

Junior Year

First Semester

ENGL 289	Technical Communications II	3
CHEM 292	Chemistry Outreach	1
Advanced Chemistry Requirement[2]		3
Advanced Elective[3]		3
Humanities or Social Science Electives		5
TOTAL		**15**

Second Semester

CHEM 340	Fundamentals of Physical Chem	3
CHEM 370	Chemical Literature	1
Advanced Elective[3]		3
Electives		9
TOTAL		**16**

Senior Year

First Semester

Advanced Chemistry Requirement[2]		3
Advanced Electives[3]		6
Electives		7
TOTAL		**16**

Second Semester

Advanced Chemistry Requirement[2]		3
Advanced Elective[3]		3
Electives		10
TOTAL		**16**

Advanced Chemistry Requirement:
Chem 460, 480, and 332 or 482 must all be taken to fulfill this requirement.

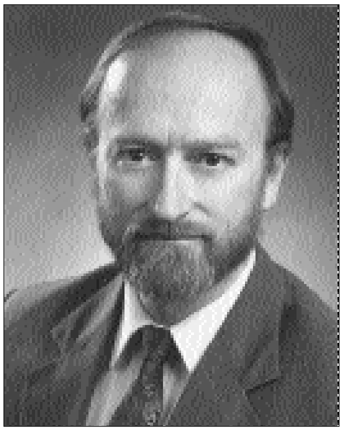
Advanced electives:
Fifteen (15) credits of electives in courses numbered 300 or higher are required; a minimum of six (6) credits of these must be taken from any combination of math, science, and/or engineering courses.

---

[1] A minimum of 16 credit hours of university-approved humanities and social sciences are required, with a minimum of six (6) hours in humanities and six (6) hours in social sciences.

[2] Chem 460, 480, and 332 or 482 must all be taken to fulfill this requirement.

[3] Fifteen (15) credits of electives in courses numbered 300 or higher are required; a minimum of six (6) credits of these must be taken from any combination of math, science, and/or engineering courses.



Stanley M. Howard, Ph.D., P.E.
Chair and Professor, Department of Materials and Metallurgical Engineering

Distinguished and Fuerstenau Professor
Kenneth N. Han, Ph.D.

Professor
Fernand D.S. Marquis, Ph.D., P.E.
Glen A. Stone, Ph.D.

Associate Professor
Jon J. Kellar, Ph.D.

Research Scientist III
William Cross, Ph.D.

Research Professor Emeritus
Amos L. Lingard, Ph.D.

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 metal 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 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, Langnuir-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.

MATERIALS & METALLURGICAL ENGINEERING CURRICULUM/CHECKLIST

FRESHMAN YEAR

First Semester

MATH 123	Calculus I[5]	4
CHEM 112	Gen. Chem.[6]	3
ENGL 101	Freshman Eng. I[1]	3
GE 115	Professionalism in Eng & Sci	2
PE	Physical Education	1
Gen Ed Humanities or Social Science Elective[3, 4]		3
TOTAL		**16**

Second Semester

MATH 124	Calculus II	4
CHEM 114	Gen. Chem. II[6]	3
PHYS 211	University Physics I	3
CHEM 113	Exp. Gen. Chem.	1
GE 117	Prof & Pract Eng & Sci	2
PE	Physical Education	1
Gen Ed Humanities or Social Science Elective[3, 4]		3
TOTAL		**17**

SOPHOMORE YEAR

First Semester

MET 232	Properties of Materials	3
MET 231	Properties of Materials Lab	1
MATH 231	Ord. Diff. Equations	4
PHYS 213	University Physics II	3
CHEM 115	Experimental Gen. Chem. II	1
ENGL 279	Technical Communications I[1]	3
Gen Ed Humanities or Social Science Elective[3, 4]		3
TOTAL		**18**

Second Semester

MATH 225	Calculus III	4
EM 217	Statics & Strengths of Materials	4
PHYS 214	University Physics II Lab	1
MET 220	Min. Proc. & Resources Recov.	3
MET 221	Min. Proc. & Resources Lab	1
Gen Ed Humanities or Social Science Elective[3, 4]		4
TOTAL		**17**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II[2]	3
MET 320	Met. Thermo.	4
MET 330	Physics of Metals	3
MET 331	Physics of Metals Lab	1
MET 351	Engineering Design I	1
EE 301	Intro. Systems Anal.	4
TOTAL		**16**

Second Semester

MET 332	Thermomechanical Treatment	3
MET 352	Engineering Design II	1
MATH 374	Appl. Numeric. Anal.	3
MET	Directed Elective	3
MET	Set A or B	7
TOTAL		**17**

SENIOR YEAR

First Semester

MET 422	Transport Phenomena	4
MET 440	Mechanical Metallurgy	4
MET 433	Process Control	3
MET 451	Engineering Design III	2
IENG 301	Basic Engineering Economics	2
Science Elective		3
TOTAL		**18**

Second Semester

MET/ME443	Composite Materials	3
MET 452	Engineering Design IV	1
MET 434	Process Control Lab	1
Elective		5
MET	Set A or B	7
TOTAL		**17**

136 semester credits required.

[1] Satisfies General Education Goal #1
[2] Satisfies General Education Goal #2
[3] Satisfies General Education Goal #3
[4] Satisfies General Education Goal #4
[5] Satisfies General Education Goal #5
[6] Satisfies General Education Goal #6

Set A		
MET 310	Aqueous Proc	3
MET 311	Aqueous Proc Lab	1
Science Elective		3
OR		
Set B		
MET 321 High Temp Proc		4
Humanities or Social Science Elective		3

Mikhail Foygel, Ph.D.
Chair and Professor, Department of Physics

Professor
T. Ashworth, Ph.D.

Associate Professor
Robert L. Corey, Ph.D.
Andrey Petukhov, Ph.D.

Professor Emeritus
Don C. Hopkins, Ph.D.
Robert D. Redin, Ph.D.

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 which 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 which 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.

A minor in physics requires a minimum of 18 hours of courses in physics which must include PHYS 213 and at least 15 hours of physics courses numbered above 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. See your 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

Freshman Year

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry I	3
CHEM 113	Experimental General Chemistry I	1
ENGL 101	Freshman English I	3
GE 112	Personal Computer Programming (Preferred)	2
	OR	
GE 111	FORTRAN Programming	2
PE	Physical Education	1
Elective		3
TOTAL		**17**

Second Semester

MATH 124	Calculus II	4
PHYS 211	University Physics I	3
PE	Physical Education	1
CHEM 114	General Chemistry II	3
CHEM 115	Experimental General Chemistry II	1
CSC 150	Computer Science I	3
TOTAL		**15**

Sophomore Year

First Semester

MATH 225	Calculus III	4
PHYS 213	University Physics II	3
PHYS 214	University Physics II Lab	1
ENGL 279	Tech Comm I	3
Elective		3
TOTAL		**14**

Second Semester

MATH 231	Ordinary Differential Equations	4
EE 211	Intro. to Electrical Engineering I	4
ENGL 289	Technical Communications II	3
Electives		6
TOTAL		**17**

At the end of the sophomore year twelve (12) hours of electives must include six (6) hours in humanities (in 2 disciplines or in a sequence of foreign language courses) and six (6) hours in social sciences (in 2 disciplines).

Junior Year

First Semester

MATH 332	Partial Differential Equations	3
PHYS 341	Thermodynamics	3
PHYS 312	Experimental Physics I	2
CENG 241	Real-Time Comp. Appl.	4
Elective		3
TOTAL		**15**

Second Semester

MATH 315	Matrices and Linear Algebra	4
PHYS 451	Classical Mechanics	4
PHYS 471	Quantum Mechanics	4
PHYS 343	Statistical Physics*	4
PHYS 314	Experimental Physics II	2
TOTAL		**18**

Senior Year

First Semester

PHYS 421	Electricity & Magnetism	4
PHYS 361	Optics*	3
PHYS 412	Advanced Projects	2
PHYS 481	Mathematical Physics*	4
Electives		4
TOTAL		**17**

Second Semester

PHYS 433	Nuclear & Particle Physics*	3
PHYS 439	Solid State & Semiconductor Physics*	4
PHYS 414	Advanced Projects II	2
Electives		6
TOTAL		**15**

Curriculum Notes

The electives must contain a minimum of 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.

PHYS 481 effective Fall 1999.

* Courses offered alternate years.

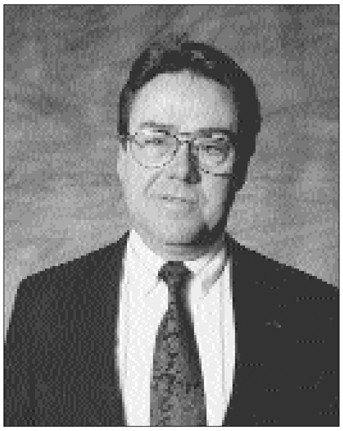
COMPUTER ENGINEERING

ELECTRICAL ENGINEERING

MECHANICAL ENGINEERING

INDUSTRIAL ENGINEERING

MATHEMATICS



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 teams and the Tech Multimedia Group 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 which 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 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
Interim Dean, College of Systems Engineering

Larry A. Simonson, Ph.D., P.E.
Chair and Professor, Department of Electrical and Computer Engineering

Professor
Michael J. Batchelder, Ph.D.
Executive Director, Center of Excellence for Advanced Manufacturing and Production

Assistant Professor
Brian T. Hemmelman, Ph.D.
Timour Paltashev, Ph.D.

Professor Emeritus
A.L. Riemenschneider, Ph.D., P.E.

Supporting Faculty

Professor
Harold E. Carda, M.N.S.
Edward M. Corwin, Ph.D.
Abul R. Hasan, Ph.D.
Larry G. Meiners, Ph.D., P.E.
Roger L. Opp, M.S.

Associate Professor
Neil F. Chamberlain, Ph.D.
Antonette M. Logar, Ph.D.
Manuel Penaloza, Ph.D.

Assistant Professor
James W. Cote, Ph.D.
David H. Grow, M.S.

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 coursework 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.

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.
- 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 by graduate assistants 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 thin-film electronic materials, solid state devices, analog and digital systems, and microprocessor development.

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 COMPUTER ENGINEERING COURSES

Classes that are typically offered every semester include CENG 241, CENG 244, CENG 314, CENG 342, CENG 491, and CENG 492.

Classes that are typically offered every fall semester include, CENG 444, and CENG 448. Classes that are typically offered every spring semester include CENG 442, CENG 446, and CENG 472.

Classes that are typically offered in the spring semester of odd numbered years, for example spring 1997, include CENG 447. Classes that are typically offered in the spring semester of even numbered years, for example spring 1998, include CENG 420.

COMPUTER ENGINEERING CURRICULUM/CHECKLIST

FRESHMAN YEAR

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry	3
ENGL 101	Freshman English I	3
CHEM 113	Exper. Gen. Chemistry	1
GE 112	PC Programming	2
PE	Physical Education (1)	1
Gen Ed Humanities or Social Science Elective		3
TOTAL		**17**

Second Semester

MATH 124	Calculus II	4
CENG 241	Real-Time Comp. Appl.	4
CSC 150	Computer Science I	3
PHYS 211	University Physics I	3
PE	Physical Education (1)	1
Gen Ed Humanities or Social Science Elective		3
TOTAL		**18**

SOPHOMORE YEAR

First Semester

EE 211	Intro. to Electrical Eng. I	4
MATH 231	Ord. Diff. Equations	4
PHYS 213	University Physics II	3
PHYS 214	University Physics II Lab	1
Gen Ed Humanities or Social Science Elective		3
TOTAL		**15**

Second Semester

ENGL 279	Tech. Communications I	3
EE 212	Intro. to Electrical Eng. II	4
CSC 250	Computer Science II	4
CENG 314	Assembly Language or	3
Gen Ed Humanities or Social Science Elective		3
TOTAL		**17**

JUNIOR YEAR

First Semester

ENGL 289	Tech. Communications II	3
CENG 244	Intro. to Digital Systems	4
CSC 251	Finite Structures	4
MATH 225	Calculus III	4
EM 219	Engineering Mechanics	4
Humanities or Social Science Elective		3
TOTAL		**19**

Second Semester

EE 312	Signals	3.5
EE 321	Electronics I	4
MATH 281	Probability & Statistics I	3
CSC 371	Data Structures	4
CENG 342	Digital Systems	4
TOTAL		**18.5**

SENIOR YEAR

First Semester

EE 311	Systems	3.5
CSC 477	Software Engineering	3
IENG 301	Engineering Economics	2
CENG 491	Comp. Eng. Design I	1
CENG	Elective (2)	4
CENG	Elective (2)	4
TOTAL		**17.5**

Second Semester

CENG 492	Comp. Eng. Design II	2
CENG 472	Operating Systems	3
	OR	
CSC 472	Operating Systems	
CENG	Elective (2)	4
Humanities or Social Science Elective		4
Free Elective (3)		1
TOTAL		**14**

Curriculum Notes

(1) 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.

(2) 12 CENG elective credits are required. Total design content of CENG electives must be a minimum of 6 hours. Half of the credits in each of the CENG electives listed below are design credits.

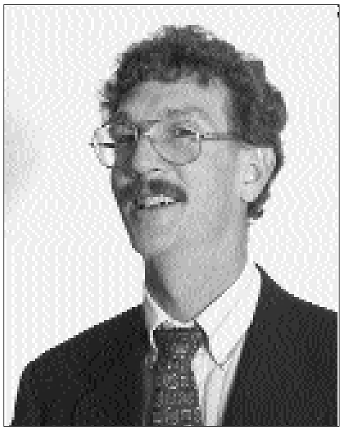
(3) A free elective is any college level course 100 level or above which is acceptable towards an engineering or science degree. Military Science courses, 100 level and above, apply as free electives only; substitution for departmental, humanities, or social science electives is not permitted.

CENG ELECTIVES

EE 322	Electronics II	3
EE 421	Communications Systems	3
EE 451	Control Systems	3
CENG 420	Design of Digital Signal Processing Systems	3
CENG 442	Microprocessor Design	3
CENG 444	Computer Networks (credit for only one of CENG 444 or CSC 441 may be used)	3
CENG 446	Advanced Computer Architectures (credit for only one of CENG 446 or CSC 440 may be used)	3
CENG 447	Computer Applications	3
CENG 448	VLSI Design	3
CSC 440	Advanced Digital Systems	3
CSC 441	Data Communications	4
CSC 451	Intro. to Artificial Intelligence	3
CSC 471	Theory of Compilers	3
CSC 464	Introduction to Digital Image Processing & Computer Vision	3

A maximum of 4 co-op credits may be used towards the CENG elective requirement if a written request 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 FE (Fundamentals of Engineering) exam prior to graduation



Donald A. Teets, D.A.
Chair and Associate Professor, Department of
Mathematics and Computer Science

Professor
Harold E. Carda, M.N.S.
Edward M. Corwin, Ph.D.
Roger L. Opp, M.S.

Associate Professor
Antonette M. Logar, Ph.D.
Manuel Penaloza, Ph.D.
John M. Weiss, Ph.D.

Assistant Professor
Jeffrey S. McGough, Ph.D.

Personalized Resources for Individualized Math Education (PRIME) Coordinator
Donna Kliche, M.S.

Professor Emeritus
Ronald C. Weger, M.S., Ph.D.

GENERAL PREREQUISITES

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. 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 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.

COMPUTER SCIENCE MAJOR

Students majoring in Computer Science will use the Computer Science curriculum below. In addition, electives may be chosen to satisfy the requirements for a minor in a field of science. Any student desiring a minor 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.

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.

A Computer Science major must complete a minimum of 16 credits in Humanities and Social Science with at least 6 credit hours in Humanities and at least 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.

The sample schedule below 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.

MINOR IN COMPUTER SCIENCE

The requirements for a minor in Computer Science are CSC 150, CSC 250, CSC 251, CSC 314, CSC 371, and CENG 244.

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.

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 this double major should plan to take the courses listed in the Computer Science curriculum, as well as the advanced mathematics courses Math 313 (Abstract Algebra), Math 400 (Undergraduate Research), Math 421 (Intro to Complex Analysis), and Math 423-424 (Advanced Calculus I, II). Computer Science electives should be chosen from a list of electives approved for the double major. Students should see their advisors for a complete list of requirements for the double major.

COMPUTER SCIENCE CURRICULUM/CHECKLIST

FRESHMAN YEAR

First Semester

ENGL 101	Freshman English	3
CHEM 112	General Chemistry	3
MATH 123	Calculus I	4
CSC 150	Computer Science I	3
Gen Ed Humanities or Social Science Elective		3
TOTAL		**16**

Second Semester

MATH 124	Calculus II	4
PHYS 211	University Physics I	3
CSC 250	Computer Science II	4
CSC 251	Finite Structures	4
PE	Physical Education	1
Science lab (PHYS or CHEM)		1
TOTAL		**17**

SOPHOMORE YEAR

First Semester

MATH 225	Calculus III	4
CSC 314	Assembly Language	4
CENG 244	Intro. to Digital Systems	4
PE	Physical Education	1
Gen Ed Humanities or Social Science Elective		3
TOTAL		**16**

Second Semester

ENGL 279	Technical Communications I	3
CSC 341	Computer Org. & Design	4
CSC 371	Data Structures	4
Gen Ed Humanities or Social Science Elective		6
TOTAL		**17**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II	3
MATH 231	Ord. Diff. Equations	4
PHYS 213	University Physics II	3
CSC 440	Advanced Digital Systems	3
*Elect. or CSC Elect.		3
TOTAL		**16**

Second Semester

MATH 315	Matrices & Linear Algebra	4
MATH 481	Engineering Statistics	2
MATH 482	Engineering Statistics II	2
CSC 370	Prog. Lang. Concepts	3
*Elect. or Science Elect.		4
TOTAL		**15**

SENIOR YEAR

First Semester

CSC 477	Software Engineering	3
CSC 461	Numerical Analysis	3
CSC 484	Database Mgt.	3
*Elect. or CSC Elect.		6
TOTAL		**15**

Second Semester

CSC 472	Operating Systems	4
CSC 478	Senior Design	3
HUM 375	Computers in Society	3
*Elect. or CSC Elect.		6
TOTAL		**16**

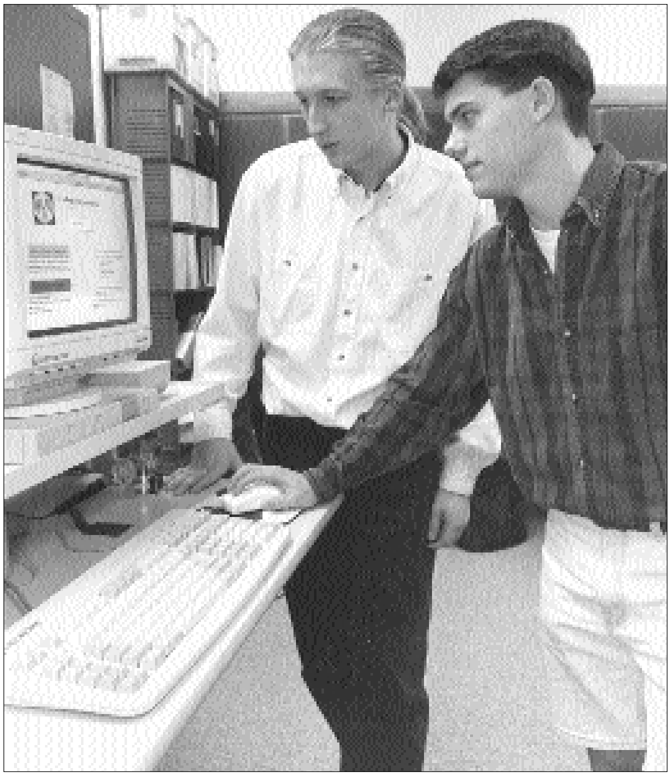
128 semester credits required.

Curriculum Notes

- It is intended that CSC 477 and CSC 478 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 478, Senior Design. The overall results of this exam will be used to assess the Computer Science program.

* 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 hours must be in Humanities and at least six hours must be in Social Sciences. This may include HUM 375 which is required.
2. Three (3) credit hours of Humanities and three (3) credit hours of Social Science must be completed within the first 48 hours, and six credit hours of each within the first 64 hours.
3. One additional lecture course from either Physics or Chemistry and one laboratory course from either Physics or Chemistry. (These courses may not be chosen from PHYS 111 or 185 or CHEM 100, 106, 107 or 108.)
4. Thirty (30) total hours in Humanities, Social Science, or other disciplines that serve to broaden the background of the student. This may include all English classes, Physical Education, and those courses used to meet requirement (1) above.
5. A minimum of three Computer Science elective courses numbered 300 or above must be taken. Co-op credit may be substituted for one Computer Science elective. Independent study courses may not be used to satisfy the Computer Science elective requirement.



COMPUTER SCIENCE

Larry A. Simonson, Ph.D., P.E.
Chair and Professor, Department of Electrical and Computer Engineering

Professor
Michael J. Batchelder, Ph.D.
  Executive Director, Center of Excellence for Advanced Manufacturing and Production
Abul R. Hasan, Ph.D.
Larry G. Meiners, Ph.D., P.E.

Associate Professor
Neil F. Chamberlain, Ph.D.

Assistant Professor
James W. Cote, Ph.D.
David H. Grow, M.S.
Brian T. Hemmelman, Ph.D.

Professor Emeritus
Cyrus W. Cox, M.S., P.E.
William L. Hughes, Ph.D., P.E.
Richard D. McNeil, M.S., P.E.
A.L. Riemenschneider, Ph.D., P.E.

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 coursework 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.

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.
- 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 by graduate assistants 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 thin-film electronic materials, solid state devices, analog and digital systems and microprocessor development.

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 301, EE 321, EE 341, EE 491, and EE 492.

Classes that are typically offered every fall semester include EE 311, EE 330, EE 381, and EE 421.

Classes that are typically offered every spring semester include EE 312, EE 322, EE 362, EE 431, EE 451, EE 461, EE 480, and EE 481.

Classes that are typically offered in the fall semester of even numbered years, for example fall 1998, include EE 482.

Classes that are typically offered in the fall semester of odd numbered years, for example fall 1999, include EE 432.

ELECTRICAL ENGINEERING CURRICULUM/CHECKLIST

FRESHMAN YEAR

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry	3
ENGL 101	Freshman English I	3
CHEM 113	Exp. General Chemistry	1
GE 112	PC Programming	2
Gen Ed Humanities or Social Science Elective		3
PE	Physical Education (1)	1
TOTAL		**17**

Second Semester

MATH 124	Calculus II	4
PHYS 211	University Physics I	3
PE	Physical Education (1)	1
CSC 150	Computer Science I	3
CENG 241	Real Time Computer Appl.	4
Gen Ed Humanities or Social Science Elective		3
TOTAL		**18**

SOPHOMORE YEAR

First Semester

EE 211	Intro. to Elect. Eng. I	4
MATH 231	Ordinary Diff. Equations	4
PHYS 213	University Physics II	3
PHYS 214	University Physics II Lab	1
Gen Ed Humanities or Social Science Elective		3
TOTAL		**15**

Second Semester

ENGL 279	Technical Communications I	3
EE 212	Intro. to Elect. Eng. II	4
MATH 225	Calculus III	4
CENG 244	Intro. to Digital Systems	4
Gen Ed Humanities or Social Science Elective		3
TOTAL		**18**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II	3
EE 311	Systems	3.5
EE 321	Electronics I	4
EE 381	Elect. & Magnetic Fields	3
EM 219	Statics and Dynamics	4
TOTAL		**17.5**

Second Semester

EE 312	Signals	3.5
EE 322	Electronics II	4
EE 330	Energy Systems	4
EE 362	E&M Properties of Matls	3
Approved Math Elective (2)		3
TOTAL		**17.5**

SENIOR YEAR

First Semester

PHYS 341	Thermodynamics	3
EE 491	Elect. Engr. Design I	1
EE	Elect. Engr. Elective (3)	4
EE	Elect. Engr. Elective (3)	4
IENG 301	Engineering Economics	2
Free Elective (5)		3
TOTAL		**17**

Second Semester

EE 480	Applied Electromagnetics	3
EE 492	Elect. Engr. Design II	2
EE	Elect. Engr. Elective (3)	4
Technical Elective (4)		3
Humanities or Social Science Elective		3
TOTAL		**16**

136 semester hours are required for graduation.

Curriculum Notes

(1) Music Ensemble courses may be substituted for Physical Education courses for qualified students. Any other substitutions must be approved in advance by the Physical Education Department Chair.

(2) MATH 315, 333, 374, and 481 are approved electives

(3) Total design content of electrical engineering electives must be a minimum of six hours. CENG 342, 420, 442, 444, 446, 447, and 448 each have two design credits and are acceptable EE electives. A maximum of 4 co-op credits may be used towards the EE elective requirement if a written request 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 6 co-op credits may be used for the EE degree).

(4) A technical elective is any 200 level or above science or engineering course which 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 6 co-op credits may be used for the EE degree).

(5) A free elective is any college level course 100 level or above which 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.

Electrical Engineering students are required to take the FE (Fundamentals of Engineering) exam prior to graduation.

Stuart D. Kellogg, Ph.D., P.E.
Pietz Professor and Industrial Engineering
Program Coordinator

Associate Professor
Frank J. Matejcik, Ph.D.

Assistant Professor
Carter J. Kerk, Ph.D.

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 the following:

- A working knowledge of the fundamental tools of science, engineering, and the humanities and social sciences on which to build systematic investigative processes.
- Expertise in applying scientific and analytical methods to a variety of situations and engineering based problems including system design utilizing the latest hardware and software in computational technology.
- A high level of competence in written and oral communication skills which are required to pursue a professional career with excellence and success.
- The ability to coordinate individual skills and thoughts with others of different backgrounds and opinions.
- The ability to have organizational skills and confidence to provide flexibility and adaptability in our ever-changing world and technological environment.

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

Freshman Year

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry	4
Gen Ed Humanities or Social Science Elective		3
PE	Physical Education*	1
ENGL 101	Freshman English I	4
CHEM 113	Exp. General Chemistry	1
GE 115	Professionalism in Engr & Sci	2
TOTAL		**17**

Second Semester

MATH 124	Calculus II	4
PHYS 211	University Physics I	3
PE	Physical Education	1
GE 117	Professionalism in Engr & Sci	2
PYSC 101	General Psychology	3
Gen Ed Humanities or Social Science Elective		3
TOTAL		**16**

Sophomore Year

First Semester

EM 219	Engr Mechanics	4
ENGL 279	Technical Communications I	3
MATH 225	Calculus III	4
IENG 381	Probabil. Theory& Stats. I	3
PHYS 213	University Physics	3
PHYS 214	University Physics Lab.	1
TOTAL		**18**

Second Semester

IENG 382	Probability & Statistics	3
MATH 231	Ord. Diff. Equations	4
ACCT 211	Principles of Accounting II	3
IENG 302	Engineering Economics	3
Math/Science Elective		3
Gen Ed Humanities or Social Science Elective		3
TOTAL		**19**

Junior Year

First Semester

ENGL 289	Technical Communications II	3
IENG 311	Work Methods & Measurements	3
ME 261	Intro. to Manufacturing	3
IENG 485	Stat. Quality Control & Reliability	3
IENG 362	Stochastic Models	3
Humanities or Social Science Elective		2
TOTAL		**17**

Second Semester

IENG 441	Simulation	3
CSC 361	Linear Optimization	3
IENG 345	Entrepreneurship	4
IENG 321	Human Factors Engineering	3
EE 301	Introductory Circuits	4
TOTAL		**17**

Senior Year

First Semester

IENG 425	Production& Operation Mgt.	3
IENG 460	Industrial Information Systems	3
IENG 471	Facilities Planning	3
IENG 478	Senior Design Project I	3
MET 232	Properties of Materials	3
Department Elective		3
TOTAL		**18**

Second Semester

IENG 366	Management Processes	3
IENG 479	Senior Design Project II	3
IENG 475	Comp. Controlled Manuf.	3
Humanities or Social Science Elective		2
Department Elective		3
TOTAL		**14**

Total credits 136

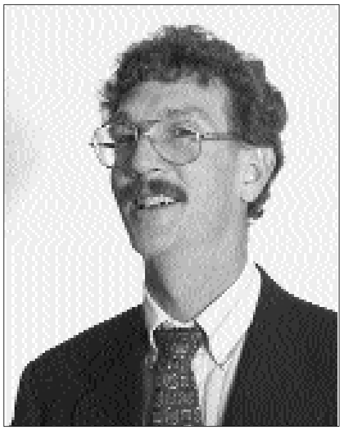
Curriculum Notes

* 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 hours must be in Humanities and at least six hours must be in Social Sciences. This may include PSYC 101 which is required.
2. Six hours of Humanities or Social Science must be included in the list of approved Cultural Diversity courses.
3. Three hours of Humanities and three hours of Social Science must be completed within the first 32 hours of study. At least six hours of Humanities and six hours of Social Science must be completed within the first sixty-four (64) hours of study.
4. At least three 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 hours of each must be completed in the first thirty-two (32) hours of study. At least six 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.

TECHFact: Rapid City has a population of approximately 55,000. It is small enough to find your way around easily, yet large enough to provide plenty of entertainment and part-time job opportunities.



Donald A. Teets, D.A.
Chair and Associate Professor, Department of
Mathematics and Computer Science

Professor
Harold E. Carda, M.N.S.
Edward M. Corwin, Ph.D.
Roger L. Opp, M.S.

Associate Professor
Janet Burgoyne, D.A.
Antonette M. Logar, Ph.D.
Roger W. Johnson, Ph.D.

Assistant Professor
Julie J. Dahl, M.S.
Jeffrey S. McGough, Ph.D.
Kyle Riley, Ph.D.

Instructor
Laura M. Geary, M.S.
Donna L. Johnson, M.S.

Personalized Resources for Individualized Math Education (PRIME) Coordinator
Donna Kliche, M.S.

Professor Emeritus
Dean C. Benson, Ph.D.
Carl A. Grimm, M.A.
Clyde L. Harbison, M.A.

GENERAL PREREQUISITES

The Department of Mathematics and Computer Science offers a Bachelor of Science Degree in Mathematics. 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.

Before registering for any course in Mathematics, a student must either have met all prerequisites, enrolled in all co-requisites, passed the appropriate placement examinations, or have obtained permission from the Chair of the Mathematics and Computer Science Department. The prerequisite for MATH 120, Trigonometry, is a grade of "C-" or better in MATH 102, College Algebra III, or MATH 115, Pre-Calculus Mathematics, or an acceptable score on the Algebra Placement Examination, or equivalent transfer credit from an accredited college or university. The prerequisite for MATH 123, Calculus I, is a grade of "C-" or better in MATH 1023, College Algebra III, or in Math 115, Pre-Calculus Mathematics, or an acceptable score on the Algebra Placement Examination, or equivalent transfer credit from an accredited college or university. Additionally, students enrolling in MATH 123, Calculus I, must have passed MATH 1202, Trigonometry II, with a grade of "C-" or better or have passed the Trigonometry Placement Exam, or enroll concurrently in MATH 1201 and 1202. The prerequisites for MATH 124, Calculus II, are a grade of "C-" or better in Calculus I or equivalent transfer credit from an accredited college or university, and the student must have passed MATH 1202 with a grade of "C-" or better or have passed the Trigonometry Placement Examination. Both 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 095 may not be used for credit toward any engineering or science 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 are planned to 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 095, MATH 1021, MATH 1022, MATH 1023, MATH 1201, MATH 1202, MATH 123, MATH 124, MATH 225, and MATH 231 during the summer.

Classes that are typically offered every semester include MATH 095, MATH 1021, MATH 1022, MATH 1023, MATH 115, MATH 1201, , MATH 1202, MATH 123, MATH 124, MATH 225, MATH 231, and MATH 374.

Classes that are typically offered every fall semester include MATH 281, MATH 381, MATH 332, and MATH 485.

Classes that are typically offered every spring semester include MATH 382, MATH 315, and MATH 481-82.

Classes that are typically offered in the fall semester of odd numbered years, for example fall 1999, include MATH 391 and MATH 423.

Classes that are typically offered in the spring semester of even numbered years, for example spring 2000, include MATH 140, MATH 424, and MATH 687.

Classes that are typically offered in the fall semester of even numbered years, for example fall 2000, include MATH 491 and MATH 313.

Classes that are typically offered in the spring semester of odd numbered years, for example spring 2001, include Math 241 and MATH 421.

MATHEMATICS MAJOR

Students majoring in Mathematics will use the accompanying Applied Mathematics curriculum above. In addition, electives may be chosen to satisfy the requirements for a minor in a field of science. Any student desiring a minor 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 481-82, MATH 687, CSC 361, and CSC 461. Information concerning these examinations can be obtained from the Department of Mathematics and Computer Science.

The primary goal of the Applied 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 and algebra. We expect them to attain a basic understanding of statistics, numerical analysis, and differential equations. 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. It also means our graduates must be prepared to continue learning throughout their careers. We further expect our graduates to develop the ability to communicate ideas effectively, both orally and in writing.

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 16 credit hours in Humanities and Social Science with at least 6 credit hours in Humanities and at least 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.

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 124, MATH 225, MATH 423 and 12 credit hours of mathematics electives at the 200 or higher level for a total of at least 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 seeking this double major should plan to take the courses listed in the Computer Science curriculum, as well as the advanced mathematics courses Math 313 (Abstract Algebra), Math 400 (Undergraduate Research), Math 421 (Intro to Complex Analysis), and Math 423-424 (Advanced Calculus I, II). Computer Science electives should be chosen from a list of electives approved for the double major.

For the Bachelor of Science in Mathematics, a student must:

1) take all of the courses listed in the Applied Mathematics Curriculum;
2) take four technical electives (technical electives are described in the accompanying Curriculum Notes); and
3) have a Departmental Grade Point Average of at least 2.00 in all Mathematics courses numbered 300 or higher. (Courses taken more than once will have only the higher grade counted for computing the Departmental Grade Point Average).

FRESHMAN YEAR

First Semester

ENGL 101	Freshman English I	3
CHEM 112	General Chemistry	3
MATH 123	Calculus I	4
CSC 150	Computer Science I	3
PE	Physical Education	1
*Elect./**Tech. Elec.		3
TOTAL		**17**

Second Semester

MATH 124	Calculus II	4
PHYS 211	University Physics I	3
PE	Physical Education	1
*Elect./**Tech. Elect.		7
TOTAL		**15**

SOPHOMORE YEAR

First Semester

MATH 225	Calculus III	4
CSC 251	Finite Structures	4
PHYS 213	University Physics II	3
*Elect./**Tech. Elect.		5
TOTAL		**16**

Second Semester

MATH 231	Ord. Diff. Equations	4
MATH 315	Matrices and Linear Algebra	4
ENGL 279	Tech. Comm. I	3
*Elect./**Tech. Elect.		5
TOTAL		**16**

JUNIOR YEAR

First Semester

MATH 332	Part. Diff. Equations	3
MATH 313	Abstract Algebra	3
MATH 391	Studies in Mathematics I	3
ENGL 289	Tech. Comm. II	3
*Elect./**Tech. Elect.		4
TOTAL		**16**

Second Semester

MATH 421	Intro. to Complex Analysis	3
MATH 498	Engineering Statistics I	2
MATH 499	Engineering Statistics II	2
*Elect./**Tech. Elect.		9
TOTAL		**16**

SENIOR YEAR

First Semester

MATH 423	Advanced Calculus I	4
MATH 491	Studies in Mathematics II	3
CSC 461	Numerical Analysis	3
*Elect./**Tech. Elect.		6
TOTAL		**16**

Second Semester

MATH 400	Undergraduate Research	1
MATH 424	Advanced Calculus II	4
*Elect./**Tech. Elect.		11
TOTAL		**16**

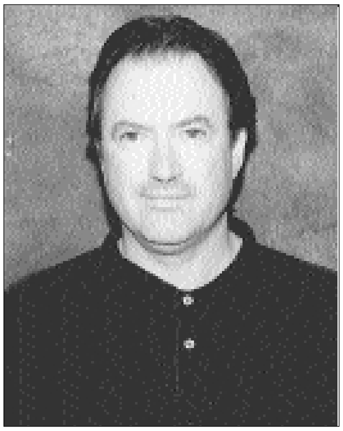
Total No. Credits Required 128.

Curriculum Notes

* Sixteen (16) semester hours of electives must be in Humanities and Social Science. At least six hours must be in Humanities and at least six hours must be in Social Science. See Humanities and Social Science sections of this catalog for courses in each area. Three credits of Humanities and three credits of Social Science must be completed within the first 48 hours, and six credit hours of each within the first 64 hours.

** The student must complete four technical elective courses satisfying the following:

1) One additional lecture course from either Physics or Chemistry and one laboratory course from either Physics or Chemistry (These courses may not be chosen from PHYS 111, 185, or CHEM 100, 106, 107 or 108); and
2) two more courses from Mathematics, Physics or Computer Science numbered 200 or higher. These may not be independent studies.



Michael A. Langerman, Ph.D.
Chair and Professor, Department of Mechanical Engineering

Professor
Daniel F. Dolan, Ph.D.
Director of Academic Programs, Center of Excellence for Advanced Manufacturing and Production
Christopher H.M. Jenkins, Ph.D., P.E.
Lidvin Kjerengtroen, Ph.D.
Wayne B. Krause, Ph.D., P.E.
Interim Dean, College of Systems Engineering

Associate Professor
Gregory A. Buck, Ph.D., P.E.
Vojislav D. Kalanovic, Ph.D.

Assistant Professor
Sanjeev K. Khanna, Ph.D.

Professor Emeritus
Chao-Wang Chiang, Ph.D., P.E.
William N. Groves, M.S., P.E.
Richard L. Pendleton, Ph.D., P.E.
Lester W. Snyder Jr., M.S., P.E.

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: thermal science and energy, mechanical systems and design, and manufacturing and controls. Beyond this basic foundation, the curriculum also develops:

The various aspects of engineering design including all aspects of design theory and teamwork.

- An effective integration of computer technology.
- Communication skills and effective presentations.
- 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. Thermal Science/Energy, e.g., heating/air conditioning and power systems design.
2. Mechanical Systems/Design, e.g., structures, vibrations, and machine design.
3. Manufacturing/Controls, e.g., design, development, and manufacture of diverse equipment and processes.

Our graduates are expected to be able to:

1. Apply the fundamental tools of science, engineering, and the humanities and social sciences to systematic investigative processes.
2. Utilize the decision-making process (often iterative) in which the basic sciences and mathematics, and engineering sciences, are applied to convert resources optimally to meet a stated objective.
3. Communicate at a high level of competence both in written and oral communication.
4. Coordinate individual skills and thoughts with others of different backgrounds and opinions.
5. Have the confidence, flexibility, and organizational skills to adapt in a diverse and changing world and technological environment.

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 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 have been 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, and fluid mechanics, and heat transfer codes on the workstation facilities.

MECHANICAL ENGINEERING CURRICULUM/CHECKLIST

FRESHMAN YEAR*

First Semester

MATH 123	Calculus I	4
CHEM 112	General Chemistry	3
CHEM 113	Exp. General Chemistry	1
GE 115	Prof. in Engineering and Science	2
ENGL 101	Freshman English I	3
PE	Phys. Ed.**	1
Gen Ed Humanities or Social Science Elective		3
TOTAL		**17**

Second Semester

MATH 124	Calculus II	4
PHYS 211	University Physics I	3
PHYS 214	University Physics Lab.	1
GE 117	Prof. in Engineering and Science	2
PE	Phys. Ed.	1
Gen Ed Humanities or Social Science Elective		6
TOTAL		**17**

SOPHOMORE YEAR

First Semester

EM 214	Statics	3
ENGL 279	Technical Communications I	3
MATH 225	Calculus III	4
ME 260	Intro. to Engr. Design	1
ME 261	Intro. to Manufacturing	3
Gen Ed Humanities or Social Science Elective		3
TOTAL		**17**

Second Semester

ME 221	Dynamics of Mechanisms	3
ME 211	Intro. to Thermodynamics	3
MATH 231	Ord. Diff. Equations	4
MET 231	Properties of Materials Lab	1
MET 232	Properties of Materials	3
EM 216	Mechanics of Materials I	3
TOTAL		**17**

JUNIOR YEAR

First Semester

ENGL 289	Technical Communications II	3
ME 316	Solid Mechanics	3
EE 211	Intro. to EE	4
CSC 150	Computer Science I	3
ME 397	Mechatronics & Meas. Systems	4
TOTAL		**17**

Second Semester

ME 313	Heat Transfer	3
ME 352	Intro. to Dynamic Systems	3
MATH 374	Applied Numerical Methods	3
ME 322	Machine Design I	3
PHYS 213	University Physics	3
Technical Elective		3
TOTAL		**18**

SENIOR YEAR

First Semester

ME 331	Thermo-Fluid Dynamics	3
ME 477	Mech. Eng. Design I	2
IENG 302	Engineering Economics	3
MATH 381	Probability/Statistics	3
ME 4XX	ME Elective #1	3
ME 4XX	ME Elective #2	3
TOTAL		**17**

Second Semester

ME 311	Engr. Thermo.	3
ME 479	Mech. Eng. Design II	2
ME 4XX	ME Elective #3 (+ Lab)	4
ME 4XX	ME Elective #4	3
Humanities or Social Science Elective		4
TOTAL		**16**

(1) Total design content of senior year mechanical engineering electives must be a minimum of 4 hours.

136 hours are required for graduation.

Curriculum Notes

* 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.

** 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.

This Catalog contains information that you, as a new, continuing, or prospective graduate student will use to make important decisions about your continuing education and future. A quick perusal of this Catalog will introduce you to the breadth of our graduate programs in engineering and science. 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, 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. Fourth, our tradition of training future engineers and scientists for employment by the private sector, in addition to academe and the government, 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 business and industry. Fifth, the most recent reorganization of SDSM&T into four interdisciplinary colleges facilitates multidisciplinary research and graduate education. Many of the most compelling and significant research areas are interdisciplinary in nature, and graduate students working on such interdisciplinary projects will gain both versatility and educational breadth.

Our strengths at SDSM&T lie not only in the opportunities 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 of Graduate Education and Research

GRADUATE STUDENT GENERAL INFORMATION

South Dakota School of Mines and Technology offers 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 spirit 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 S.D. 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 by the Graduate Education and Research Council, which is advisory to the President. The policies are approved by the faculty and the Regents of Higher Education for South Dakota and are administered by the Dean of Graduate Education and Research. The Graduate Education and Research Council consists of one faculty representative from each college, the dean of each college, and two members appointed by the Faculty Advisory Council. 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 & Science
- Mechanical Engineering
- Paleontology
- Technology Management

Doctor of Philosophy degrees are offered in:
- Atmospheric, Environmental, and Water Resources*
- Materials Engineering and Science (multi-disciplinary)
- Geology/Geological Engineering

* 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 $15 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 $15 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.

Some departments/programs require or strongly recommend that 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 departmental descriptions that follow provide information on departmental requirements.

When an application for admission to the Graduate School is received, the chair of the department or the coordinator of the multi-disciplinary program in which the applicant expects to major will evaluate the applicant's academic qualifications. The chair/coordinator will recommend whether or not the applicant should be accepted into the graduate program, and whether the admission should be as an unconditional, provisional, probationary, or special student. The Dean of Graduate Education and Research will 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 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 is required for unconditional satisfaction of the requirement. Students having scores greater than 520 but below 560 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. 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 the native language may be exempted by the Dean of Graduate Education and Research 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 that he/she is financially able to cover the projected annual costs of education at this college. 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 $15 application fee. (At the time of first registration on campus a $100 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 he/she 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 Defined: A student registered for nine or more credit hours per semester during the academic year, or six or more credit hours during the summer semester, or a student having completed 75 percent or more of the minimum course work applicable to the degree and carrying a minimum of 2 credits during any semester.

Half-Time Graduate Student Defined: A load of five credit hours per semester during the academic year, or three credit hours during a summer semester.

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 M.S. degree program (MSTM) 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 "College Costs"). State law does not permit 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 depending upon the availability of funds.

The Graduate Dean grants the award, acting upon the recommendation of the department chair or program coordinator after evaluation of the student's academic record and overall qualifications. Any student with a cumulative GPA less than 3.0 is 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 9 credit hours (6 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 may be eligible for other forms of financial aid such as Guaranteed Student Loans, National Direct Student Loans, or College Work Study Programs. Application and requests for additional information on these programs should be made to the Financial Aid Manager.

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 supports the student's thesis or dissertation research when possible.

The minimum compensation rate for graduate assistants is $10.49 per hour for Master's degree candidates and $11.19 per hour for Ph.D. students. A conventional full-time GRA/GTA (20 hours per week) for an MS degree pays $6,923 per academic year* and $1,818 per month in the summer (40 hours per week) for a total of approximately $13,286 per calendar year. A conventional full-time GRA/GTA (20 hours per week) for a Ph.D. degree pays $7,385 per academic year* and $1,940 per month in the summer (40 hours per week) for a total of approximately $14,175 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 his or her 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 2 credits during the summer period; up to 8 semester hours of research credit may be awarded for one summer of work.

Research Fellowships: A limited number of research fellowships from industry and governmental agencies 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.

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 department/program. Admittance to a different department/program requires submittal of the "Notice of Intent to Transfer" that is endorsed by the two department heads and the Dean of Graduate Education and Research.

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 the favorable recommendation of the new department/program, the Graduate Dean will issue a letter of transfer and notify the appropriate offices and the student of the change.

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 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

Graduate students, with the exception of special students, should be registered on a continuing basis for a minimum of two credit hours during each semester of the regular academic year, irrespective of whether the student is in residence, is off-campus, or is pursuing a degree on a part-time basis. The minimum registration for two credit hours is required during any semester or summer when using departmental or institutional resources (including the scheduling and taking of exams). Students who fail to so register will require permission from the Graduate Dean to return to their program of study. A student properly enrolled and about to complete degree requirements is allowed a grace period of ten class days into the next semester to finish without registration. Special students are not required to meet the minimum continuing registration requirement.

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 over eleven hours of course work per semester but may take up to twelve 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 thirteen 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 who 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 twelve 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 for graduate credit when the student was an undergraduate or as provided below.
(b) The courses 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) Courses at the 700 or 800 levels may not be taken by undergraduates.

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 the section entitled "Graduate Credit," item "e" under "General Information"
(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 (a form available from the Graduate Office) 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 of the graduate student's major department, the Graduate Dean may approve a minor variance from the twelve credit hour limit.

WORK TAKEN AT ANOTHER INSTITUTION

Credit for up to twelve 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 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 or her major department after admission to the Graduate School, 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 (numbered 600 through 800) 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 Education and Research Council for a 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, although the credit hours and grades will be counted in the final grade-point average issued by the Director of Academic and Enrollment Services. 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, 50 percent or more must be at the 700 level or above.

If a course is repeated for a passing or improved grade, the credit hours and all previous attempts of the course will be included in the computation of the cumulative grade-point averages.

A limitation of a total of nine (9) 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 General Information - Grading System 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 graduate school 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 grade or programmatic requirements (items 1-7 below) during any corresponding semester will be placed on probation and will be so informed by the Graduate Dean's Office. 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 "Financial Aid 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 will be placed on probation for failing to meet either general or specific program requirements; e.g., failure to meet the required deadlines for filing the required program of study with the Graduate Office, failure to meet the required deadlines for taking and passing applicable qualifying, comprehensive, and final exams, etc. Probation assigned for such program deficiencies will be removed by the Graduate Office only after the relevant department/program has verified that the program requirement(s) has been satisfied and subsequently forwarded a recommendation to the Graduate Office. That is, a student's probationary status will be reviewed by the student's major department/program at the close of each semester whereupon a recommendation will be made to the Graduate Office 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 numbered 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

study in the Graduate Office.

PASS-FAIL OPTION FOR GRADUATE STUDENTS

The following policy pertains to the pass/fail option at the graduate level:

(1) 100 and 200 numbered 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 numbered 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 numbered 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.

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 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 which will be difficult or costly to change until they are certain that all degree requirements can and will be satisfied.

MASTER OF SCIENCE PROGRAMS

THESIS AND NON-THESIS OPTIONS

Normally, a thesis based on original research is part of the requirements for the Master's degree. With the thesis option, the minimum graduation requirement is 30 credit hours including 6 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:

(a) A program of at least 30 credit hours of course work and research.
(b) At least 15 credit hours of graduate course work (500 numbered courses and above).
(c) At least six (6) and no more than nine (9) credit hours of thesis research.
(d) A satisfactory thesis based upon individual research.
(e) Meeting or exceeding academic standards prescribed elsewhere in this bulletin.
(f) Passing an examination on general knowledge and successfully defending the thesis.

The non-thesis option requires:

(a) A program of at least 32 credit hours of course work.
(b) At least 20 credit hours of graduate course work (500 numbered and above).
(c) Meeting or exceeding prescribed academic standards.
(d) Passing an examination on general knowledge in the field.

A candidate for the Master's degree is expected to make up undergraduate deficiencies as determined by the department/program. Credit for such makeup work is generally not allowed toward the degree. However, the policy established by the faculty does allow for a certain number of upper-level undergraduate credits to be used for the fulfillment of Master's degree requirements according to the following limitations and conditions*:

(1) For the thesis option, the number of undergraduate credits which may be used for the degree is limited to 6 hours.
(2) For the non-thesis option, the number of undergraduate credits which may be used for the degree is limited to 9 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 Education and Research Council upon written justification submitted by the chair/coordinator of the student's major department/program to the Dean of Graduate Education and Research.
(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 but only with the approval of the Graduate Education and Research Council upon written justification submitted by the chair/coordinator of the student's major department/program to the Dean of Graduate Education and Research.

*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 6 credit hours and no more than 9 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. Department/programs have the option of establishing 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 which 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 or her own 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. A guidance 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, at any later time, 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. The major professor will file a copy of the program of study and advisory committee assignments 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 with 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.

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 be submitted for publication in an appropriate professional journal.

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 or 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 48 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. 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 forward the form to the Graduate Office no less than five working days before the exam. The Graduate Office will announce this 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 coursework 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 coursework 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 8 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.")

TIME LIMITATION

A Master of Science degree program must be completed within five (5) calendar years dating from the student's formal entrance into a degree-seeking program. Courses taken by the student at any institution which are requested to be part of his/her degree program and which 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 into his/her program. 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 and a professor with whom to work. Individualized programs of study are then developed, and committee members are selected cooperatively as course work and research are undertaken. When all coursework 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 in the field.

PH.D. DEGREE REQUIREMENTS

The requirements for the Doctor of Philosophy degree are:

(a) Satisfactory completion of the Qualifying Examination.
(b) A minimum of a total of 80 semester credits (90 for the AEWR program) beyond the bachelor's degree.
(c) A minimum of 50 semester credit hours of course work (60 for the AEWR program) beyond the bachelor's degree or 26 (36 for the AEWR program) beyond the master's degree.* A maximum of twenty-four semester credits are allowed from appropriate M.S. course work to apply to the Ph.D. credits.
(d) A minimum of 20 semester credit hours (30 for the AEWR program) of appropriate research credits. A maximum of 6 semester credits of acceptable M.S. research credits can be applied to the Ph.D. research credits upon approval of a corresponding petition by the candidate's department/program and the Graduate Dean.
(e) Satisfaction of academic standards prescribed elsewhere in this catalog.
(f) At least two consecutive semesters of residence as a full-time student.
(g) Satisfaction of departmental language requirements.
(h) A dissertation written in grammatical English that represents at least the equivalent of one academic year of full-time research.

* See AEWR 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 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 which 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 three 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.

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 or her native language.

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 which 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 50-60 credit hours of required coursework 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 6-12 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 or 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 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, at any later time, 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 which 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 student who is a master's candidate at the South Dakota School of Mines and Technology 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 by the major professor 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, his/her 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 by the Graduate Dean. A copy of any amended program will be filed with the student and the Graduate Office the same 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 dissertation committee and, in the case of the MES program, of the Chairman 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 may 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.

Passing the comprehensive examination requires the approval of all but one member of the dissertation committee. 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, he or she may not attempt another such examination 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 must be passed at least five months before the dissertation is defended.

ADMISSION TO CANDIDACY

Four months before the dissertation defense, the doctoral student must apply to his/her major professor for admission to candidacy on an official certification 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 major professor will return the signed certification form 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. It must, however, 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 his/her 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 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 inform the Graduate Office of the dissertation title and the time and location of the defense no less than five working days before the defense date. The Graduate Office will announce this 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 hisher work. Questions will, in general, be confined to the dissertation and to background material related to it.

The passing of the final examination must include a "pass" vote of the Graduate Office representative and all but one of 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").

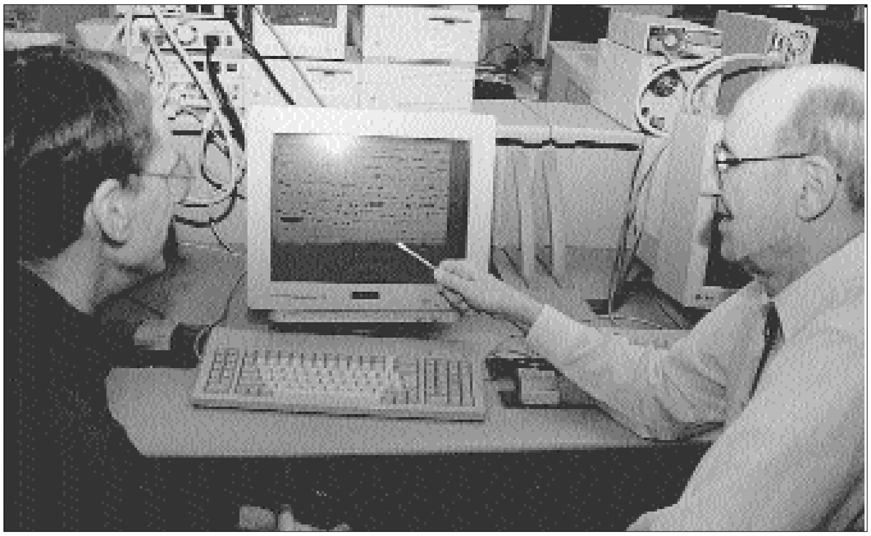
TIME LIMITATION

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 by the Graduate Education and Research Council to proceed with his or her degree program. The procedures described under "Time Limitation" for M.S. degree candidates also apply here.

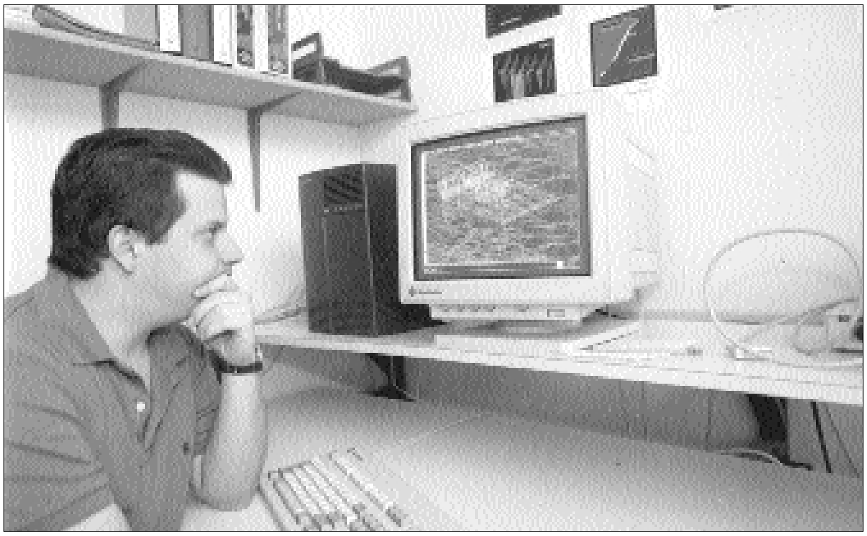
TECHFact: The Little Miner's Clubhouse provides child day care services on the SDSM&T campus for the students, faculty, and staff.

PALEONTOLOGY

ATMOSPHERIC SCIENCES



MINING ENGINEERING



CIVIL ENGINEERING

The College of Earth Systems consists of four departments: Departments of Civil and Environmental Engineering, Geology and Geological Engineering, Atmospheric Sciences, and Mining Engineering. Four bachelors of science degrees and six masters of science degrees are currently being offered in the college. The college also offers Ph.D. programs in Geology and Geological Engineering. In addition, the college provides extensive support for the newly established Ph.D. program of Atmospheric, Environmental, and Water Resources which is a joint program with the South Dakota State University and also participates in the Materials Engineering and Science Ph.D. program on campus.

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 four 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, and Mining Engineering. 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 which 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
Dean, College of Earth Systems

Patrick R. Zimmerman, Ph.D.
Chair and Professor, Department of Atmospheric Sciences;
Director, Institute of Atmospheric Sciences

Professor
Andrew G. Detwiler, Ph.D.
John H. Helsdon, Jr., Ph.D.
Mark R. Hjelmfelt, Ph. D.

Associate Professor
L. Ronald Johnson, M.S

Assistant Professor
William J. Capehart, Ph.D.
Lee A. Vierling, Ph.D.

Distinguished Professor Emeritus
Harold D. Orville, Ph.D.

Professor Emeritus
Briant L. Davis, Ph.D.
James R. Miller, Jr., M.S.
Paul L. Smith, Jr., Ph.D.

Associate Professor Emeritus
John H. Hirsch, M.S.

Research Associate Professor Emeritus
Dennis J. Musil, M.S.

The Department of Atmospheric Sciences offers advanced undergraduate and graduate courses leading to the Master of Science degree in Atmospheric Sciences 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, and atmospheric chemistry. Instruction is offered in the use of conventional weather data, satellite data, radar data, observations collected by specially instrumented aircraft 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, mathematics, or engineering. Applicants should have received credit for mathematics through ordinary differential equations; physics and chemistry are also desirable. 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 credit hours of course work in atmospheric sciences at the 500 level or above.
2. Nine credit hours of electives in atmospheric sciences or related subjects (non-atmospheric sciences electives at the 400 level or above, and 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 24 hours specified in Items 1 and 2, 18 must be at the 500 level or above, and at least half of the 30 credit hours required for an M.S. degree must be at the 700 level or above.
4. Thesis-6 credit hours.

Please note undergraduate credit limitations given under "M.S. Degree Requirements" for Master of Science degrees.

The following requirements apply for the M.S. degree in Atmospheric Sciences:

1. Students entering the master's program with a bachelor's degree in Physics, Mathematics, Computer Science, Chemistry, or Engineering, must take the following courses: ATM 450 Synoptic Meteorology I (not for graduate credit), ATM 501 Atmospheric Physics, ATM 660 Atmospheric Dynamics, ATM 650 Synoptic Meteorology II.
2. Students entering the master's program with a bachelor's degree in Atmospheric Sciences or Meteorology from another school are required to take ATM 501 Atmospheric Physics.
3. In addition all students are required to register for ATM 700 Graduate Research (Thesis) each semester and ATM 693 Graduate Seminar each spring semester.

NOTE: Elective courses outside the department are encouraged as long as the 15 hours of coursework in Atmospheric Sciences at the 600 level or above are as outlined in "Requirements for M.S. degree."

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 BSIS 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.

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.

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 meteorological instruments, tethered-balloon sampling system, and a computer-based synoptic laboratory. Computer facilities are available on the campus 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.

Current research includes aircraft investigations of thunderstorms; applications of weather radar data to rainfall measurements and severe storms; numerical modeling of cumulus clouds 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; and climatological studies of local weather patterns.

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 and placed fifth in the nation at the 1999 competition.

Terje Preber, Ph.D., P.E.
Chair and Professor, Department of Civil and Environmental Engineering

Distinguished Professor
Venkataswamy Ramakrishnan, Ph.D.

Professor
Sangchul Bang, Ph.D., P.E.
Wendell H. Hovey, Ph.D., P.E.
Srinivasa L. Iyer, Ph.D., P.E.
Directory of Industry Programs, Center of Excellence for Advanced Manufacturing and Production

Associate Professor
Marion R. Hansen, Ph.D., P.E., S.E., L.S.
Scott J. Kenner, Ph.D., P.E.
Melvin L. Klasi, Ph.D., P.E.
Henry V. Mott, Ph.D., P.E.

Assistant Professor
Thomas A. Fontaine, Ph.D., P.E.
Bruce W. Berdanier, Ph.D., P.E., L.S.

Instructor
Lois L. Arneson-Meyer, BSCE, MSTM

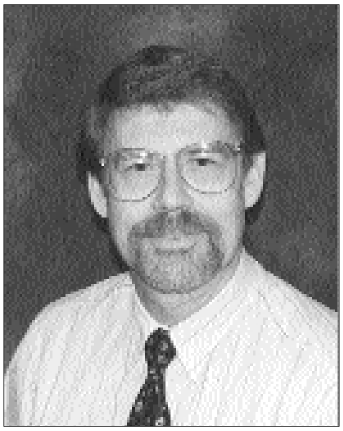
Professor Emeritus
William V. Coyle, M.S., P.E., L.S.
Thomas P. Propson, B.S.E., M.S.E., Ph.D.
Donald A. Thorson, M.S., P.E., L.S.

Associate Professor Emeritus
Francis D. Bosworth, M.S., P.E.
Richard L. Fedell, M.S., P.E.
Lavern R. Stevens, M.S., P.E.

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 hours of Graduate Research (CEE 700) 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 743. A minimum of 30 hours is required for completion of degree requirements for the thesis option; for the non-thesis option the minimum is 32 hours. All rules and regulations of the Graduate Office, included elsewhere, apply to candidates for the degree of Master of Science degree 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 coursework and research. There are a number of computer labs open to all students as well as computers for departmental use.



James E. Fox, Ph.D.
Chair and Professor, Department of Geology and Geological Engineering

Professor Emeritus

John Paul Gries, Ph.D.
John C. Mickelson, Ph.D.
Perry H. Rahn, Ph.D., P.E.
Director, Black Hills Natural Sciences Field Station
Jack A. Redden, Ph.D.

GEOLOGY

Professor

Philip R. Bjork, Ph.D.
Paleontologist and Director, Museum of Geology at the Journey Museum
Edward F. Duke, Ph.D.
Manager of Analytical Services, Engineering and Mining Experiment Station
Alvis L. Lisenbee, Ph.D.
James E. Martin, Ph.D.
Curator of Vertebrate Paleontology, Museum of Geology

Assistant Professor

Maribeth H. Price, Ph.D.

Haslem Post-doctoral Fellow in Paleontology

Julia T. Sankey, Ph.D.

GEOLOGICAL ENGINEERING

Mickelson Professor

Arden D. Davis, Ph.D., P.E.

Professor

William M. Roggenthen, Ph.D.

Assistant Professor

Larry D. Stetler, Ph.D.

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. Areas of specialization include:

Geology Track

Petroleum Geology
Environmental/Exploration Geophysics
Ground Water Geology
Mineral Deposits/Mineralogy/Petrology
Precambrian Geology
Sedimentation/Stratigraphy/Paleontology
Structural Geology

Geological Engineering Track

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)
(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 may be approved by the student's graduate committee, however, if required by special circumstances in the student's background and research interest.

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 program includes eight credits of thesis research and one credit of graduate seminar in fulfilling requirements of the Graduate Office, as well as twenty-three 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.

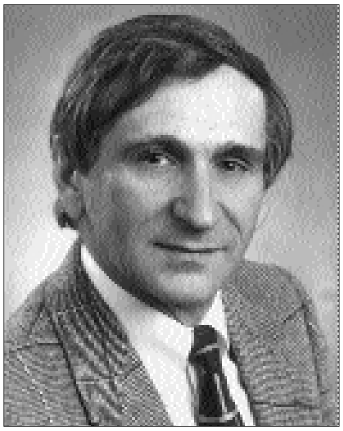
All entering graduate students are expected to take a core curriculum which includes GEOL 633 (Sedimentation). In addition, Geological Engineering students take GEOE 766 (Digital Modeling of Ground Water), and Geology students take GEOL 704 (Advanced Field Geology). Other courses appropriate to the area 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).



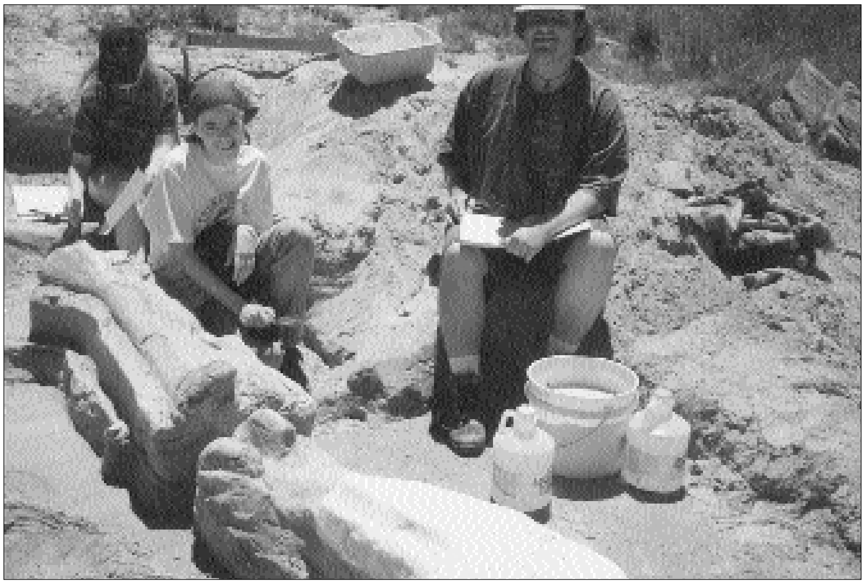
Zbigniew Hladysz, Ph.D.
Professor and Mining Engineering Program Coordinator

Professor
E. Ashworth, Ph.D.

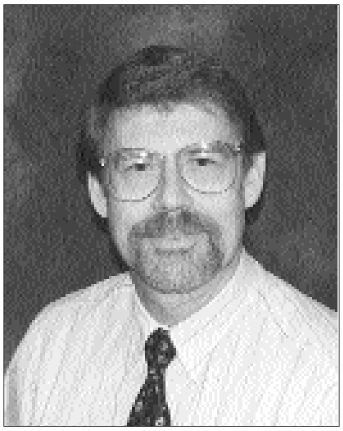
Associate Professor
Charles A. Kliche, Ph.D., P.E.

Professor Emeritus
John Duff Erickson, M.S.

The Mining Engineering program offers elective and graduate courses as service to other programs and departments including: Geology/Geological Engineering, Technology Management, and Civil Engineering. For a complete list of graduate courses in Mining Engineering, please refer to the "COURSES" section in the back of this book.



TECHFact: Faculty and staff from the Museum hold summer paleontological field programs that have unearthed unique specimens including Jurassic mammals, giant sea turtles, mososaurs, saurapods, allosaurus and numerous other fossils. Each year hundreds of students and volunteers participate in these dinosaur digs. Recent significant discoveries include 140 million year old Jurassic mammals, mososaurs with young, and camarasaurus.



James E. Fox, Ph.D.
Chair and Professor, Department of Geology and Geological Engineering

Professor
Philip R. Bjork, Ph.D.
Paleontologist and Director, Museum of Geology at the Journey Museum
James E. Martin, Ph.D.
Curator of Vertebrate Paleontology, Museum of Geology

Haslem Post-doctoral Fellow in Paleontology
Julie T. Sankey, Ph.D.

Professor Emeritus
Robert W. Wilson, Ph.D.

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 undergraduate training a minimum of one year each 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 Methods
Sedimentation
Stratigraphy and Sedimentation
Structural Geology

The courses listed above are in the geology section in the Undergraduate Catalog of the South Dakota School of Mines and Technology. Thirty-two 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, 632	Rocky Mountain Stratigraphy
GEOL 633	Sedimentation
PALE 671	Advanced Field Paleontology
PALE 673	Comparative Osteology
GEOL 700	Graduate Research (a minimum of 6 credits)
PALE 770	Seminar in Vertebrate Paleontology
PALE 776	Vertebrate Paleontology
GEOL 793	Graduate Seminar
PALE 778	Vertebrate Biostratigraphy

These courses are listed in the Geology section of the Graduate Bulletin.

The following courses are recommended:

GEOL 615	Geographic Information Systems
GEOL 643	Introduction to Microbeam Instruments
PALE 672	Micropaleontology
PALE 684	Paleoenvironments
GEOL 704	Advanced Field Geology or other appropriate courses in geology.

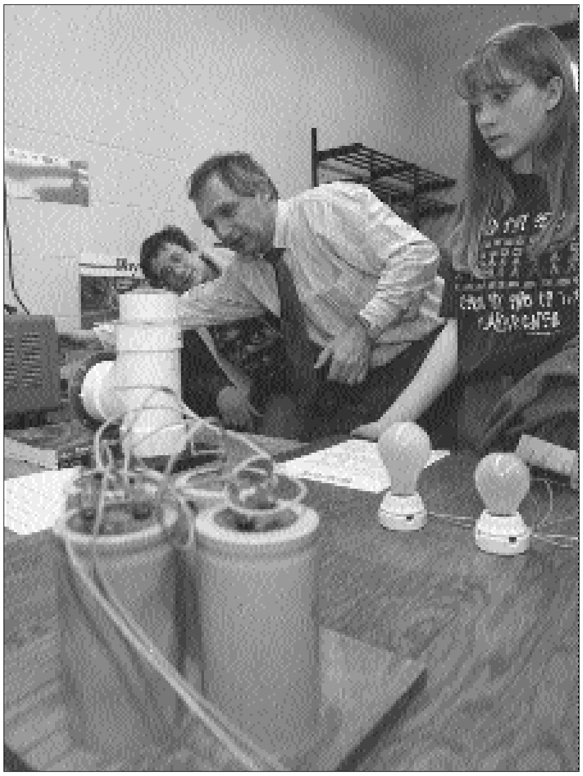
The candidate will pass a reading examination in one of the following languages: French, German, Spanish, Russian. Because the candidate's thesis is apt to involve research in Cretaceous or Oligocene-Miocene faunas, it is better to be prepared in French or German, followed by the others in the order given.

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

TECHFact: In the summer of 1994, Tech formalized an agreement with the Techishe Universitat, 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. Academic credits received by the students are recognized by both universities. For more information contact Academic and Enrollment Services at 605-394-2400.

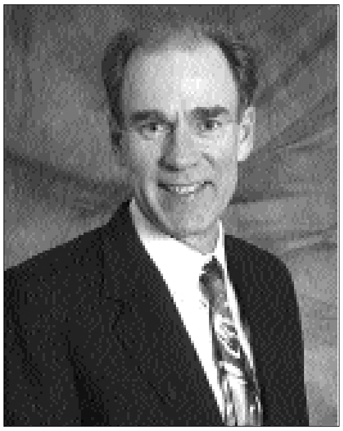
CHEMISTRY

PHYSICS



CHEMICAL ENGINEERING

MATERIALS AND METALLURGICAL ENGINEERING



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 biology program of the university also resides in the College.

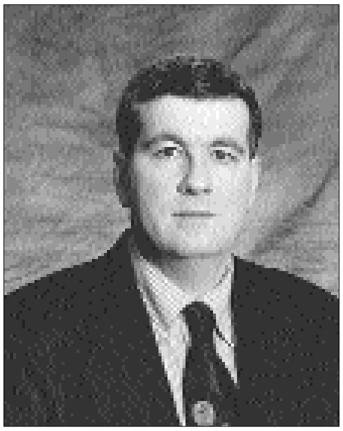
Nearly all students at the university will take some basic science courses within the College. Graduates of the College's programs find exciting and rewarding opportunities for careers in industrial or government employment, private practice, or consulting. Faculty members of the College are active in research, from developing practical new materials that can withstand extreme conditions to studying the theoretical behavior of the atom. The faculty of the College has taken a lead role in the university's Ph.D. program in Materials Engineering and Science.

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,

James M. Munro

Dr. James M. Munro
Interim Dean,
College of Materials Science and Engineering



M. Steven McDowell, Ph.D.
Chair and Associate Professor, Department of Chemistry & Chemical Engineering

Professor
Larry G. Bauer, Ph.D.
James M. Munro, Ph.D., P.E.
Interim Dean, College of Materials Science and Engineering
Jan A. Puszynski, Ph.D.

R. L. Sandvig Professor
Robb M. Winter, Ph.D.

Associate Professor
David J. Dixon, Ph.D.

Professor Emeritus
William A. Klemm, Sc.D.
Robert L. Sandvig, Ph.D.

The Department of Chemistry and Chemical Engineering offers programs 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 6 credits must be earned toward a total requirement of 30 credits in an approved program. For the non-thesis option a student must earn 32 credits in an approved program.

EXECUTIVE PROGRAM

Students pursuing the non-thesis option may elect to take their coursework 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.

Qualifying examinations may be required of entering graduate students. These examinations will be administered during a student's first semester of residence.

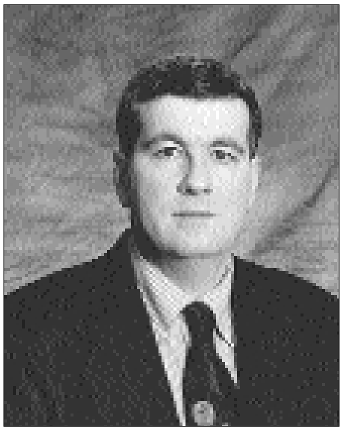
Written final examinations in Transport Phenomena, Thermodynamics, Reactor Design and an optional area are required. An oral thesis defense, or oral examination for the non-thesis degree, is also required.

A core curriculum required of all M.S. candidates in Chemical Engineering includes the following courses or approved substitutions:

ChE 550	Systems Analysis App. ChE	3
ChE 712	Transport Phenomena: Momen.	3
ChE 713	Transport Phenomena: Heat	3
ChE 721 or 722	Thermodynamics	3
Kinetics elective[1]		3
Applied Computation elective[2]		3

[1] Kinetic elective: ChE 544 or MES 728
[2] Applied Comp. Elec.: ChE/ME 616, Math 332, or IENG 485

In addition to the core curriculum, students pursuing the non-thesis option must complete a minimum of two credits of non-thesis research, ChE 702, and one three credit course in technology management.



M. Steven McDowell, Ph.D.
Chair and Associate Professor, Department of Chemistry & Chemical Engineering

Professor
Dale E. Arrington, Ph.D.

Associate Professor
John T. Bendler, Ph.D.
David A. Boyles, Ph.D.
Cathleen J. Webb, Ph.D.

Assistant Professor
Daniel L. Heglund, Ph.D

Professor Emeritus
Jack R. Gaines, Ph.D.
J. Haworth Jonte, Ph.D.
Robert W. Looyenga, Ph.D.
Carl E. Schilz, M.S.

Master of Science in Chemistry

See Master of Science in Materials Engineering and Science

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 & Engineering which directs study leading to the Master of Science degree in Materials Engineering & Science (MS/MES). The program works in concert with other colleges and the Doctor of Philosophy in Materials Engineering & Science (Ph.D./MES).

The MS/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, 24 hours of course work and a minimum 6 credit hours of thesis research are required. With the second option, 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 directly administered by the Dean of the College with a committee consisting of the Chairs of the three representative departments.

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 12 credit hours from the following five core courses:

MES 603	Atomic/Molecular Structure of Materials
MES 601	Thermochemical Processing Fundamentals
MES 604	Structure-Property Relationships of Materials
MES 708	Advanced Instrumental Analysis
MES 709	Experimental Advanced Instrumental Analysis

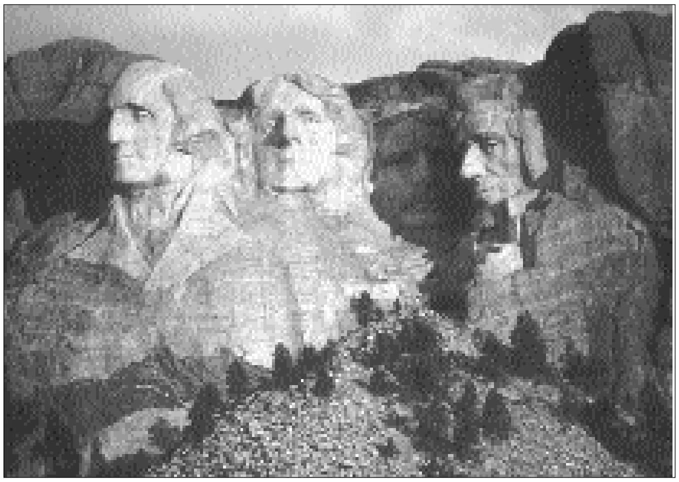
These courses are modularized and are variable credit so that students can take their 12 credit hours of core coursework utilizing the modules that will most benefit their plan of study.

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.

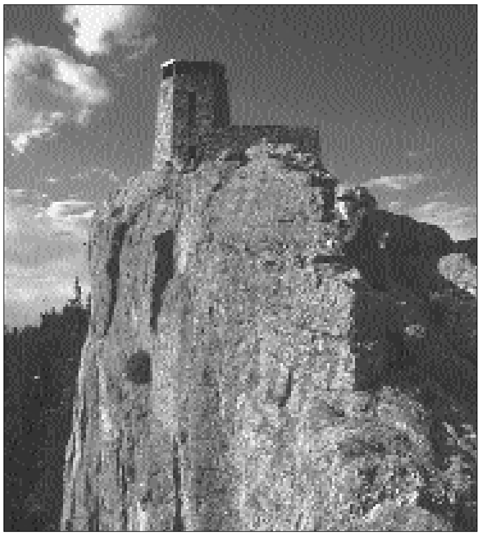
Areas of research currently carried out include inorganic, organic, and biological behavior/synthesis/treatments of materials, solid state physics, interfacial chemistry/physics, thermal, magnetic and transport properties of semiconductors, superconductors, metals and alloys, dielectric and composite 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 MS/MES Program

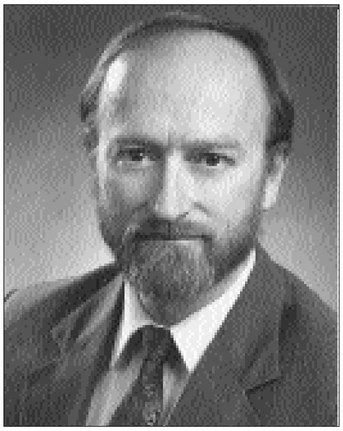
The breadth of the field of materials engineering and science is such that graduates from any of the following disciplines should be prepared for graduate study in the MS/MES program: chemistry, physics, metallurgical engineering, chemical engineering, materials engineering, mechanical engineering, civil 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 coursework.



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



Photos Courtesy of SD Department of Tourism



Stanley M. Howard, Ph.D., P.E.
Chair and Professor, Department of Materials and Metallurgical Engineering

Distinguished and Furstenau Professor
Kenneth N. Han, Ph.D.

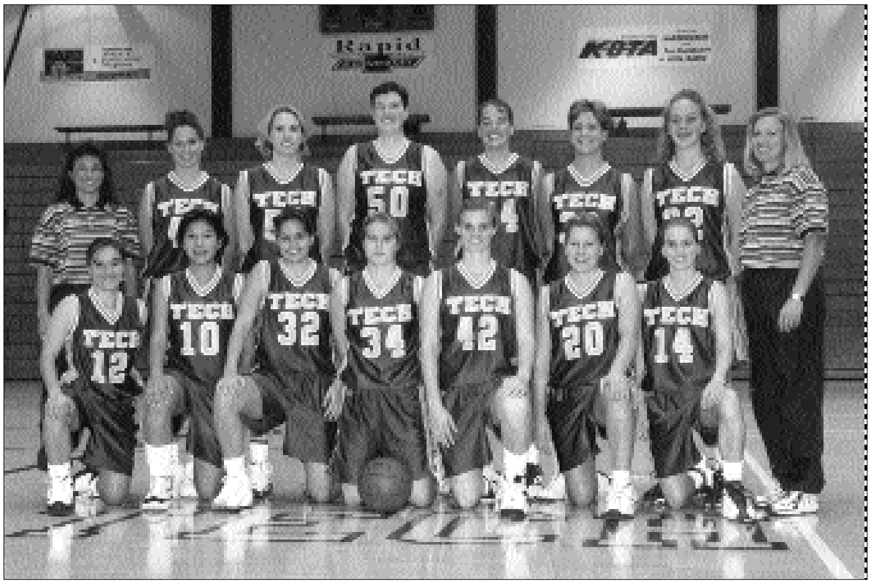
Professor
Fernand D.S. Marquis, Ph.D., P.E.
Glen A. Stone, Ph.D.

Associate Professor
Jon J. Kellar, Ph.D.

Research Scientist III
William Cross, Ph.D.

Research Professor Emeritus
Amos L. Lingard, Ph.D.

Master of Science in Materials and Metallurgical Engineering
See Master of Science in Materials Engineering and Science



TECHFact: The women's basketball team reached the NAIA Final Four in the 1998 and 1999 tournaments.

Mikhail Foygel, Ph.D.
Chair and Professor, Department of Physics

Professor
T. Ashworth, Ph.D.

Associate Professor
Robert L. Corey, Ph.D.
Andrey Petukhov, Ph.D.

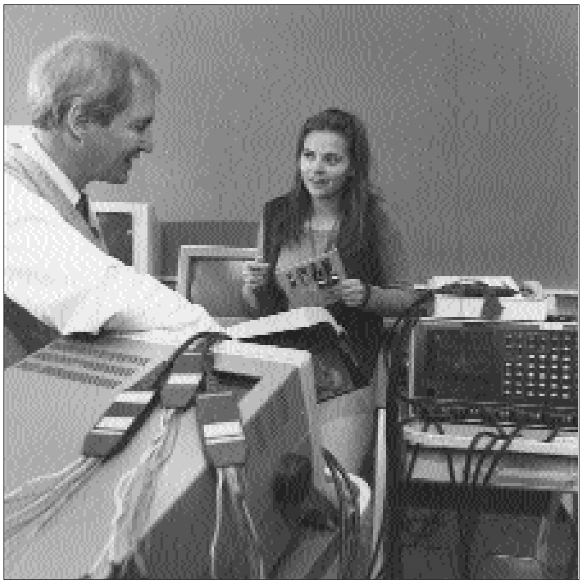
Professor Emeritus
Don C. Hopkins, Ph.D.
Robert D. Redin, Ph.D.

Master of Science in Physics

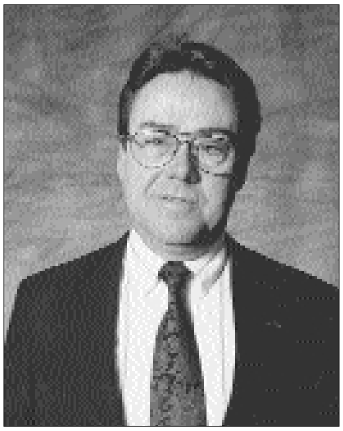
See Master of Science in Materials Engineering and Science

COMPUTER SCIENCE

ELECTRICAL ENGINEERING



MECHANICAL ENGINEERING



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 teams and the Tech Multimedia Group give you a chance to learn by doing outside the classroom. The Center of Excellence in Manufacturing and Production 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 which 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.

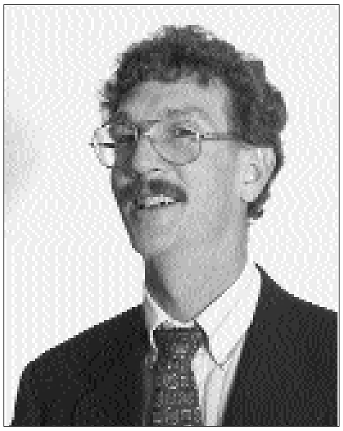
Faculty within the college cooperate and collaborate in curriculum development and research. We have research projects underway in areas such as computer-aided manufacturing, wind power feasibility, computer graphics and neural network applications. These efforts enable faculty to increase our knowledge 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
Interim Dean, College of Systems Engineering



Donald A. Teets, D.A.
Chair and Associate Professor, Department of Mathematics and Computer Science

Professor
Harold E. Carda, M.N.S.
Edward M. Corwin, Ph.D.
Roger L. Opp, M.S.

Associate Professor
Antonette M. Logar, Ph.D.
Manuel Penaloza, Ph.D.
John M. Weiss, Ph.D.

Assistant Professor
Jeffrey S. McGough, Ph.D.

Professor Emeritus
Ronald C. Weger, M.S., Ph.D.

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 and must provide 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, 124)
- one semester of discrete mathematics (e.g. CSC 251)
- a CS 1 course (e.g. CSC 150)
- a CS 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)

A student who is admitted to the program without this background in Computer Science 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 candidate for the M.S. degree in Computer Science may choose a thesis or a non-thesis option.

The candidate who chooses the thesis option must complete:

(1) At least 18 semester credit hours of Computer Science courses numbered 600 or higher exclusive of CSC 700 and CSC 702.
(2) 6 semester credit hours of CSC 700, Thesis Research.
(3) Additional hours of electives to total at least 30 semester credit hours.

The candidate who chooses the non-thesis option must complete:

(1) At least 24 semester credit hours of Computer Science courses numbered 600 or higher exclusive of CSC 700 and CSC 702.
(2) At least 3 semester credit hours of CSC 702. Each non-thesis student Must complete an approved project under faculty supervision.
(3) Additional hours of electives to give a total of at least 32 semester credit hours.

The South Dakota School of Mines and Technology has a variety of computing platforms available. Resources include an extensive PC network and various UNIX workstation environments., SUN workstations, DEC workstations, RS6000 workstations, SGI workstations and four transputers running OCCAM which are used for parallel processing. Other resources may be accessed via Internet. The institution encourages its students to use the computer facilities in the creative and efficient solution of scientific and engineering problems.

Larry A. Simonson, Ph.D., P.E.
Chair and Professor, Department of Electrical and Computer Engineering

Professor
Michael J. Batchelder, Ph.D.
Executive Director, Center of Excellence for Advanced Manufacturing and Production
Abul R. Hasan, Ph.D.
Larry G. Meiners, Ph.D., P.E.

Associate Professor
Neil F. Chamberlain, Ph.D.

Assistant Professor
James W. Cote, Ph.D.
David H. Grow, M.S.
Brian T. Hemmelman, Ph.D.

Professor Emeritus
Cyrus W. Cox, M.S., P.E.
William L. Hughes, Ph.D., P.E.
Richard D. McNeil, M.S., P.E.
A.L. Riemenschneider, Ph.D., P.E.

The graduate program in Electrical Engineering consists of research and study leading to the Master of Science degree in Electrical Engineering and a Ph.D. degree in Materials Engineering and Science. Course work in Electrical Engineering can be supplemented by related offerings in other departments. Master's degree candidates may choose either a thesis or non-thesis program. The Ph.D. degree candidate's program must emphasize Materials. In special cases, with the consent of the Chairman of the Electrical and Computer Engineering Department, students may elect to do research in association with another engineering or science department.

Master's candidates must complete course requirements which are determined by the choice of a thesis or non-thesis option. The requirements are as follows:

THESIS OPTION

(1) 6/9 credit hours of EE thesis research (EE 700)
(2) At least 12 credit hours of EE courses
(3) 30 credit hours total, half of which must be 700 level or above

NON-THESIS OPTION

(1) 3 credit hours of EE non-thesis research
(2) At least 15 credit hours of EE courses
(3) 32 credit hours total, half of which must be 700 level or above.

Suggested areas of emphasis with suggested EE course offerings are:

SIGNALS/SYSTEMS

EE 611	Advanced Systems I
EE 621	Information and Coding Theory
EE 651	Digital Control Systems
EE 712	Advanced Systems II
EE 622	Statistical Communication Systems
EE 698	Digital Wireless Communications
EE 618	Instrumentation Systems
EE 723	Random Signals and Noise
EE 751	Nonlinear & Optimal Control Systems

POWER/CONTROLS

EE 611	Advanced Systems I
EE 633	Power System Analysis I
EE 651	Digital Control Systems
EE 618	Instrumentation Systems
EE 723	Random Signals and Noise
EE 734	Power System Analysis II
EE 751	Nonlinear & Optimal Control Systems

DIGITAL AND COMPUTERS

EE 642	Digital System Theory
EE 643	Advanced Testing of Digital Systems
EE 644	Fault Tolerant Computing
EE 618	Instrumentation Systems
EE 741	Digital System Design
EE 743	Advanced Digital Systems

MATERIALS AND VLSI

EE 643	Advanced Testing of Digital Systems
EE 662	Advanced Microelectronics I
EE 618	Instrumentation Systems
EE 699	Heterojunction Materials and Devices
EE 745	Advanced Systems and VLSI Testing
EE 781	Electromagnetic Field Theory I
MIES 765	Advanced Microelectronics II
MIES 766	Electronic Materials

Each student's program of study must be approved by the candidate's graduate committee before preregistration for the second semester following the acceptance of the student into the graduate program. The student's graduate committee has the right to disallow any course proposed in the student's program of study which 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.

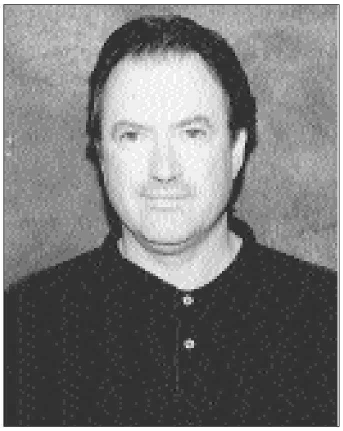
At the discretion of the graduate advisor, graduates of other institutions may also be required to take:

(1) A technical communications course if no equivalent has been previously passed.
(2) One semester of junior laboratory.
(3) One or more courses of preparatory undergraduate work depending on the student's undergraduate background.

Applicants who are graduates of institutions which are not accredited by the Accreditation Board of Engineering and Technology are required to sit for the Graduate Record Exam and have their scores submitted prior to consideration for admission.

Undergraduate students taking 600 level graduate courses and petitioning these courses for graduate credit must realize that these courses may or may not apply to the students' graduate programs if they later apply and are accepted into the graduate program. A student's graduate committee must approve any student's program of study. A student's graduate program will come under the control of the graduate advisor and the student's graduate committee at the time the student is accepted into the graduate program.

TECHFact: Tech's Human Powered Vehicle (HPV) Team took 7th place overall at the American Society of Mechanical Engineers 1999 HPV Competition. The team took 16th in the Design Competition; 4th in Combined Sprint - 5th in Men's Sprint & 5th in Women's Sprint; and 3rd in the Road Event.



Michael A. Langerman, Ph.D.
Chair and Professor, Department of Mechanical Engineering

Professor
Daniel F. Dolan, Ph.D.
    Director of Academic Programs, Center of Excellence for Advanced Manufacturing and Production
Christopher H.M. Jenkins, Ph.D., P.E.
Lidvin Kjerengtroen, Ph.D.
Wayne B. Krause, Ph.D., P.E.
    Interim Dean, College of Systems Engineering

Associate Professor
Gregory A. Buck, Ph.D., P.E.
Vojislav D. Kalanovic, Ph.D.

Assistant Professor
Sanjeev K. Khanna, Ph.D.

Professor Emeritus
Chao-Wang Chiang, Ph.D., P.E.
William N. Groves, M.S., P.E.
Lester W. Snyder Jr., M.S., P.E.
Richard L. Pendleton, Ph.D., P.E.

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 transfer phenomena, and interfacial phenomena.

The Mechanical Engineering Department is the largest department 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 Heat Transfer Lab. The campus fosters interdisciplinary research, and state-of-the-art equipment such as 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
Credit hours required at 700	16
Project ME 794	6
Seminar ME 799	1
Remaining @ the 700-level	9
Total 700-level credits	**16**
Remaining 16 hours are taken as	
@ the 400*/500-level	9
@ the 600-level	7
Total 400 - 600 level credits	**16**

(2) Thesis

Total credit hours required	30
Credit hours required at 700	16
Thesis ME 700	6
Seminar ME 799	1
Remaining @ the 700-level	9
Total 700-level credits:	**16**
Remaining 14 hours are taken as	
@ the 400*/500-level	9
@ the 600-level	5
Total 400 - 600 level credits	**14**

*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 Education 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	Computational Methods in Heat Transfer
ME 713	Transport Phenomenon-Heat
ME 712	Transport Phenomenon-Momentum

Mechanical Systems

ME 623	Advanced Mechanical Vibrations
ME 722	Advanced Mechanical Design
EM 698	Advanced Mechanics of Materials
MES 713	Advanced Solid Mechanics

Manufacturing and Controls

ME 683	Advanced Mechanical System
ME 781	Robotics
ME 782	Integrated Manufacturing Systems
ME 797	Applied Intelligent Control

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 which are not accredited by the Accreditation Board of Engineering and Technology are required to sit for the Graduate Record Exam and have their scores submitted prior to consideration for admission.

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 coursework as prescribed in the Graduate Bulletin. A Mechanical Engineering graduate student with an accumulated GPA of 3.4 or better in those courses in their graduate program will have their coursework 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 coursework oral examination will be administered the student's graduate committee. The GPA will be computed using midterm grades for the semester in which the student is currently enrolled. The coursework examination will examine primarily over 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 which 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 coursework taken by the student in their graduate program will be identical to the rules stipulated above for those students taking the thesis option.

TECHNOLOGY MANAGEMENT

MATERIALS ENGINEERING & SCIENCE

TECHFact: During the 1998 calendar year SDSM&T awarded 279 bachelors degrees, 46 masters degrees, and 3 doctorate degrees. Tech offers commencement in December and May.

Sherry O. Farwell, Ph.D.
Dean, Graduate Education and Research

Program Management Committee

Bruce W. Berdanier, Ph.D., Department of Civil and Environmental Engineering
William J. Capehart, Ph.D., Assistant Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences
Arden D. Davis, Ph.D., Mickelson Professor, Department of Geology and Geological Engineering
Andrew G. Detwiler, Ph.D., Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences
Edward F. Duke, Ph.D., Professor, Department of Geology and Geological Engineering and Manager, Analytical Services, Engineering and Mining Experiment Station
Thomas A. Fontaine, Ph.D., Assistant Professor, Department of Civil and Environmental Engineering
James E. Fox, Ph.D., Chair and Professor, Department of Geology and Geological Engineering
Dan Heglund, Ph.D., Assistant Professor, Department of Chemistry and Chemical Engineering
John H. Helsdon, Jr., Ph.D., Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences
Mark R. Hjelmfelt, Ph.D., Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences
Wendell H. Hovey, Ph.D., Professor, Department of Civil and Environmental Engineering
L. Ronald Johnson, M.S., Associate Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences
Scott J. Kenner, Ph.D., Associate Professor, Department of Civil and Environmental Engineering
Henry V. Mott, Ph.D., Associate Professor, Department of Civil and Environmental Engineering
Harold D. Orville, Ph.D., Distinguished Professor Emeritus, Department of Atmospheric Sciences and Institute of Atmospheric Sciences
Maribeth H. Price, Ph.D., Assistant Professor, Department of Geology and Geological Engineering
Paul L. Smith Jr., Ph.D., Professor Emeritus, Department of Atmospheric Sciences and Institute of Atmospheric Sciences
Larry D. Stetler, Ph.D., Assistant Professor, Department of Geology and Geological Engineering
Cathleen J. Webb, Ph.D., Associate Professor, Department of Chemistry and Chemical Engineering
Patrick R. Zimmerman, Ph.D., Chair and Professor, Department of Atmospheric Sciences and Director, Institute of Atmospheric Sciences

In October 1993, the 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. A number of disciplines at each institution will be involved in delivering the program, including the various engineering specialties such as agricultural, chemical, civil and environmental, mining; geology; water resources; atmospheric sciences; environmental sciences; biology; chemistry; hydrology; wildlife and fisheries. Degree candidates will be expected to complete an approved program of study integrating course work from among these disciplines yet providing a focus for their research. A common core of courses includes courses from each university. Students may enroll in doctoral studies in any of the three fields mentioned.

A common program core will be required of all students, which includes four courses and seminars taken by all students in the joint doctoral program. These courses were chosen to give every student in the program some knowledge in all three disciplines and to assure some capability in modeling fluid systems, a basis for much Ph.D. work in these areas. The seminars will be taught over the Rural Development Telecommunications Network (RDTN) and should give students a broader and deeper background in the three disciplines. The four core courses plus seminars are listed in Table 1.

TABLE 1
Common Core Courses
(CRH is semester credit hours and initials in parentheses indicate originating university)

Course	
CEE721	Environmental Engineering CRH: (3) (SDSU)
CEE 635	Water Resources Engineering CRH: (3) (SDSU/SDSM&T)
ATM 605	Air Pollution CRH: (3) (SDSM&T)
CEE 784	Modeling and Computations in Civil Eng. CRH: (3) (SDSM&T/SDSU)
AEWR 793	Seminar (a minimum of 3 during the program) CRH: (3) (SDSM&T/SDSU)

There also will be secondary core of courses related to the three areas of specialization. The courses in Atmospheric Resources are selected to give the students a basic education in topics especially related to atmospheric resources, with some connections to the other two disciplines. The courses in Environmental and Water Resources are selected to represent three basic topics of which all students in these disciplines should have knowledge. Students will take the three courses appropriate to their degree. Table 2 shows the separate degree core course listings for the atmospheric, environmental, and water resources degrees. A characteristic of these lists is that students at either university can take the courses, primarily over the RDTN. These core courses are incorporated into the sample programs displayed below and provide 24 of the 60 semester course credit hours required for the Ph.D.

TABLE 2
(Secondary Core Courses)

Atmospheric Resources Courses
SDSM&T Courses (SDSU has personnel who could assist or in some instances teach these courses.)

ATM 620	Satellite Remote Sensing I
ATM 630	Radar Meteorology
ATM 751	Applied Climatology and Meteorology

Environmental Resources Courses
SDSU/SDSM&T Courses

CEE 627/628	Environmental Engineering Instrumentation
CEE 725/600	Biological Principles in Environmental Engineering
CEE 726/600	Physical-Chemical Principles of Environmental Engineering

Water Resources Courses
SDSU/SDSM&T Courses

CEE 633	Open Channel Flow
CEE 634	Engineering Hydrology (Surface Water)
GEOE 664	Advanced Ground Water

Of the four common core courses, the three degree core courses and the elective courses, five must be taken from faculty at the school that is not the student's home institution, if the student starts from the bachelor's degree level. Students entering the program with a qualifying Master of Science Degree will take a reduced number of courses, but at least three courses exclusive of the seminars, from the non-home institution. The Ph.D. program will include a minimum of 60 semester course credit hours beyond the B.S. degree and a minimum of 30 dissertation/research credit hours. Thirty semester credit hours are the maximum that can be allocated to dissertation credit. We believe that this is an innovative joint program that will give students a broad background in closely related water and environmental topics.

PROGRAM MANAGEMENT

To provide for management of this program and the development of consistent standards, an Atmospheric, Environmental, and Water Resources Ph.D. Steering Committee will be formed. This committee will be inter-institutional and be composed of the following:

2 Presidents
1 Executive Director or designee
2 faculty from SDSU
2 faculty from SDSM&T

The Committee will act on applicant admission standards, approval of curricular changes in the program, coordination and implementation of the program plan, and in monitoring student progress. The committee will also develop inter-campus relationships in such areas as scholarly research, seminars, annual joint conferences, scholarships, joint and courtesy faculty appointments, and other activities of mutual benefit. This committee is a steering committee and will adhere to the policies of the respective Graduate Schools. It should not be confused with the advisory committee that each individual student will have.

The Steering Committee will promote utilization of telecommunications (fiber optics and satellite uplinks and downlinks), computer networking between the universities, faculty interchanges and joint class offerings. Interactive classroom technology will facilitate communication between Steering Committee and Advisory Committee members and potentially allow graduate students at either university to participate in reciprocal class offerings. Electronic bulletin boards could be established through computer technology which would facilitate day-to-day communication between the committees, cooperating faculty, and graduate students.

In addition to the Steering Committee, a Campus Coordinating Committee will be established on each campus. The Campus Coordinating Committee provides a mechanism for dealing with campus issues relating to the program. This committee shall consist of the campus representatives named to the Steering Committee plus an additional faculty member from each of the departments participating in the program. The Campus Coordinating Committee may include additional members as deemed appropriate by the respective institutions.

Sample programs for the three specialty areas follow.

Atmospheric Resources (Post M.S.)
Remote Sensing Track

	Semester Cr. Hrs.	
Fall, First Year		
AEWR 800	Dissertation Research	3
ATM 630	Radar Meteorology	3
CSC 751	Digital Image Modeling and Analysis	3
CEE 635	Water Resources Engineering	3
TOTAL		**12**
Spring, First Year		
AEWR 793	Graduate Seminar	1
AEWR 800	Dissertation Research	3
ATM 720	Satellite Remote Sensing II	3
CEE 721	Environmental Engineering	3
TOTAL		**10**
Fall, Second Year		
AEWR 800	Dissertation Research	3
CSC 661	Artificial Intelligence	4
ATM 751	Applied Climatology & Meteorology	3
ATM 773	Mesometeorology	3
TOTAL		**13**
Spring, Second Year		
AEWR 793	Graduate Seminar	1
AEWR 800	Dissertation Research	3

ATM 710	Advanced Radiative Transfer	3
CEE 784	Modeling and Computations in Civil and Environmental Eng.	3
TOTAL		**10**

Fall, Third Year

AEWR 800	Dissertation Research	9
TOTAL		**9**

Spring, Third Year

AEWR 793	Graduate Seminar	1
AEWR 800	Dissertation Research	9
TOTAL		**10**

* Assume ATM 610, Atmospheric Radiative Transfer; ATM 605, Air Pollution, and ATM 620, Satellite Remote Sensing I, completed in the M.S. program.

Atmospheric Resources - Physical Meteorology Track

In arriving at the Physical Meteorology track listed below, the following assumptions are made. The required core courses of CEE 721, 635, and 784; *ATM 605; and AEWR 793 (taken 3 times for a total of 3 credits) would be taken by all students and account for 15 of the required 36 credits (post-M.S.). Next, of the secondary core courses (ATM 620, 630, and 750), which comprise 9 credits, one course would already have been taken in the M.S. program leaving 6 credits for the Ph.D. program. Thus the secondary courses would account for 6 of the 36 credits. In all, the core courses account for 21 credits leaving 15 for a Physical Meteorology track. The Department requires 2 physical and 1 dynamic meteorology courses for the track and 1 elective physical course and 1 elective physical or dynamic course. This maintains the emphasis on physical meteorology while broadening the students' exposure to dynamics. The following is the Physical Meteorology track.

*ATM 701	Advanced Physical Meteorology
*ATM 743	Precipitation Physics and Cloud Modification
**ATM 773	Mesometeorology

- One 3 hour credit elective in physical meteorology
- One 3 hour credit elective in physical or dynamic meteorology or an out-of-department course

AEWR 800	Dissertation Research, 3 credits taken every semester

Physical Meteorology Electives

ATM 602	Meteorological Instrumentation
ATM 610	Atmospheric Radiative Transfer
ATM 640	Atmospheric Electricity
ATM 708	Atmospheric Chemistry
ATM 710	Advanced Radiative Transfer
ATM 720	Satellite Remote Sensing II
ATM 730	Advanced Radar Meteorology
ATM 740	Advanced Atmospheric Electricity
ATM 744	Advanced Atmospheric Numerical Modeling
ATM 770	Boundary Layer Processes

Dynamic Meteorology Electives

ATM 760	Advanced Atmospheric Dynamics
ATM 762	General (Global) Circulation
ATM 763	Atmospheric Waves
ATM 742	Physics and Dynamics of Clouds
ATM 770	Boundary Layer Processes

* If the student has already taken this course or its equivalent he/she must substitute a course from the Physical Meteorology Electives.

** If the student has already taken this course or its equivalent he/she must substitute a course from the Dynamic Meteorology Electives.

Doctor of Philosophy in Environmental Resources Program Requirements (post BS)

Common core courses (see Table 1)	12 credits
Environmental Resources core courses (see Table 2)	9 credits
Elective (see Table 3)	36 credits
Seminar	3 credits
Dissertation	30 credits
	90 credits

Table 3 - Elective Courses for the Environmental Resources Ph.D.

Available through SDSM&T:

CHE 611	Fundamentals of Biochemical Engineering I
CHE 612	Fundamentals of Biochemical Engineering II
CHE 641	Reaction Kinetics I
CHE 717	Transport Phenomena: Momentum
CHE 718	Transport Phenomena: Heat
CHE 719	Transport Phenomena: Mass
CHE 721	Advanced Chemical Engineering Thermodynamics I
CHE 722	Advanced Chemical Engineering Thermodynamics II
CHE 620	Advanced Topics in Organic Chemistry
CHE 628	Heterocyclic Organic Chemistry
CHE 699	Industrial Organic Chemistry
CHE 726	Ionic Organic Reactions
CHE 736	Advanced Instrumental Analysis
CEE 626	Advanced Environmental Engineering
CEE 628	Environmental Engineering Laboratory
CEE 723	Environmental Contaminant Free and Transport
CEE 725	Treatment, Disposal, and Management of Hazardous Waste
CEE 731	Water Quality Assessment
CEE 733	Techniques of Surface Water Resource and Water Quality Investigations I
CEE 734	Techniques of Surface Water Resource and Water Quality Investigations II
CEE 738	Unsteady Flow in Fluid Systems
CEE 784	Modeling and Computation in Civil Engineering
GEOE 641	Geochemistry
GEOE 664	Advanced Ground Water
GEOE 763	Ground Water Chemistry
GEOE 766	Digital Modeling of Ground Water Flow Systems
GEOE 799	Fluid Flow in Porous Media
ATM 605	Air Pollution
ATM 660	Atmospheric Dynamics
ATM 705	Air Quality Modeling
ATM 708	Atmospheric Chemistry
ATM 770	Boundary Layer Processes

Available through SDSU:

ARE 733	Ground Water Engineering in Agriculture
BOT 705	Aquatic Plants
BOT 715	Advanced Plant Ecology
CHE 622	Advanced Organic Chemistry
CHE 632	Advanced Analytical Chemistry
CHE 662	Principles of Biochemistry
CHE 726	Bioorganic Chemistry
CHE 728	Physical Organic Chemistry
CHE 732	Analysis in Agricultural and Environmental Chemistry
CHE 736	Chromatography and Separations
CHE 748	Chemical Kinetics
CHE 753	Organometallic Chemistry
CHE 764	Biochemistry I
CHE 766	Biochemistry II
CHE 768	Plant Biochemistry
CHE 782	Radioisotope Techniques
CEE 623	Environmental Engineering
CEE 635	Water Resources Engineering
CEE 723	Advanced Sanitary Engineering
CEE 724	Land Treatment of Water
CEE 725	Hazardous and Toxic Waste Disposal
CEE 731	Ground Water and Seepage
CEE 732	Numerical Methods for Ground Water Analysis
CEE 733	Advanced Water Resources Engineering
CEE 734	Water Resources I (Water Quality)
CEE 735	Water Resources II (Water Quality)
CEE 736	Water Resources III (Water Management)
ECON 672	Resource Economics
GEO 765	Advanced Studies in Land Utilization
MICR 636	Molecular and Microbial

	Genetics
MICR 637	Systematic Bacteriology
MICR 713	Industrial Microbiology
MICR 738	Microbial Metabolism
PS 743	Physical Properties of Soils
PS 754	Chemical Properties of Soils of Crop Production
WL 611	Limnology
WL 711	Aquatic Ecology

<u>Courses Common to SDSM&T and SDSU:</u>

CHEM 652	Advanced Inorganic Chemistry
CHEM 654	Advanced Organic Chemistry
CHEM 744	Chemical Thermodynamics
CEE 627	Advanced Waste Water Eng.
CEE 633	Open-Channel Flow
CEE 633	Open-Channel Hydraulics
CEE 637	Design of Hydraulic Systems
CEE 724	Industrial Waste Treatment and Disposal
CEE 728	Adv. Water Supply Engineering
CEE 728	Waste Water Treatment Plant Design
CEE 736	Eng. Hydraulics
CEE 737	Hydraulic Design
CEE 738	Advanced Hydraulics

Sample Program of Study
Water Resources Option
(Post B.S.)

Fall, First Year

*CEE 635	Environmental Engineering	3
ATM 605	Air Pollution	3
CEE 633	Open-Channel Flow	3
CEE 634	Surface Hydrology	3
TOTAL		**12**

Spring, First Year

*CEE 635	Water Resources Engineering	3
CEE 784	Modeling and Computations	3
GEOE 664	Advanced Ground Water	3
AEWR 793	Seminar	1
AEWR 800	Dissertation Research	1
TOTAL		**11**

Fall, Second Year

CEE 730	Operational Hydrology	4
CEE 733	Techniques I	3
*CEE 724	Land Treatment of Water	3
ATM 751	Applied Climatology & Meteorology	3
TOTAL		**13**

Spring, Second Year

CEE 736	Engineering Hydraulics	3
CEE 731	Water Quality Assessment	3
GEOE 766	Digital Modeling of Ground Water	3
AEWR 793	Seminar	1
AEWR 800	Dissertation Research	1
TOTAL		**11**

Fall, Third Year - Semester

*PS 743	Physical Properties of Soils	3
GEOE 763	Ground-Water Geochemistry	3
GEOE 799 F	luid Flow in Porous Media	3
ATM 630	Radar Meteorology	3
TOTAL		**12**

Spring, Third Year

*CEE 733	Advanced Water Resources Engineering	3
AEWR 793	Seminar	1
AEWR 800	Dissertation Research	8
TOTAL		**12**

Fall, Fourth Year

AEWR 800	Dissertation Research	10
TOTAL		**10**

Spring, Fourth Year

AEWR 800	Dissertation Research	10
TOTAL		**10**

Water Resources Elective Courses
(36 credits for post-B.S.)

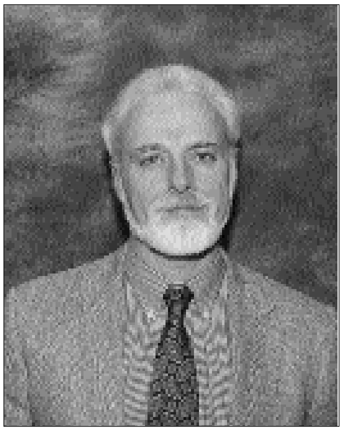
CEE 730	Operational Hydrology	4
CEE 731	Water Quality Assessment	3
CEE 733	Techniques of Surface Water Resource and Water Quality Investigations I	3
CEE 736	Engineering Hydraulics	3
GEOE 763	Ground-Water Geochemistry	3
GEOE 766	Digital Modeling of Ground-Water Flow Systems	3
GEOE 799	Fluid Flow in Porous Media	3
ATM 630	Radar Meteorology	3
ATM 751	Applied Climatology and Meteorology	3
*CEE 733	Advanced Water Resources Engineering	3
*CEE 724	Land Treatment of Water	3
*PS 743	Physical Properties of Soils	

* Denotes SDSU Course (five total courses required)

Credit Summary

a.	Common Core Courses plus Secondary Core Courses	21
b.	Seminars	3
c.	Elective Courses (36 required)	37
d.	Dissertation	30
TOTAL		**91** (61/30) (90 required)

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 placed in the top ten in five out of the seven events at the Mini-Baja Western Competition April 15-17, 1999. They took 4th in Hill Climb; 6th in Safety and Design; 8th in Maneuverability; 9th in Sales presentation; 9th in Acceleration; 48th in Endurance; 42nd in cost; and 30th overall.



Christopher H.M. Jenkins, Ph.D., P.E.
Professor, Department of Mechanical Engineering;
Program Coordinator, Materials Engineering and Science

Advisory Council

John T. Bendler, Ph.D.
    Associate Professor, Department of Chemistry and Chemical Engineering
Jon J. Kellar, Ph.D.
    Associate Professor, Department of Metallurgical Engineering
Lidvin Kjerengtroen, Ph.D.
    Professor, Department of Mechanical Engineering
Fernand D.S. Marquis, Ph.D., P.E.
    Professor, Department of Materials and Metallurgical Engineering
Larry G. Meiners, Ph.D.
    Professor, Department of Electrical and Computer Engineering
Andrey Petukhov, Ph.D.
    Associate Professor, Department of Physics
Terje Preber, Ph.D., P.E.
    Chair and Professor, Department of Civil and Environmental Engineering
Jan A. Puszynski, Ph.D.
    Professor, Department of Chemistry and Chemical Engineering

The Doctor of Philosophy Program in Materials Engineering and Science 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
Polymer Matrix Composites
Reaction Kinetics
Semiconductor Materials
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 Chairman 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, 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	30-20
Total beyond the B.S. degree	80

I. GENERAL PROGRAM REQUIREMENTS (Minimum program requirements: 80 credits)

MS 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 MS program of study (subject to approval).

ANALYTICAL MATHEMATICS (3 credits)

ME 772	Applied Engineering Analysis I	3
PHYS 671	Mathematical Physics I	3
PHYS 673	Mathematical Physics II	3

NUMERICAL MATHEMATICS (3 credits)

CEE 784	Modeling and Computation in Civil Engineering	3
CEE 785	Applications of Finite Element Methods in Civil Engineering	3
ME/CHE 616	Computational Methods in Transfer Phenomena	3
MATH 687	Statistical Design and Analysis of Experiments	3
ME 773	Applied Engineering Analysis II	3

MET 714	Advanced Metallurgical Simulation Techniques	3

PROGRAM EMPHASIS (30 credits)

See Sections II and III below for the two program emphasis areas available: Materials Science (Sec. II) and Materials Engineering (Sec. III).

RESEARCH (20 credits min.)

MES 800	Dissertation Research	
(19 credits min.)		
MES 860	Graduate Seminar	
(1-0)		

A maximum of 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 or engineering emphasis, but students are not limited to this selection. Students may take courses out of each emphasis when developing their programs of study, subject to approval of their committee.

II. SCIENCE EMPHASIS REQUIREMENTS (Minimum program requirements: 30 credits)

THERMODYNAMICS OF SOLIDS (3 credits)

MES 712	Interfacial Phenomena	3
MET 736	Thermodynamics of Solids	3
MET 738	Solid State Phase Transformations	3
PHYS 743	Statistical Mechanics	3

TRANSPORT IN SOLIDS (3 credits)

ChE 713	Transport Phenomena: Heat	3
ChE 714	Transport Phenomena: Mass	3
EE 765	Semiconductor Theory and Devices	3
MES 728	Heterogeneous Kinetics	3
MES 731	Solid State Diffusion	3

CRYSTAL STRUCTURE/CHEMISTRY OF SOLIDS (3 credits)

CHEM 652	Advanced Inorganic Chemistry	3
MES 697	Atomic/Molecular Structure of Materials	0.5-7
MES 699	Structure-Property Relationships of Materials	1-5
GEOL 711	Crystal Chemistry of Minerals	3
MES 737	Solid State Physics I	3
MES 739	Solid State Physics II	3
PHYS 777	Quantum Mechanics I	3
PHYS 779	Quantum Mechanics II	3

BULK OR SURFACE ANALYSIS (3 credits)

CHEM 736	Advanced Instrumental Analysis	1
EM 717	Experimental Methods of Engineering	2
GEOL 647	Quantitative X-ray Diffraction Analysis	3
GEOL 643	Theory of Microbeam Instruments	3
GEOL 742	Operation of Scanning Electron Microscope	1
GEOL 747	AA/ICP Spectroscopy	1
MES 734	SEM and TEM Analysis	2

FUNDAMENTAL ENGINEERING MECHANICS (6 credits)

Courses from the Engineering emphasis section can also be used to fulfill this requirement.

ME 424	Fatigue Design of Mechanical Components	3
ME 425	Probabilistic Mechanical Design	3
ME 442	Failure Modes of Engineering Materials	3
MET 625	Strengthening Mechanism in Materials	3
MET 540	Mechanical Metallurgy	3
MET 443	Composites Materials	3

DISSERTATION RELATED TOPICS (12 credits)

III. ENGINEERING EMPHASIS REQUIREMENTS (minimum program requirements: 30 credits)

ANALYTICAL MECHANICS

ME 713	Advanced Heat Transfer	3
MES 713	Advanced Solid Mechanics	3
MES 770	Continuum Mechanics	3
ME 623	Advanced Mechanical	

	Vibrations	3

ELASTICITY/PLASTICITY

CEE 646	Stability of Soil and Rock Slopes	3
CEE 743	Advanced Soil Mechanics I	3
CEE 744	Advanced Soil Mechanics II	3
CEE 749	Experimental Solid Mechanics	3
MES 713	Advanced Solid Mechanics	3
MinE 712	Rock Mechanics III	3
MinE 750	Rock Slope Engineering	3

FAILURE ANALYSIS FRACTURE MECHANICS

CE 717	Advanced Composites	3
CE 757	Advanced Reinforced Concrete - Theory and Design	3
CE 716	Advanced Engineering Materials Technology	3
MES 714	Mechanics of Composite Materials	3

FUNDAMENTAL MATERIAL SCIENCE

(6 credits)

Courses from the Science Emphasis section can also be used to fulfill this requirement

MES 697	Atomic/Molecular Structure of Materials	0.5-7
MES 699	Structure-Property Relationships of Materials	1-5
MES 698	Thermochemical Processing Fundamentals	1-
5 MES 799	Advanced Instrumental Analysis	1-3
CHEM 420	Organic Chemistry III	4
CHEM 452	Inorganic Chemistry	3
CHEM 426	Polymer Chemistry	3
CHEM 797	Chemistry of Materials I: Structure and Properties	4
CHEM 798	Chemistry of Materials II: Synthesis and Physical Methods	2
CHE 474	Introduction to Polymer Technology	2
CHE 674	Polymer Technology	3
PHYS 437	Semiconductor Physics	3
GEOL 647	Qualitative XRD Analysis	3
MET 453	Oxidation and Corrosion of Metals	3

A qualifying examination is required to enter into a Ph.D. program. Students applying for the program will take the examination no later than the second semester of residence. The MES Ph.D. Council and the student's advisory committee will be responsible for administering the examination and evaluating the student's performance. The MES Ph.D. Program Coordinator will inform the Dean of Graduate Education and Research of the results of the examination.

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. Student Handbook.

Stuart D. Kellogg
Pietz Professor, Industrial Engineering; Program Coordinator, Technology Management

South Dakota School of Mines &Technology Faculty

E. Ashworth, M.Sc., M.S., Ph.D.
  Professor, Mining Engineering Program
Frank J. Matejcik, M.S., Ph.D.
  Associate Professor, Industrial Engineering
Carter J. Kerk, M.S., Ph.D.
  Assistant Professor, Industrial Engineering

University of South Dakota Faculty

Michael K. Madden, Ph.D.
  Professor, Economics and Statistics
William Hearne, M.S., M.B.A.
  Assistant Professor, 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) and South Dakota State University (SDSU), it combines both technically oriented courses and courses in business and management.

Application should be made at the SDSM&T Office of Academic and Enrollment Services. 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 semester hours of natural and physical science (fields of geology, astronomy, biology, meteorology, chemistry, and physics) and which must include at least 3 credit hours of chemistry or physics.
3. Three semester hours each of Micro or Macroeconomics 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 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 24 credits of course work and six credits of research for the thesis option, or 32 credits of coursework for the non-thesis option. Twelve credits must be selected from USD and shall include the core courses below. 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 bulletin. The probation policy outlined in the SDSM&T bulletin 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, composed of faculty from both institutions, and file their committee program of study, with the SDSM&T Graduate Office and PMB/USD office according to the directions specified under "Supervision of the Master's Program" of the MASTER OF SCIENCE PROGRAMS section of this bulletin.

CORE COURSE REQUIREMENTS

TM 742	Engineering Management and Labor Relations	3
TM 661	Engineering Economics for Managers	3
TM 665	Project Management	3
BAD 720	Quantitative Analysis*	3
BAD 760	Production and Operations Management**	3
BAD 782	Managerial Economics	3

*May be satisfied through TM 631 Optimization Techniques

**May be satisfied through TM 663 Operations Planning

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 available programs as directed by the student's guidance committee.

TM courses are available in distance learning mode.

SDSM&T COURSES

TM 621	Management Information Systems	3
TM 631	Optimization Techniques	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
TM 750	Technology Assessment	3
GE 650	Business Structure & Management Processes	3
MinE 641	Environment and Reclamation	3
MinE 643	Economics of Mining	3
MinE 645	Health and Safety Law	3
Math 485	Statistical Quality Control and Reliability	4

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 742	Eng. Mgt. & Labor Relations	3
TM 661	Eng. Econ. for Managers	3
BA 760	Production	3
BA 720	Quantitative Analysis	3
ECON 782	Managerial Economics	3
TM 665	Project Management	3
TM 732	Stochastic Models in Operations Research	3
MinE 641	Environment & Reclamation	3
TM 700	Thesis Research	6
TOTAL		**30**

Student B

TM 742	Eng. Mgt. & Labor Relations	3
TM 661	Engineering Economics for Managers	3
TM 663	Operations Planning	3
BA 720	Quantitative Analysis	3
ECON 782	Managerial Economics	3
Math 481	Engineering Statistics	4
TM 665	Project Management	3
CSC 651	Database Design	3
Chem 630	Adv. Topics Analyt. Chem.	3
Chem 636	Adv. Instr. Analysis	3
Chem 750	Adv. Topics Inorgan. Chem.	1
TOTAL		**32**

DEFINITIONS OF ABBREVIATIONS USED IN COURSE DESCRIPTIONS

Abbreviation	Definition
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
EURS	European Studies
FREN	French
GE	General Engineering
GEOE	Geological Engineering
GEOG	Geography
GEOL	Geology
GERM	German
HIST	History
HUM	Humanities
IENG	Industrial Engineering
IS	Interdisciplinary Sciences
LAW	Law
MATH	Mathematics
ME	Mechanical Engineering
MET	Metallurgical Engineering
MINE	Mining Engineering
MES	Materials Engineering and Science
MSC	Military Science
MUAP	Applied Music
MUEN	Music Ensemble
MUS	Music
PE	Physical Education
PHIL	Philosophy
PHYS	Physics
POLS	Political Science
PSYC	Psychology
SOC	Sociology
SPAN	Spanish
SPCM	Speech
TM	Technology Management

Courses above 400 level are normally reserved for graduate studies; however, in some cases, undergraduate students may take graduate level courses.

ACCT 210 PRINCIPLES OF ACCOUNTING I
ACCT 211 PRINCIPLES OF ACCOUNTING II

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.

AEWR 790 SPECIAL TOPICS IN ATMOSPHERIC, ENVIRONMENTAL & WATER RESOURCES

1 to 3 credits. Prerequisites: Permission of department chair. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve reading, library research, laboratory work, and preparation of papers, as agreed in advance between student and instructor.

AEWR 793 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 800 DISSERTATION SEMINAR

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 is required.

ANTH 210 CULTURAL ANTHROPOLOGY

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.

ANTH 220 PHYSICAL ANTHROPOLOGY

3 credits. An examination of the origins of human culture, human ethnology, fossil evidence in the geologic time scale, and vertebrate genetic diversity.

ANTH 421 NATIVE NORTH AMERICAN ETHNOGRAPHY

3 credits. Prerequisite: SOC 100, or ANTH 210, or permission of instructor. An investigation of the relationships among environment, technology and social change in pre-colonial, colonial, and contemporary Native North America.

ART 111 DRAWING AND PERCEPTION I

3 credits. Studio drawing and visual perception with emphasis on references to American and European masters of art.

ART 112 DRAWING & PERCEPTION II

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.

ARTH 151 INDIAN ART HISTORY

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 credits. A historical survey of art from 25,000 BC to 1800 AD, with special emphasis on painting, sculpture, and architecture.

ARTH 320 MODERN ART AND ARCHITECTURE

3 credits. An exploration of the technological and cultural influences on materials and content of modern art in western civilization. Special emphasis on the works of contemporary American artists.

ARTH 490 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 faculty. A maximum of six (6) credits of special topics will be allowed for degree credit.

ARTH 494 INDEPENDENT STUDIES IN ART

1 to 3 credits. Prerequisite: Three semester hours of art or art history credit and permission of instructor. Seminar on specific problems in art with opportunities for dialogue, individual research, and interpretation. Study of topics selected from a suggested list. Possible methods of study to include guest lectures, field trips to studios or galleries, panel discussions, and slide presentations.

ATM 120 REMOTE SENSING/GLOBAL CLIMATE CHANGE I

(2-1) 3 credits. Prerequisites: Completion of MATH 1202 (trigonometry) or permission of instructor. Remote sensing/global climate change from the analysis of satellite data. Topics include: satellite sensors, orbits, calibration, and image registration; radiometric and geometric image enhancement; global issues of climate change, ozone depletion, and deforestation.

ATM 301 INTRODUCTION TO ATMOSPHERIC SCIENCES
(3-0) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. 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 302 CLIMATE AND GLOBAL CHANGE
(3-0) 3 credits. Basic physical principles are applied to the study of climate and climate change. Topics include major climatic controls, the major global chemical cycles and how they interact with climate, the distribution of different climate regimes around the globe, paleoclimates, global and regional climate change.

ATM 320 INTRODUCTORY SATELLITE METEOROLOGY
(2-1) 3 credits. Prerequisites: Completion of MATH 1202 (trigonometry); knowledge of at least one programming language (C preferred). This course emphasizes a hands-on approach to learning the fundamentals of satellite remote sensing using actual data. The course includes: satellite sensors, orbit mechanics, calibration, registration, navigation, electromagnetic radiation, digital image display, image processing, enhancement techniques, image transforms, filtering, and classification.

ATM 399 INTRODUCTION TO ATMOSPHERIC SCIENCES
(2-1) 3 credits. Prerequisite: Junior or senior standing or permission of instructor. 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. Use on-line web site for programmed learning and real-time forecasting exercises. (Experimental)

ATM 450 SYNOPTIC METEOROLOGY I
(2-1) 3 credits. Prerequisite: ATM 301. Weather analysis using surface synoptic weather charts, upper air charts, and vertical temperature-moisture soundings; the structure of extratropical storms; synoptic-scale processes responsible for development of precipitation and severe weather phenomena.

ATM 494 INDEPENDENT STUDIES IN ATMOSPHERIC SCIENCES
1-3 credits. Prerequisite: Permission of department chair. Directed independent study of topics of special interest in Atmospheric Sciences. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 3 credit hours.

ATM 501 ATMOSPHERIC PHYSICS
(3-0) 3 credits. Prerequisites: PHYS 213, MATH 231 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. This course provides the basis for the bulk of topics taught in the remainder of the curriculum.

ATM 605 AIR POLLUTION
(3-0) 3 credits. 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.

ATM 608 AIR QUALITY MODELING
(2-1) 3 credits. A treatment of diffusion, dispersion and source apportionment modeling for point, line, and area emissions. Gaussian diffusion, climatological dispersion, and effective variance least squares apportionment models will be treated in detail in laboratory applications. Some knowledge of computer programming is desirable.

ATM 610 ATMOSPHERIC RADIATIVE TRANSFER
(3-0) 3 credits. This course is designed to cover a broad range of topics concerning radiative transfer in planetary atmospheres. Areas covered are introduction to basic concepts: black body radiation, the greenhouse effect, absorption and transmission; remote sensing of temperature, gaseous components, clouds, surface features and minerals, Multiple Scattering - Theory; calculation methods: Eddington, delta-function, Adding and Monte Carlo approaches; and MIE theory: wave-particle interactions. Remote sensing includes: preprocessing, enhancement, image processing, classification, discrimination and spectral pattern recognition using Landsat digital data.

ATM 615 CLIMATE SYSTEMS MODELING
(3-0) 3 credits. Prerequisite: Permission of instructor. 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.

ATM 620 SATELLITE REMOTE SENSING I
(2-1) 3 credits. Prerequisite: Permission of instructor. Programming experience strongly recommended. 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.

ATM 630 RADAR METEOROLOGY
(3-0) 3 credits. 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.

ATM 640 ATMOSPHERIC ELECTRICITY
(3-0) 3 credits. Prerequisites: PHYS 213, MATH 231. 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.

ATM 650 SYNOPTIC METEOROLOGY II
(2-1) 3 credits. Prerequisites: ATM 450 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 the suite of forecasting models run daily by the National Center 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).

ATM 660 ATMOSPHERIC DYNAMICS
(3-0) 3 credits. Prerequisites: ATM 501 (may be taken concurrently), MATH 231 and PHYS 213. 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.

ATM 690 ADVANCED TOPICS IN ATMOSPHERIC SCIENCES
1 to 3 credits. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory work, and preparation of papers, as agreed in advance between student and instructor.

ATM 693 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 694 INDEPENDENT STUDIES IN ATMOSPHERIC SCIENCES
1 to 3 credits. Independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory work, and preparation of papers, as agreed in advance between student and instructor.

ATM 700 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 is required. Graduate research assistants and students receiving faculty supervision of their research are required to enroll in this course each semester.

ATM 701 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.

ATM 708 ATMOSPHERIC CHEMISTRY
(3-0) 3 credits. Prerequisite: One year of college chemistry. Chemical and radiative processes associated with formation of acid precipitation, wet and dry deposition, "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.

ATM 710 ADVANCED RADIATIVE TRANSFER
(3-0) 3 credits. Prerequisite: ATM 610. This advanced course covers the following topics in depth: Rotation, vibration and electronic transitions; line and band absorptions; MIE scattering theory; scattering by non-spherical particles; polarization and

Stokes theory; and lidar backscattering.

ATM 720 SATELLITE REMOTE SENSING 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.

ATM 730 ADVANCED RADAR METEOROLOGY
(3-0) 3 credits. Prerequisite: ATM 630. Fundamentals of Doppler signal processing; ambiguity problems and system design considerations; single-Doppler data interpretation; multiple-Doppler analysis and synthesis of wind fields; fundamentals of polarimetry; circular and linear polarimetric observations; inference of hydrometeor characteristics from polarimetric observations. Consideration of other techniques (multiple-wavelength, attenuation, wind profilers, lidars) as time permits.

ATM 740 ADVANCED ATMOSPHERIC ELECTRICITY
(3-0) 3 credits. Prerequisites: ATM 640, ATM 742. This course is a continuation of ATM 640 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 742 PHYSICS AND DYNAMICS OF CLOUDS
(3-0) 3 credits. Prerequisite: ATM 501. Cloud thermodynamics and dynamics, including liquid and ice phases; cloud buoyancy, numerical modeling of clouds and cloud observations.

ATM 743 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.

ATM 744 ATMOSPHERIC NUMERICAL MODELING
(3-0) 3 credits. Prerequisite: ATM 660. Basic governing equations; wave motion, scale analysis; numerical methods; Galerkin Methods; numerical prediction models; boundary layer; moisture and radiation parameterization.

ATM 751 APPLIED CLIMATOLOGY AND METEOROLOGY
(3-0) 3 credits. Prerequisites: ATM 301 and a basic course in statistics, e.g., MATH 481. Course surveys physical climatology including radiation, water, heat, and energy balances. A study is made of approaches to using meteorological and climatic information to aid in the solution of a range of problems wherein man's activities are affected by the weather. The applications of several statistical techniques to climatic data are also discussed. Each student is required to develop and present results of a problem oriented, applied climatological project.

ATM 760 ADVANCED ATMOSPHERIC DYNAMICS
(3-0) 3 credits. Prerequisite: ATM 660. Derivation, solution, and physical interpretation of the fundamental hydrothermodynamic equations by perturbation methods; and numerical methods. Advanced topics in large-scale atmospheric circulations.

ATM 762 GENERAL (GLOBAL) CIRCULATION
(3-0) 3 credits. A study of the general circulation of the atmosphere including quasi-geostropic equations; planetary waves; geostropic adjustment; barotropic, baroclinic instability; frontogenesis; tropical cyclones.

ATM 763 ATMOSPHERIC WAVES
(3-0) 3 credits. Prerequisites: ATM 660 or permission of instructor. The general theory of waves and the solution of the wave equation in several coordinate systems will be presented. Boundary conditions and the perturbation method will be emphasized. The application of wave theory to many atmospheric situations including sound waves, inertial waves, Rossby waves, gravity waves, etc. will be examined in detail.

ATM 770 BOUNDARY LAYER PROCESSES
(3-0) 3 credits. Prerequisites: ATM 501, ATM 660, 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.

ATM 773 MESOMETEOROLOGY
(3-0) 3 credits. Prerequisites: ATM 660 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.

ATM 790 ADVANCED TOPICS IN ATMOSPHERIC SCIENCES
1 to 3 credits. Prerequisite: Permission of department chair. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve reading, library research, laboratory work, and preparation of papers, as agreed in advance between student and instructor.

ATM 794 INDEPENDENT STUDIES IN ATMOSPHERIC SCIENCES
1 to 3 credits. Prerequisite: Permission of department chair. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve reading, library research, laboratory work, and preparation of papers, as agreed in advance between student and instructor.

BAD 101 SURVEY OF BUSINESS AND TECHNOLOGY
3 credits. The study of multinational business and its relationship to technology is analyzed relative to contemporary ethical and societal issues.

BAD 299 MANAGERIAL STATISTICS
(3-0) 3 credits. Prerequisite: Permission of instructor. 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), time series analysis and forecasting, smoothing techniques, and multiple regression techniques. (Experimental)

BAD 345 ENTREPRENEURSHIP
4 credits. Prerequisites: GE 250 and IENG 301 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. Cross listed with IENG 345.

BAD 350 LEGAL ENVIRONMENT OF BUSINESS
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 & MANAGEMENT
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; exploration of the decision-making process through case studies.

BAD 370 MARKETING
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.

BAD 399 FINANCIAL MANAGEMENT
3 credits. Prerequisite: ACCT 210 and 211. This course studies the decisions of the firm in regard to internal investment decisions and investment analysis. Technology applications to capital formation is emphasized. (Experimental)

BIOL 121 BASIC ANATOMY
(3-0) 3 credits. Anatomy of the human body. Basic biological principles and medical nomenclature.

BIOL 122 BASIC ANATOMY LABORATORY
(0-1) 1 credit. Pre- or co-requisite: 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 124 BASIC PHYSIOLOGY LABORATORY
(0-1) 1 credit. Pre- or co-requisite: 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 152 GENERAL BIOLOGY I LABORATORY
(0-1) 1 credit. Pre- or co-requisite: 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 154 GENERAL BIOLOGY II LABORATORY
(0-1) 1 credit. Pre- or co-requisite: BIOL 153. Laboratory exercises designed to reinforce subject material covered in BIOL 153 lectures.

BIOL 211 PRINCIPLES OF ECOLOGY
(3-0) 3 credits. Most of the course covers the relationship between organisms and the environment. The rest relates to man's influence on the earth. A prior course in biology is recommended.

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 232 GENERAL MICROBIOLOGY LABORATORY
(0-1) 1 credit. Prerequisites: CHEM 106/107 or equivalent, concurrent registration in CHEM 108 and CHEM 109 recommended. Pre- or co-requisite: 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 370 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 423 PATHOGENIC MICROBIOLOGY
(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 which include both normal flora and pathogens.

BIOL 424 PATHOGENIC MICROBIOLOGY LABORATORY
(0-1) 1 credit. Prerequisites: BIOL 232 or equivalent; pre- or co-requisite: 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 432 recommended but not required.

BIOL 432 INDUSTRIAL MICROBIOLOGY LABORATORY
(0-1) 1 credit. Prerequisites: BIOL 232 or equivalent; pre- or co-requisite: 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 485 TECHNOLOGY AND THE ENVIRONMENT
(3-0) 3 credits. Prerequisite: BIOL 211 or permission of instructor and upper-class standing. A course in the study of basic processes and principles of ecosystems and their modification by technological activities.

BIOL 490 SPECIAL TOPICS IN BIOLOGY
1 to 3 credits. Prerequisite: Upper-class standing. Intensive classroom study of selected biological topics. Taught as required.

BIOL 494 INDEPENDENT STUDIES IN BIOLOGY
1 to 3 credits. Directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or fieldwork, and preparation of papers, as agreed in advance between student and instructor.

BIOL 690 ADVANCED TOPICS IN BIOLOGY
1 to 3 credits. Prerequisite: Permission of instructor and major professor. Intensive classroom study of selected biological topics. Taught as required.

BIOL 694 INDEPENDENT STUDIES IN BIOLOGY
1 to 3 credits. Directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or fieldwork, and preparation of papers, as agreed in advance between student and instructor.

CEE 206 CIVIL ENGINEERING PRACTICE AND ENGINEERING SURVEYS I
(2-2) 4 credits. Prerequisite: An acceptable score on the Trigonometry Placement Examination; or MATH 1201 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. Computer applications are required.

CEE 207 ENGINEERING SURVEYS II
(0-2) 2 credits. Prerequisite: CEE 206 or permission of instructor. Fundamental principles, theories, and practices involved in directional control, triangulation, engineering astronomy, stadia, boundary surveys, public land survey system, mine surveys and a final road design project. Introduction to photogrammetry.

CEE 284 DIGITAL COMPUTATION APPLICATIONS IN CIVIL ENGINEERING
(3-0) 3 credits. Prerequisite: MATH 123. QBasic programming applications of numerical and digital computation methods in civil engineering. Roots of equations, numerical integration, matrix computations, solution of simultaneous equations, curve fitting techniques, and statistical methods as applied to civil engineering.

CEE 285 MICROCOMPUTER APPLICATIONS IN CIVIL ENGINEERING
(1-1) 2 credits. Prerequisites: CEE 284. Emphasis on microcomputer applications to civil engineering problems. Applications of spreadsheets, Math Cad, and other commonly available microcomputer software to the numerical methods studied in CEE 284.

CEE 298 COMPUTATIONAL METHODS IN CIVIL ENGINEERING
(2.5-0.5) 3 credits. Prerequisite: MATH 123. Topics include applications of numerical and digital computation methods to Civil Engineering problems using regression, interpolation, differentiation, integration and root solving techniques. Structured programming, spreadsheet computations and other current mathematical software will be employed in problem-solving activities. (Experimental)

CEE 316 ENGINEERING AND CONSTRUCTION MATERIALS
(2-1) 3 credits. Prerequisite: Preceded by or concurrent with EM 216, and CEE 285. 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.

CEE 326 INTRODUCTION TO ENVIRONMENTAL ENGINEERING
(3-0) 3 credits. Prerequisites: CHEM 114, EM 223 and CEE 285. An introduction to the theories, principles, and design of environmental engineering systems. Topics include water chemistry, water and wastewater treatment, solid and hazardous waste management, and the mass balance approach to systems analysis. This course is cross-listed with MINE 326.

CEE 327 ENVIRONMENTAL ENGINEERING PROCESS FUNDAMENTALS
(2-1) 3 credits. Prerequisite: CEE 326 or permission of instructor. Continuing study of the theories, principles, and design of environmental engineering systems. Emphasis is on the mass-balance approach to problem solving with consideration of kinetics and limitations of physical/chemical and biological processes. Laboratory reports with computer generated text, tables and figures are required.

CEE 336 HYDRAULIC SYSTEMS DESIGN
(2-1) 3 credits. Prerequisite: EM 223 and CEE 285. 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.

CEE 346 GEOTECHNICAL ENGINEERING I
(2-1) 3 credits. Prerequisite: EM 216 and CEE 285 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; 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 MINE 346.

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. Computer applications are required.

CEE 356 THEORY OF STRUCTURES I
(3-0) 3 credits. Prerequisites: EM 216 and CEE 285. 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 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 and 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 BS degree requirements. Directed research investigation of a selected problem culminating in an acceptable written report. Oral defense of the report and research findings is 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.

CEE 426/526 ENVIRONMENTAL ENGINEERING UNIT OPERATIONS AND PROCESSES
(3-0) 3 credits. Prerequisites: CEE 326 and CEE 327, or permission of instructor. A study of physical, chemical and biological processes employed in treatment of water for potable use and in renovation of wastewaters generated by society's activities. Computer applications are required. Students enrolling in CEE 526 will be held to a higher standard than those enrolling in CEE 426.

CEE 427/527 ENVIRONMENTAL ENGINEERING REMEDIATION PROCESSES
(3-0) 3 credits. Prerequisites: CEE 326 and CEE 327 or permission of instructor. Advanced study of unit operations and unit processes used in environmental engineering (solid waste environmental controls, carbon adsorption, ion exchange, air stripping, and techniques of insitu contaminant and remediation) with emphasis on conceptual and theoretical development. Limitations of theoretical expressions, development of experimentally derived coefficients, and relationship between theory and practice are discussed. Students enrolling in CEE 527 will be held to a higher standard than those enrolling in CEE 427.

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.

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. Computer applications are required. Students enrolling in CEE 533 will be held to a higher standard than those enrolling in CEE 433.

CEE 435 WATER RESOURCES SYSTEMS MANAGEMENT
(3-0) 3 credits. Prerequisites: CEE 336, CEE 337 and preceded by or concurrent with IENG 301. This course provides an introduction to the theory and application of systems analysis for management of water resources. Two-thirds of the course is devoted to systems analysis covering: linear and dynamic programming, sensitivity, optimization and multi-objective analysis. Application of these methods to decision making and water resources policy is

covered in the last third of the course.

CEE 437 WATERSHED AND FLOODPLAIN MODELING

(3-0) 3 credits. Prerequisites: CEE 336, CEE 337. This course will consist of the application of the HEC1 Flood Hydrograph Package and HEC2/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. Development of the model imputes will include review of hydrologic and hydraulic processes relating to the modeling options.

CEE 447 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. Computer applications are required.

CEE 448 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.

CEE 456 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. Computer applications are required.

CEE 457 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. Computer applications are required.

CEE 458 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 466 CIVIL ENGINEERING CAPSTONE DESIGN

(3-0) 3 credits. Prerequisites: one of two track electives in the specialty area and concurrent registration in the second. Content will include a major engineering design experience integrating fundamental concepts of mathematics, basic science, engineering science, engineering design, communication skills, humanities and the social sciences.

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.

CEE 490 SPECIAL TOPICS IN CIVIL ENGINEERING

1 to 3 credits. Prerequisite: Senior standing and permission of instructor. Lecture course involving the study of a topic or field of special interest.

CEE 492 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 494 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, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor. A description of the work to be performed must be filed in the department office.

CEE 628 ENVIRONMENTAL ENGINEERING MEASUREMENTS

(2-1) 3 credits. Prerequisite: Permission of instructor. 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. Use of computers is required.

CEE 635 WATER RESOURCES ENGINEERING
(3-0) 3 credits. Prerequisite: Permission of instructor. Principles of water resource use objectives, law, economics, government policies, planning, management, conservation and engineering practices.

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. Computer applications are required.

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 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. Computer applications are required.

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 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 aramic design and testing of primary structural members including prestressing elements. Application of composite materials to engineering.

CEE 656 ADVANCED STRUCTURAL ANALYSIS
(2-1) 3 credits. Prerequisite: Permission of instructor. 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. Computer applications are required.

CEE 690 ADVANCED TOPICS IN CIVIL ENGINEERING
1 to 3 credits. Prerequisite: Senior or graduate standing and permission of instructor. Lecture course involving the study of a topic or field of special interest.

CEE 694 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, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor. A description of the work to be performed must be filed in the department office.

CEE 700 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 the thesis and research findings is required.

CEE 702 GRADUATE RESEARCH (NON-THESIS)

Credit to be arranged; not to exceed 3 credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the M.S. non-thesis option. Directed research investigation of a selected problem culminating in an acceptable written report. Oral defense of the report and research findings is required.

CEE 716 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 717 ADVANCED COMPOSITES

(2-1) 3 credits. Prerequisite: Permission of instructor. Advanced study of the basic principles and properties of composites. Fabrication and preparation of composite specimens for destructive and nondestructive testing. Stress concentration study under different load cases. Analysis and design of fasteners and adhesive bonding. Practical applications to structural components.

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. Computer applications will be required.

CEE 724 INDUSTRIAL AND HAZARDOUS WASTEWATER TREATMENT AND DISPOSAL

(3-0) 3 credits. Prerequisites: CEE 326, CEE 327 and CEE 426, or permission of instructor. Characteristics and composition of industrial wastes, sampling, methods of analysis, and remedial methods for treatment and disposal will be discussed. Special consideration will be given to the unit operations and unit processes used in the treatment of industrial wastewaters.

CEE 725 TREATMENT, DISPOSAL AND MANAGEMENT OF HAZARDOUS WASTE

(3-0) 3 credits. Prerequisite: Permission of instructor. 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 OPERATIONAL HYDROLOGY

(4-0) 4 credits. Prerequisites: MATH 281 and CEE 337 or permission of instructor. Stochastic process, probability and statistics applied to hydrologic problems. Data synthesis, correlation, time series and spectral analysis. Linear systems theory application to hydrologic cycle components and rainfall-runoff processes.

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 732 WATER RESOURCE SYSTEM ENGINEERING

(2-1) 3 credits. Prerequisite: CEE 336 or permission of instructor. The use of system analysis methods in the planning and management of complex water resource systems. Application of systems methodologies including mathematical models to water projects having multiple goals, constraints and alternatives.

CEE 733 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 734 TECHNIQUES OF SURFACE WATER RESOURCE AND WATER QUALITY INVESTIGATIONS II

(1-2) 3 credits. Prerequisite: CEE 326, CEE 327, CEE 336, CEE 733, or permission of instructor. More advanced 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: radiochemistry, hazardous waste investigations for radionuclides and organics, stable isotopes, tracing, advanced statistical analysis of hydrologic and water quality data, and water quality methods for organics and radioactive chemicals.

CEE 743 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 744 ADVANCED SOIL MECHANICS II

(3-0) 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; earth reinforcing techniques.

CEE 747 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 749 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 757 ADVANCED REINFORCED CONCRETE THEORY AND DESIGN

(2-1) 3 credits. Prerequisite: Permission of instructor. Comprehensive study of properties of concrete and the theoretical, experimental, and practical aspects as related to design of framing systems. Limit analysis and design of reinforced concrete frames. Permissible rotation capacities. Serviceability check. Simple space frames and special structures subjected to combined loadings, shear, torsion, and bi-axial bending. Computer applications are required.

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. Computer applications are required.

CEE 785 APPLICATIONS OF FINITE ELEMENT METHODS IN CIVIL ENGINEERING

(3-0) 3 credits. Prerequisite: Permission of instructor. 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. Computer applications are required.

CEE 790 ADVANCED TOPICS IN CIVIL ENGINEERING

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course involving the study of a topic or field of special interest.

CEE 793 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 794 INDEPENDENT STUDIES IN CIVIL ENGINEERING

1 to 3 credits; not to exceed 3 credits toward fulfillment of M.S. degree requirements. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. This may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in

advance between student and instructor. A description of the work to be performed must be filed in the department office.

CENG 241 REAL-TIME COMPUTER APPLICATIONS
(3-1) 4 credits. Prerequisite GE 112 or equivalent, CSC 150 completed or concurrent. This course builds on previous programming experience to introduce the student to real-time computing with application to instrumentation and control systems. Each student must build a PEL interface kit which will be used in the course. PCs with the C programming language are used in the course.

CENG 244 INTRODUCTION TO DIGITAL SYSTEMS
(3 -1) 4 Credits. Prerequisite: Completion of MATH 1023 (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 250 SPECIAL TOPICS IN COMPUTER ENGINEERING I
1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits of special topics is allowed for degree credits. Taught as required.

CENG 252 INDEPENDENT STUDIES IN COMPUTER ENGINEERING I
1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits of special topics is allowed for degree credits. Taught as required.

CENG 314 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. Graduation credit will not be allowed for both this course and CSC 314.

CENG 342 DIGITAL SYSTEMS
(3-1) 4 credits. Prerequisite: CENG 244, CENG 241. 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 - 2 credits)

CENG 350 SPECIAL TOPICS IN COMPUTER ENGINEERING I
1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits of special topics is allowed for degree credits. Taught as required.

CENG 352 INDEPENDENT STUDIES IN COMPUTER ENGINEERING II
1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits of special topics is allowed for degree credits. Taught as required.

CENG 400 UNDERGRADUATE RESEARCH
Credits to be arranged; not to exceed 4 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 420/520 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. Students enrolling in CENG 520 will be held to a higher standard than those enrolling in CENG 420. (Design content - 2 credits)

CENG 442 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 - 2 credits)

CENG 444 COMPUTER NETWORKS
(3-1) 4 credits. Prerequisite: CENG 244, MATH 381 or 333 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 - 2 credits)

CENG 446 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 - 2 credits)

CENG 447 COMPUTER APPLICATIONS
(3-1) 4 credits. Prerequisites: CENG 241, CSC 150. This course provides an introduction to programming digital systems in high level languages such as C and C++. It covers computer interfacing fundamentals, elementary computer architecture as well as an introduction to software engineering. (Design content - 2 credits)

CENG 448 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 - 2 credits)

CENG 450 SPECIAL TOPICS IN COMPUTER ENGINEERING III
1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits of special topics is allowed for degree credits. Taught as required.

CENG 452 INDEPENDENT STUDIES IN COMPUTER ENGINEERING III
1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits of special topics is allowed for degree credits. Taught as required.

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 COMPUTER ENGINEERING DESIGN I
(1-0) 1 credit. Prerequisites: CENG 342, EE 321 . Completed or concurrent CSC 477, EE 311, EE 312, ENGL 289. This course will focus on the design process and culminate with faculty approval of design projects. Typical topics included are: developing a product mission statement, identifying the customer and customer needs, developing target specifications, consideration of alternative designs using a decision matrix, project management techniques, legal and ethical issues, FCC verificiation and certification, use of probability and statistics for reliable design, interpretation of data sheets, and component selection. (Design content - 1 credit)

CENG 492 COMPUTER ENGINEERING DESIGN II
(2-0) 2 credits. Prerequisites CENG 491. This course is a continuation of CENG 491. Final design, construction, test and evaluation of the design project initiated in CENG 491. (Design content - 1 credit)

CHE 111 INTRODUCTION ENGINEERING MODELING
(0-1) 1 credit. Prerequisites: an acceptable score on the Basic Algebra portion of the Calculus I Qualifying Examination. Pre- or co-requisite: 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, blueprints, and process flowsheets (P & IDs); and an introduction to a CAD program such as Autocad or CadKey 7.

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.

CHE 218 CHEMICAL ENGINEERING II
(3-0) 3 credits. Prerequisites: CHE 217, MATH 124. 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. Pre- or co-requisite: 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. Pre- or co-requisite: 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 231. 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.

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.

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
(3-0) 3 credits. Prerequisites: CHE 217, GE 113, concurrent with MATH 231 or permission of instructor. The application of digital computer techniques to the solution of chemical engineering problems.

CHE 361 CHEMICAL ENGINEERING LABORATORY II
(0-1) 1 credit. Prerequisite: CHE 218. Laboratory experiments on momentum transfer.

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. 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 431 CHEMICAL ENGINEERING DESIGN I
(2-2) 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 432 CHEMICAL ENGINEERING DESIGN II
(2-1) 3 credits. Prerequisite: CHE 431. A continuation of CHE 431.

CHE 433 PROCESS CONTROL
(3-0) 3 credits. Prerequisite: MATH 231 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 DESIGN OF SEPARATION PROCESSES
(1-1) 2 credits. Prerequisite: CHE 431. 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 450/550 SYSTEMS ANALYSIS APPLIED TO CHEMICAL ENGINEERING
(3-0) 3 credits. Prerequisites: 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.

CHE 461 CHEMICAL ENGINEERING LABORATORY IV
(0-1) 1 credit. Prerequisite: CHE 318. Laboratory experiments on mass transfer.

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 575 will be held to a higher standard than students enrolling in CHE 475.

CHE 475/575 EXPERIMENTAL POLYMER TECHNOLOGY
(0-1) 1 credit. Pre- or co-requisite: 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 & operations will be discussed. Students enrolling in CHE 584 will be held to a higher standard than those enrolling in CHE 484.

CHE 490 SPECIAL TOPICS IN CHEMICAL ENGINEERING
1 to 3 credits. Lecture course on a topic or field of special interest. A maximum of six (6) credits of special topics will be allowed for degree credit.

CHE 494 INDEPENDENT STUDIES IN CHEMICAL ENGINEERING
1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or fieldwork, and preparation of papers, as agreed in advance between student and instructor.

CHE 616 COMPUTATIONS IN TRANSPORT PHENOMENA
(3-0) 3 credits. Prerequisite: MATH 374 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 632 ADVANCED CHEMICAL ENGINEERING DESIGN
(2-2) 4 credits. Prerequisite: CHE 432. The economic, scientific and engineering factors relating to the location, design and construction of chemical plants; loss and profit analysis; size, shape and design problems; and control equipment.

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. Cross-listed with MET 676.

CHE 690 ADVANCED TOPICS IN CHEMICAL ENGINEERING

1 to 3 credits. Lecture course on a topic or field of special interest. A maximum of six (6) credits of advanced special topics will be allowed for degree credit.

CHE 694 INDEPENDENT STUDIES IN CHEMICAL ENGINEERING

1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or fieldwork, and preparation of papers, as agreed in advance between student and instructor.

CHE 700 GRADUATE RESEARCH (THESIS)

Credit to be arranged; not to exceed 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.

CHE 702 GRADUATE RESEARCH (NON-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. non-thesis option. Directed research investigation of a selected problem culminating in an acceptable written report. Oral defense of the report and research findings is required.

CHE 712 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 712.

CHE 713 TRANSPORT PHENOMENA: HEAT

(3-0) 3 credits. 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 methods. This course is cross-listed with ME 713.

CHE 714 TRANSPORT PHENOMENA: MASS

(3-0) 3 credits. Principles of binary and multicomponent diffusion in gases, liquids, and solids. Unsteady state diffusion. Analysis of convective mass transfer. Mass transfer coupled with chemical reaction. Dispersion in homogeneous and heterogeneous systems. Transport through membranes. Cross listed with MES 714 and GEOE 714.

CHE 721 ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS I

CHE 722 ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS II

(3-0) 3 credits each. 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 790 ADVANCED STUDIES IN CHEMICAL ENGINEERING

1 to 3 credits. Lecture course or directed advanced study of a topic or field of special interest. Advanced study may involve readings, library research, laboratory or fieldwork and preparation of papers, as agreed in advance between student and instructor. A maximum of six (6) credits of special topics courses will be allowed for degree credit.

CHE 794 INDEPENDENT STUDIES IN CHEMICAL ENGINEERING

1 to 3 credits. Prerequisite: Permission of instructor. Directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or fieldwork, and preparation of papers, as agreed in advance between student and instructor.

CHEM 100 INTRODUCTORY CHEMISTRY

(3-0) 3 credits. Prerequisite: One year of high school algebra or concurrent registration in MATH 095. 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 a science or engineering degree. Not recommended for nursing majors.

CHEM 106 CHEMISTRY SURVEY
(3-0) 3 credits. Prerequisite: One year of high school algebra or MATH 095. 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 IS).

CHEM 107 EXPERIMENTAL CHEMISTRY SURVEY
(0-1) 1 credit. Pre or corequisite: Chem 106. Laboratory designed to accompany CHEM 106.

CHEM 108 INTRODUCTORY 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 IS).

CHEM 109 EXPERIMENTAL ORGANIC AND BIOCHEMISTRY
(0-1) 1 credit. Pre or corequisite: CHEM 108. Laboratory designed to accompany CHEM 108. May not be used for credit toward an engineering or science degree (except IS).

CHEM 112 GENERAL CHEMISTRY I
(3-0) 3 credits. Prerequisites: High school chemistry (or CHEM 100 completed with a grade of C- or better), high school algebra or MATH 095, and an acceptable score on the Chemistry Diagnostic Test. An in-depth examination of the principles of chemistry including properties of matter, atomic structure, stoichiometry, reactions in aqueous solution, thermochemistry, electronic structure, periodic properties, bonding, states of matter, and intermolecular forces.

CHEM 113 EXPERIMENTAL GENERAL CHEMISTRY
(0-1) 1 credit. Pre 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. Properties of solutions; chemical thermodynamics; kinetics; gaseous and acid-base equilibria; electrochemistry and redox reactions; selected topics in the descriptive chemistry of the elements.

CHEM 115 EXPERIMENTAL GENERAL CHEMISTRY II
(0-1) 1 credit. Prerequisite: CHEM 113. Pre 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: 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 216 FUNDAMENTALS OF ORGANIC CHEMISTRY
(3-0) 3 credits. Prerequisite: CHEM 114. A one-semester survey of all the major topics of organic chemistry. The functional group approach is adopted to acquaint students needing breadth of coverage in the context of a one-semester organic course. Topics include principles of organic structure, nomenclature, synthesis and reactivity of organic compounds including their applications by society.

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 I
(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 232 ANALYTICAL CHEMISTRY I
(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.

CHEM 233 EXPERIMENTAL ANALYTICAL CHEMISTRY I

(0-1) 1 credit. Pre or corequisite: CHEM 115. Laboratory to accompany CHEM 230 and CHEM 232. Experimental methods and techniques of gravimetry, titrimetry, pH, and UV-Vis and AA spectrometry.

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 292 CHEMISTRY OUTREACH

(0.5-0.5) 1 credit. Prerequisite: CHEM 107 or CHEM 113. 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 BS in Chemistry.

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 327 EXPERIMENTAL ORGANIC CHEMISTRY I

(0-2) 2 credits. Pre or corequisite: CHEM 115. Pre- or co-requisite: 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 329 EXPERIMENTAL ORGANIC CHEMISTRY II

(0-2) 2 credits. Prerequisite: CHEM 327. Pre or corequisite: CHEM 328. Syntheses of organic compounds. Structural characterization is performed by instrumental methods of analysis including infrared and nuclear magnetic resonance spectrometry.

CHEM 332 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.

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 342 PHYSICAL CHEMISTRY I

(2-0 or 3-0) 2 or 3 credits. Prerequisites: CHEM 114, MATH 225. Pre or corequisite: PHYS 213. Prerequisite for students enrolling for 2 credits: CHE 222. Modules 1, 2, and 3 are required for chemistry majors; chemical engineering majors are required to take modules 2 and 3.

Module 1: (1-0) 1 credit. Thermal characterization of chemical systems. Material covered: liquid and gas equations of state, thermochemistry, heats of reaction, Gibbs energy and entropy changes in chemical reactions, chemical potential, fugacities.

Module 2: (1-0) 1 credit. Solutions, colloids, and suspensions. Material covered: ideal and non-ideal solutions, colligative properties, colloidal and polymer structure, self-assembly.

Module 3 (1-0) 1 credit. Phase diagrams. Material covered: Gibbs phase rule, coexistence curves in single component systems, binary and ternary phase diagrams, influence of pressure and temperature.

CHEM 343 EXPERIMENTAL PHYSICAL CHEMISTRY

(0-1 or 0-2) 1 or 2 credits. Prerequisites: CHEM 220 or CHEM 327, CHEM 233 and CHEM 342, pre or corequisite: CHEM 344. Experimental methods used in modern physical chemistry. Spectroscopic, kinetic, thermostatic, and electrochemical techniques are studied. Chemistry majors must register for 2 credits; chemical engineering majors register for 1 credit.

CHEM 344 PHYSICAL CHEMISTRY II

(2-0 or 3-0) 2 or 3 credits. Prerequisite: CHEM 342 and PHYS 213. Modules 4, 5, and 6 are required for chemistry majors; chemical engineering majors are required to take modules 4 and 5.

Module 4: (1-0) 1 credit. Kinetic-Molecular Theory and Transport Properties. Material covered: Maxwell-Boltzmann distribution, viscosity and diffusivity of gases and liquids, thermal conductivity, estimation of transport coefficients.

Module 5: (1-0) 1 credit. Ionic equilibria and electrochemistry. Material covered: electrochemical cells, structure and dynamics of ions in solution, cell potentials, Nernst equation, introduction to corrosion.

Module 6: (1-0) 1 credit. Spectroscopy and Quantum Theory. Material covered: Planck's hypothesis, Schrödinger equation, quantum theory, hydrogenic atoms, quantum states, and electronic transitions.

CHEM 345 EXPERIMENTAL PHYSICAL CHEMISTRY II

(0-1) 1 credit. Prerequisites: CHEM 343 and CHEM 344. A continuation of CHEM 343. Electrochemical kinetic and spectroscopic methods are emphasized.

CHEM 370 CHEMICAL LITERATURE

(1-0) 1 credit. Prerequisites: CHEM 230 or CHEM 232 and CHEM 252, pre or corequisite: CHEM 328. The use of the chemical library. Character of the various chemical journals, dictionary, reference books, computer literature searching, and other sources of information. Oral and 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 422 ENVIRONMENTAL ORGANIC CHEMISTRY

(3-0) 3 credits. Prerequisite: CHEM 114. A course in organic chemistry emphasizing hazardous organic compounds commonly used industrially and the effect of those compounds on the environment. Duplicate credit for CHEM 422 and CHEM 326 not allowed.

CHEM 424/524 SPECTROMETRIC METHODS OF 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 435 EXPERIMENTAL INSTRUMENTAL ANALYSIS

(0-2) 2 credits. Pre 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 444/544 INDUSTRIAL ORGANIC CHEMISTRY

(3-0) 3 credits. Prerequisite: 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. Pre 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 453/553 EXPERIMENTAL INORGANIC CHEMISTRY

(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. Student enrolling in CHEM 553 will be held to a higher standard than those enrolling in CHEM 453.

CHEM 460 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.

CHEM 480 TOXICOLOGY FOR SCIENTISTS AND ENGINEERS

(3-0) 3 credits. Prerequisites: CHEM 114 and permission of instructor. An introduction to the fundamentals and industrial aspects of toxicology. Topics include: background physiology and biology, terminology and methods of human/animal studies, systematic classification of toxic substances and other industrial hazards, legal and regulatory aspects, industrial hygiene, recognition and control of potential industrial toxins. Emphasis on toxic substances in the chemical, metallurgical and mining industries as they relate to environmental, occupational and consumer toxicology.

CHEM 482/582 ENVIRONMENTAL CHEMISTRY

(3-1) 4 credits. Prerequisites: CHEM 114, CHEM 115, and at least junior standing. The study of pollutants and their reactions, fate and transport in air, water and soil environments. Laboratory included. Students enrolling in CHEM 582 will be held to a higher standard than those enrolling in CHEM 482.

CHEM 490 SPECIAL TOPICS IN CHEMISTRY

(1, 2 or 3-0) 1 to 3 credits. Discussion of topics or fields of special interest. Course activities in addition to lecture may involve outside readings, library research, laboratory or fieldwork, and preparation of papers, as agreed in advance between student and instructor. A maximum of six (6) credits of special topics and independent study credits will be allowed for degree credit.

CHEM 494 INDEPENDENT STUDIES IN CHEMISTRY

1 to 3 credits. Directed independent study of a topic or field of special interest and may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and 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 634 SPECTRAL INTERPRETATION

(2-0) 2 credits. Prerequisites: CHEM 230 or 232 and CHEM 328. The theory and interpretation of spectroscopic data, including UV-VIS, IR, NMR, and MS. The optional laboratory (CHEM 635) provides hands-on experience in obtaining and interpreting spectra of samples of commercial interest.

CHEM 635 SPECTRAL INTERPRETATION LABORATORY

(0-1) 1 credit. Prerequisites: Concurrent registration in CHEM 634. Laboratory to accompany CHEM 634. Hands-on experience in obtaining and interpreting UV-VIS, IR, and NMR spectra of samples, including those of commercial interest.

CHEM 642 QUANTUM CHEMISTRY

(3-0) 3 credits. Prerequisites: MATH 225 and CHEM 344. The use of wave mechanics to explain atomic and molecular structure. Descriptive methods are emphasized.

CHEM 652 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.

CHEM 726 IONIC ORGANIC REACTIONS
(3-0) 3 credits. Prerequisites: CHEM 328 or its equivalent. Physical organic chemistry with the main emphasis on the chemical aspects of organic theory.

CHEM 740 ADVANCED TOPICS IN PHYSICAL CHEMISTRY
1 to 3 credits. Prerequisite: CHEM 344. Topics which may be covered, according to student demand, include absorption, catalysis, colloids, electrochemistry, heterogeneous equilibria (phase rule), etc.

CHEM 750 ADVANCED TOPICS IN INORGANIC CHEMISTRY
1 to 3 credits. Prerequisite: CHEM 452 or equivalent. Topics selected to broaden the background of the individual student.

CP 201 COOPERATIVE EDUCATION (FALL)
CP 301 COOPERATIVE EDUCATION (FALL)
CP 401 COOPERATIVE EDUCATION (FALL)
CP 202 COOPERATIVE EDUCATION (SPRING)
CP 302 COOPERATIVE EDUCATION (SPRING)
CP 402 COOPERATIVE EDUCATION (SPRING)
CP 204 COOPERATIVE EDUCATION (SUMMER)
CP 304 COOPERATIVE EDUCATION (SUMMER)
CP 404 COOPERATIVE EDUCATION (SUMMER)
(2-0) 2 credits. Prerequisite: One full academic year of studies and have maintained a minimum 2.5/4.0 GPA. 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 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 the Director of Cooperative Education and the departmental Cooperative Education representative in order to enroll.

CP 601 CAREER PLANNING - COOPERATIVE INTERNSHIP
(2-0) 2 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.

CP 602 CAREER PLANNING - COOPERATIVE INTERNSHIP
(2-0) 2 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.

CP 604 CAREER PLANNING - COOPERATIVE INTERNSHIP
(2-0) 2 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 101 COMPUTER LITERACY
Variable credit up to three hours. This course will introduce students to what computers are and what they do. The course content will vary from semester to semester and may include word processing, spreadsheets, databases and other application programs along with the computer language BASIC. This course may not be counted toward any mathematics, computer science, or engineering degree. Other majors should consult their departments on policy regarding this course.

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. This course cannot be used for graduation

credit in any engineering or non-interdisciplinary degree program at SDSM&T.

CSC 150 COMPUTER SCIENCE I
(2-1) 3 credits. Prerequisites: Completion of MATH 1023 (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.

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 MATH 1023 (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 290 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 devoted to the study of a topic or field of special interest. May be repeated to a total of 5 credit hours.

CSC 294 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. Independent study may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 5 credit hours.

CSC 314 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. Cross listed with CENG 314 Graduation credit will not be allowed for both this course and CENG 314.

CSC 341 COMPUTER ORGANIZATION AND DESIGN
(4-0) 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.

CSC 361 LINEAR OPTIMIZATION
(3-0) 3 credits. Prerequisite: MATH 231 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.

CSC 370 PROGRAMMING LANGUAGE CONCEPTS
(3-0) 3 credits. Prerequisite: 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. This course together with CSC 471 form a two-course sequence.

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 390 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 devoted to the study of a topic or field of special interest. May be repeated to a total of 5 credit hours.

CSC 394 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. Independent study may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 5 credit hours.

CSC 400 UNDERGRADUATE RESEARCH
Credit to be arranged; not to exceed 6 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 6 credit hours.

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 ADVANCED DIGITAL SYSTEMS
(3-0) 3 credits. Prerequisites: CSC 341 or permission of instructor. Content: Memory and disk systems, bus and I/0 systems, parallel processing. Applications of digital systems in real-time processing. Graduation credit will not be allowed for both this course and CENG 446.

CSC 441 DATA COMMUNICATIONS
(4-0) 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.

CSC 445/545 THEORY OF COMPUTATION
(3-0) 3 credits. Prerequisite: 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, neural networks.

CSC 461 NUMERICAL ANALYSIS
(3-0) 3 credits. Prerequisites: MATH 225 and either MATH 231 or MATH 315. Interpolation, solution of higher degree algebraic and transcendental equations, least squares, numerical differentiation and integration, direct and iteractive methods for solving systems of linear, algebraic equations, approximation theory.

CSC 462 NON-LINEAR OPTIMIZATION
(3-0) 3 credits. Prerequisite: MATH 225. Content: 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.

CSC 464 INTRODUCTION TO DIGITAL IMAGE PROCESSING AND COMPUTER VISION
(3-0) 3 credits. Prerequisites CSC 371 and MATH 124. 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 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 OPERATING SYSTEMS
(3-1) 4 credits. Prerequisite: 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 477 SOFTWARE ENGINEERING
(3-0) 3 credits. Prerequisite: 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 478 SENIOR DESIGN PROJECT
(3-0). 3 credits. Prerequisite: 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 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 490 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 devoted to the study of a topic or field of special interest. May be repeated to a total of 3 credit hours.

CSC 494 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. Independent study may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 5 credit hours.

CSC 499 GRAPHICAL USER INTERFACES
(3-0) 3 credits. Prerequisite: CSC 371. This course in event-driven graphical user interface programming will cover selected topics such as windows programming, Visual Basic, and Java.

CSC 631 COMPUTER GRAPHICS
(3-0) 3 credits. Scan-conversion algorithms, viewing transformations, visible-surface determination, illumination models, color theory.

CSC 661 ARTIFICIAL INTELLIGENCE
(3-0) 3 credits. Prerequisite: CSC 371 or permission of instructor. Knowledge representation, problem solving algorithms, expert systems.

CSC 671 THEORY OF COMPUTATION
(3-0) 3 credits. Prerequisites: CSC 251 or permission of instructor. This course covers models for computation, numerical and non-numerical algorithms, NP complete problems and the theory of bounds on arithmetic operations.

CSC 690 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 devoted to the study of a topic or field of special interest. May be repeated to a total of 6 credit hours.

CSC 694 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. Independent study may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 5 credit hours.

CSC 700 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 is required.

CSC 702 GRADUATE RESEARCH (NON-THESIS)
Credit to be arranged; not to exceed 3 credits toward fulfillment of M.S. degree requirements. Open only to students pursuing the M.S. non-thesis option. Directed investigation of a selected problem culminating in an acceptable written report. Oral defense of the report and findings is required.

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. Prerequisite: 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. Prerequisite: CSC 371 or permission of instructor. Content: 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. Prerequisite: 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 773 PARALLEL AND DISTRIBUTED SYSTEMS
(3-0) 3 credits. Prerequisite: 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 781 DISTRIBUTED DATABASE SYSTEMS
(3-0) 3 credits. Prerequisite: CSC 681 or permission of instructor. This course covers the technical concepts, characteristics and problems of distributed databases (DDBs). The emphasis will be on the transformation, decomposition, optimization and concurrency control of queries in DDBs. Major commercial implementations of DDBs will be examined.

CSC 784 DATABASE DESIGN
(3-0) 3 credits. Prerequisite: 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 790 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 devoted to the study of a topic or field of special interest. May be repeated to a total of 6 credit hours.

CSC 793 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 794 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. Independent study may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 5 credit hours.

ECON 201 PRINCIPLES OF MICROECONOMICS
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 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 INTRODUCTION TO ELECTRICAL ENGINEERING I

(3-1) 4 credits. Prerequisite: GE 112 or equivalent, MATH 124 completed with a grade of "C" or better, MATH 231 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 INTRODUCTION TO ELECTRICAL ENGINEERING II

(3-1) 4 credits. Prerequisites: EE 211 completed with a grade of "C" or better, Math 231. 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 250 SPECIAL TOPICS IN ELECTRICAL ENGINEERING I

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor.

EE 252 INDEPENDENT STUDIES IN ELECTRICAL ENGINEERING I

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor.

EE 301 INTRODUCTORY CIRCUITS, MACHINES, AND SYSTEMS

(3-1) 4 credits. Prerequisites: MATH 231, PHYS 213 Not for majors in electrical engineering. Introduces the essential concepts of electrical engineering concerning circuits, machines, electronics, and systems.

EE 311 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 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 ELECTRONICS I

(3-1) 4 credits. Prerequisite: EE 212 completed with a grade of "C" or better, CENG 241. 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 which still meet specifications even when there are statistical variations in the component values.

EE 322 ELECTRONICS II

(3-1) 4 credits. Prerequisite: EE 321. EE 311 completed or concurrent. Completed or concurrent: EE 311.A continuation of EE 321 with emphasis on design applications of linear and nonlinear integrated circuits.

EE 330 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 341 COMPUTER INTERFACING AND INSTRUMENTATION

(2-1) 3 credits. Prerequisites: EE 211. Topics for this course include electronics (p-n junctions, diodes, transistors, and op-amps), real-world computer applications and data acquisition systems (A/D, D/A, and transducers). IBM PCs will be used. Each student must have a PEL data acquisition and control system. Graduation credit cannot be counted for both this course and CENG 241.

EE 350 SPECIAL TOPICS IN ELECTRICAL ENGINEERING II

1 to 4 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a

topic or field of special interest. Independent study may involve readings, library research, laboratory or fieldwork, and preparation of papers, as agreed in advance between the student and the instructor.

EE 352 INDEPENDENT STUDIES IN ELECTRICAL ENGINEERING II
1 to 4 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field, work, and preparation of papers, as agreed in advance between the student and the instructor.

EE 362 ELECTRIC AND MAGNETIC PROPERTIES OF MATERIALS
(3-0) 3 credits. Prerequisites: MATH 225, MATH 231, 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 231, and PHYS 213. Fundamentals of vector field theory as applied to electric and magnetic phenomena. Electrostatics, magnetostatics, Maxwell's equations, plane wave phenomena.

EE 397 MECHATRONICS AND MEASUREMENT SYSTEMS
(3-1) 4 credits. Co-requisites: EE 211 and CSC 150. 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, 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 397. (Experimental)

EE 400 UNDERGRADUATE RESEARCH
Credit to be arranged: not to exceed 4 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 421/521 COMMUNICATION SYSTEMS
(3-1) 4 credits. Prerequisites: EE 312, 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. Students enrolling in EE 521 will be held to a higher standard than those enrolling in EE 421. (Design content - 2 credits)

EE 431/531 POWER SYSTEMS
(3-1) 4 credits. Prerequisite: EE 311 or EE 330. The principles of energy conversion and transmission in modern power systems. Specialized problems of design, control, and protection are included. Students enrolling in EE 531 will be held to a higher standard than those enrolling in EE 431. (Design content - 2 credits)

EE 432 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 - 2 credits)

EE 450 SPECIAL TOPICS IN ELECTRICAL ENGINEERING II
1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits of special topics is allowed for degree credit. Taught as required.

EE 451/551 CONTROL SYSTEMS
(3-1) 4 credits. Prerequisite: EE 311. Analysis and design of automatic control and process systems by techniques encountered in modern engineering practice, including both linear and nonlinear systems with either continuous or discrete signals. Students enrolling in EE 551 will be held to a higher standard than those enrolling in EE 451. (Design content - 2 credits)

EE 452 INDEPENDENT STUDIES IN ELECTRICAL ENGINEERING II
1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits of special topics is allowed for degree credit. Taught as required.

EE 461 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 - 2 credits)

EE 480 APPLIED ELECTROMAGNETICS
(3-0) 3 credits. Prerequisite: EE 381. Theory of electromagnetic waves; applications to boundary value problems, distributed parameter models, radiation, interference, diffraction, and geometric and Fourier optics. Typical applications will include waveguides, transmission lines, and lenses.

EE 481 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 - 2 credits)

EE 482/582 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. Students enrolling in EE 582 will be held to a higher standard than those enrolling in EE 482. (Design content - 2 credits)

EE 491 ELECTRICAL ENGINEERING DESIGN I
(1-0) 1 credit. Prerequisites: Approved Math elective completed, Completed or concurrent: EE 311, EE 312, EE 322,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: developing a product mission statement, identifying the customer and customer needs, developing target specifications, consideration of alternative 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 - 1 credit)

EE 492 ELECTRICAL ENGINEERING DESIGN II
(2-0) 2 credits. Prerequisites: ENGL 289 and 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 - 2 credits)

EE 611 ADVANCED SYSTEMS I
(3-0) 3 credits. Analysis techniques for discrete and continuous systems; signal space and other vector space concepts; spectral nature of signals, state equations of continuous and discrete systems; sampling theorems; active and digital filters, random signals; topological and tensor properties of systems.

EE 618 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; basic concepts of information theory.

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 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 TESTING OF DIGITAL SYSTEMS
(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 for testing of digital systems. After an introduction to fault modeling, various test generation algorithms will be presented. Important topics in testing, such as fault simulation, functional testing, design for testability, scan design, built-in self testing, fault diagnosis and self-checking will be covered in detail.

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 650 ADVANCED TOPICS IN ELECTRICAL ENGINEERING
1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits will be allowed for degree credit. Taught as required.

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 INDEPENDENT STUDIES IN ELECTRICAL ENGINEERING
1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits will be allowed for degree credit. Taught as required.

EE 698 DIGITAL WIRELESS COMMUNICATIONS
(3-0) 3 Credits. Prerequisite: Permission of instructor. Principles and practice of modern mobile communications, emphasizing cellular telephone and personal communications systems. Digital speech CODECs, propagation considerations, modern principles and architectures, advanced digital modulation techniques, multiple access, spread spectrum, coding, cellular standards. (Experimental)

EE 700 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 is required.

EE 702 GRADUATE RESEARCH (NON-THESIS)
Credit to be arranged; not to exceed 3 credits toward fulfillment of the M.S. degree requirements. Prerequisite: Permission of instructor and student's graduate committee. The student will execute an assigned development project in a simulated industrial environment. The project will consist of design, construction, test, and evaluation phases. Oral and written progress and final reports will be required.

EE 712 ADVANCED SYSTEMS II
(3-0) 3 credits. Continuation of EE 611. Analysis techniques for discrete and continuous systems; signal space and other vector space concepts; spectral nature of signals, state equations of continuous and discrete systems; sampling theorems; active and digital filters, random signals; topological and tensor properties of systems.

EE 723 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 734 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 741 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 743 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 745 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 750 ADVANCED TOPICS IN ELECTRICAL ENGINEERING
1 to 3 credits. Prerequisite: Permission of instructor. Lecture, course or directed independent study of a topic or field of special interest. Independent study may involve readings, library, research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits will be allowed for degree credit. Taught as required.

EE 751 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 752 INDEPENDENT STUDIES IN ELECTRICAL ENGINEERING
1 to 3 credits. Prerequisite: Permission of instructor. Lecture, course or directed independent study of a topic or field of special interest. Independent study may involve readings, library, research, laboratory or field work, and preparation of papers, as agreed in advance between the student and the instructor. A maximum of 6 credits will be allowed for degree credit. Taught as required.

EE 781 ELECTROMAGNETIC FIELD THEORY
(3-0) 3 credits. Prerequisites: EE 381 and EE 480, or equivalents. Review of the fundamental concepts and experiments leading to Maxwell's equations; skin effect; radiation and propagation of electromagnetic waves; transmission lines; metal and dielectric waveguides; antennas.

EE 793 GRADUATE SEMINAR
(1-0) 1 credit. Oral presentation followed by group discussion. Seminar credit does not apply toward graduation requirements.

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 124 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 124. 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 124 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 397 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. (Experimental)

EM 680 ADVANCED STRENGTH OF MATERIALS
(3-0) 3 credits. Prerequisites: EM 216, MATH 225, MATH 231. 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.

EM 717 EXPERIMENTAL METHODS OF ENGINEERING
(2-1) 2 credits. Prerequisite: Permission of instructor. Electrical resistance strain gauges, brittle coating methods, two and three dimensional photoelasticity, reflection polariscope and Moire's fringe method. Similitude and the planning of experimental programs.

ENGL 101 FRESHMAN ENGLISH I
3 credits. A practical writing course emphasizing basic language conventions, style, and the organization and development of expository prose.

ENGL 102 FRESHMAN ENGLISH II
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 credits. Prerequisite: ENGL 101 or 102 or equivalent. 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 credits. Prerequisite: ENGL 101 or 102 or equivalent. Continues the survey of British literature with the Romantic Movement, the Victorian Age, and the Twentieth Century.

ENGL 241 AMERICAN LITERATURE I
3 credits. Prerequisite: ENGL 101 or 102 or equivalent. A study of representative works by major American writers from the colonial period to the mid-nineteenth century.

ENGL 242 AMERICAN LITERATURE II
3 credits. Prerequisite: ENGL 101 or 102 or equivalent. A study of representative works by major American writers from the mid-nineteenth century to the present.

ENGL 250 SCIENCE FICTION
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 credits. Prerequisites: ENGL 101 or equivalent and sophomore standing. Written and oral technical communications with emphasis on technical library research and semi-technical or technical explanations of scientific and engineering topics.

ENGL 289 TECHNICAL COMMUNICATIONS II
3 credits. Prerequisites: ENGL 101 and ENGL 279 or equivalent and junior or senior standing. Advanced

written and oral technical communications with emphasis on process narratives, proposals, progress reports, oral technical presentations, and informal and formal technical reports.

ENGL 300 THE LITERARY EXPERIENCE OF NATURE
3 credits. Prerequisite: Junior or senior standing or permission of instructor. An interdisciplinary survey of writing about nature, examining the relationship between literary, cultural, and scientific perspectives.

ENGL 325 READINGS IN A MAJOR WRITER
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 333 SHAKESPEARE
3 credits. Prerequisite: Three credits in literature or permission of instructor. Introduces relevant background material, but emphasizes understanding and appreciation of each play as a self-sufficient, integrated work.

ENGL 350 HUMOR IN AMERICAN CULTURE
3 credits. Prerequisite: Junior or senior standing or permission of instructor. The interdisciplinary study of American literary humor and its relationship to significant historical and regional issues.

ENGL 360 STUDIES IN EUROPEAN LITERATURE
3 credits. Prerequisite: Junior or senior standing or permission of instructor. 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 366 THE CONTEMPORARY NOVEL
3 credits. Prerequisite: Three credits in literature. Aims to reveal significant trends in modern fiction through a close examination of selected major American and European novels of the twentieth century.

ENGL 374 STUDIES IN AMERICAN LITERATURE
1 to 3 credits. Prerequisite: Junior or senior standing or permission of instructor. 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 credits. Prerequisite: ENGL 101 or 102 or equivalent. Offers systematic study of prose types and styles, practical experience in writing articles and essays, and workshop critiques of student writings.

ENGL 390 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 faculty. A maximum of six (6) credits of special topics will be allowed for degree credit.

ENGL 394 INDEPENDENT STUDIES IN TECHNICAL COMMUNICATIONS
1 to 3 credits. Prerequisite: Permission of department chair. Individualized instruction in technical communications designed for transfer students needing to complete either the speech or writing component of technical communications.

EURS 301 SEMINAR IN EUROPEAN CULTURE
3 credits. Prerequisites: Junior or senior standing or permission of instructor. Topics in European culture as expressed in literature, art, music, philosophy, and religion. The topic may be limited to a theme or to a period in history. (May be repeated once for credit when the topic is different and with permission of department chair.)

FREN 101 INTRODUCTORY FRENCH I
FREN 102 INTRODUCTORY FRENCH II
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 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 110 INTRODUCTION TO FORTRAN
(3-0) 3 credits. Prerequisite: Completion of MATH 1023 (college algebra) and MATH 115 completed with a grade of "C" or better or an acceptable score

on the Calculus I Qualifying Examination. The student, in consultation with an advisor, should determine whether GE 110 or GE 111 is appropriate. An Advisory Placement Examination is available from the department upon request. The course will cover the basic principles of the FORTRAN programming language, including arithmetic, control structures, arrays, files, input/output, functions, subroutines, and basic numerical applications in engineering and science. The course will cover the material at a somewhat slower pace than GE 111 and is intended for those students who have little or no programming background. Credit cannot be given for both GE 110 and GE 111. Two credits of this course can be used toward degree requirements at SDSM&T.

GE 111 FORTRAN PROGRAMMING

(2-0) 2 credits. Prerequisite: Completion of MATH 1023 (college algebra) and MATH 115 completed with a grade of "C" or better or an acceptable score on the Calculus I Qualifying Examination. The student, in consultation with an advisor, should determine whether GE 110 or GE 111 is appropriate. An Advisory Placement Examination is available from the department upon request. This course will cover the basic principles of the FORTRAN programming language, including arithmetic, control structures, arrays, files, input/output, functions, subroutines, and basic numerical applications in engineering and science. This course will cover the material at a somewhat faster pace than GE 110 and is intended for those students who have reasonable background in some computer language. Credit cannot be given for GE 110 and GE 111.

GE 112 PERSONAL COMPUTER PROGRAMMING

(1-1) 2 credits. Prerequisite: Completion of MATH 1023 (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 & ENGINEERING WORK STATION PROGRAMMING

(3-0) 3 credits. Prerequisite: Completion of MATH 1023(college algebra)with a grade of "C" or better or an acceptable score on the Calculus Qualifying Examination in Algebra. The course provides an introduction to personal computers including Windows, spreadsheets, word processors, and their applications. An introduction to using workstations and UNIX is presented. FORTRAN programming on workstations is covered, including program development, input/output, DO loops, subscripted variables, array manipulations, subroutines, compiling and linking, and applications to engineering and science. An introduction to the computer and workstation computational assets is given, including POLYMATH and AspenPlus Process Simulator. This course may be taken by students majoring in Chemical Engineering. Students majoring in other departments should consult their advisor.

GE 115 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 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 200 SYSTEMS ENGINEERING

(2-1) 3 credits. Prerequisite: Permission of instructor. This course introduces students to the issues involved in the design and implementation of a complex multi-disciplinary engineering project. Each year an actual project will be chosen as the focus of the course. In the context of this project, such issues as project design, modeling the interaction of component parts, allocation of human and financial resources, project scheduling and tracking, implementation trade-offs and addressing implementation problems will be studied. The laboratory component of the course will be devoted to the implementation of the chosen project. Details of the coming year's project can be obtained from the Department of Electrical and Computer Engineering, the Department of Mathematics and Computer Science, the Department of Mechanical Engineering or the College of Systems Engineering.

GE 250 ACCOUNTING FOR ENGINEERS
(3-0) 3 credits. Introduces basic accounting concepts and operating characteristics of accounting systems. Principles of financial and cost accounting, design of accounting systems. Principles of financial and cost accounting, design of accounting systems, techniques of analysis and cost control are surveyed. Interpretation and use of accounting information for industrial decision making is stressed.

GE 300 SYSTEMS ENGINEERING II
(3-0) 3 credits. Prerequisite: GE 200 or permission of instructor. This course is a continuation of GE 200 which introduces students to the issues involved in the design and implementation of a complex multi-disciplinary engineering project. Each year an actual project will be chosen as the focus of the course. In the context of this project, such issues as project design, modeling the interaction of component parts, allocation of human and financial resources, project scheduling and tracking, implementation trade-offs and addressing implementation problems will be studied. The laboratory component of the course will be devoted to the implementation of the chosen project. Details of the coming year's project can be obtained from the Department of Electrical and Computer Engineering, the Department of Mathematics and Computer Science, the Department of Mechanical Engineering or the College of Systems Engineering.

GE 399 COMMUNICATIONS AND NETWORKING ISSUES IN MANUFACTURING
(3-0) 3 credits. Prerequisite: EE 211 or EE 301. Introduction to analog and digital signal transmission; performance characteristics such as distortion, bandwidth requirements, signal-to-noise ratio, and error probability. Basic principles of computer networks as applied in manufacturing are covered. Graduation credit will not be allowed for both this course and CSC 441 or CENG 444. (Experimental)

GE 499 INTEGRATIVE DESIGN AND PRODUCTION
Variable credits. Prerequisite: Senior standing. Integrates concepts from all areas of engineering into a practical team-based design project. A maximum of four credits of GE 499 may count towards graduation. The student's degree program determines whether this course is taken over one or two semesters. (Experimental)

GE 650 BUSINESS STRUCTURE AND MANAGEMENT PROCESSES
(3-0) 3 credits. Prerequisite: Permission of instructor. An analysis of forms of businesses organization and management responsibilities including concepts of strategic planning, leadership, financial analysis, problem solving, decision making, and human resource functions.

GE 665 PROJECT PLANNING AND CONTROL
(3-0) 3 credits. Prerequisite: PSYC 101 preferred. Project planning, execution and control of less repetitive types of work. This includes quantitative aspects such as costs, time and performance specifications; and qualitative aspects such as organization structures, psychological and sociological relationships. This course is cross-listed with TM 665.

GEOE 211 EARTH SYSTEMS ENGINEERING ANALYSIS
(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 298 GEOLOGY FOR ENGINEERS
(3-0) 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. (Experimental)

GEOE 322 STRUCTURAL GEOLOGY
(2-1) 3 credits. Prerequisites GEOL 201, 205, and 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.

GEOE 324 ENGINEERING GEOPHYSICS I
(2-1) 3 credits. Prerequisites MATH 124 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.

GEOE 410 ENGINEERING FIELD GEOLOGY
(0-5) to (0-6) 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 5-week course are devoted to engineering problems including surface-water and ground-water hydrology, geotechnics, and minerals. Conducted for five weeks during the summer at Ranch A in the northern Black Hills. Arrangements for transportation, room, and board are made through the Black Hills Natural Sciences Field Station.

GEOE 421 MINERAL AND PETROLEUM ECONOMICS
(3-0) 3 credits. Prerequisite: Junior standing. Time value of money and economic decision-making techniques on a before-tax basis. Estimation of oil and gas reserves. Tax considerations for minerals and hydrocarbons. Probability and uncertainty in investment decisions. After-tax investment decision methods for mineral and hydrocarbon production, including investment program designs for various applications.

GEOE 425/525 ENGINEERING GEOPHYSICS II

(2-1) 3 credits. Prerequisites: MATH 225, 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 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 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 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 466 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.

GEOE 475 GROUND WATER
(2-1) 3 credits. Prerequisites: GEOL 201 or GEOE 298 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.

GEOE 482 APPLIED GEOMORPHOLOGY
(2-1) 3 credits. Prerequisites: GEOL 201 and 205; GEOE 322. A systematic analysis of landform evolution with emphasis on process and terrain analysis. Topics include process-response in geomorphic systems and quantitative techniques used in engineering design applications. Laboratory consists of aerial photos, topographic map interpretation and the application of geomorphology as an engineering tool. Field trips taken to regional areas of interest. Computer solutions in engineering analysis and a design project are required.

GEOE 490 SPECIAL TOPICS IN GEOLOGICAL ENGINEERING
1 to 3 credits. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor. A description of the work to be performed must be filed in the Geology/Geological Engineering Office.

GEOE 491 GEOLOGICAL ENGINEERING DESIGN PROJECT I
(3-0) 3 credits. Prerequisites: Completion of junior-year studies. Independent engineering design work by students on a comprehensive geological engineering project that integrates 1) ground-water hydrology, surface-water hydrology, and environmental cleanup, or 2) mineral exploration and development. 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 492 GEOLOGICAL ENGINEERING DESIGN PROJECT II
(3-0) 3 credits. Prerequisites: Completion of junior-year studies. Independent engineering design work by students on a comprehensive geological engineering project that integrates 1) geotechnics, environmental site planning, and engineering geology, or 2) petroleum, reservoir, and drilling engineering. 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 494 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 may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 3 credit hours research findings is require

GEOE 605 ENVIRONMENTAL REGULATIONS IN GROUND-WATER ENGINEERING
(3-0) 3 credits. Description and analysis of the impact of federal and state regulations governing ground-water development, contamination, and remediation. Emphasis will be placed on the significance of these regulations in engineering projects.

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 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. Prerequisite: CHEM 342, MET 320, or permission or 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.

GEOE 652 GEOCHEMICAL EXPLORATION
(2-1) 3 credits. Prerequisite: 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.

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 664 ADVANCED GROUND WATER
(2-1) 3 credits. Prerequisites: GEOL 201, EM 216, EM 327, and CEE 346. 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. (Experimental)

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 681 PETROLEUM RESERVOIR ENGINEERING
(3-0) 3 credits. Introduction to hydrocarbon reservoirs. Evaluation of rock and fluid properties. Mechanics of fluid flow in porous media. Reservoir drive mechanisms. Steady and unsteady state flow equations. Solution of diffusivity equation and well testing. Material balance applied to oil and gas reservoirs. Water influx calculations. Immiscible displacement mechanism. Design and analysis of reservoir operations.

GEOE 694 INDEPENDENT STUDIES IN GEOLOGICAL ENGINEERING
1 to 3 credits. Prerequisite: Senior or graduate standing. Directed independent study of a topic in field of interest. This may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor. A description of the work to be performed must be filed in the Geology/Geological Engineering Office.

GEOE 700 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 is required.

GEOE 728 GEOPHYSICAL ANALYSIS
(1-2) 3 credits. Prerequisites: GE 111 and permission of instructor. Involves the acquisition and analysis of geophysical data. Field studies are emphasized. Digital computer manipulation and modeling of data acquired by student is also stressed. Geophysical techniques investigated include primarily refraction/reflection seismics, gravity, and magnetics although other techniques may be included if desired by a sufficient number of students.

GEOE 762 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 763 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 765 FLUID FLOW IN POROUS MEDIA
(3-0) 3 credits. Prerequisites: MATH 231, 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 766 DIGITAL MODELING OF GROUND-WATER FLOW SYSTEMS
(2-1) 3 credits. Prerequisite: GEOE 475 or CEE 634, EM 327, CEE 346, MATH 225, 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 782 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 2 field trips to surrounding areas of interest.

GEOE 790 ADVANCED TOPICS IN GEOLOGICAL ENGINEERING
1 to 3 credits. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor. A description of the work to be performed must be filed in the Geology/Geological Engineering Office.

GEOE 793 GRADUATE SEMINAR
(I -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 794 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 may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 3 credit hours.

GEOE 800 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 is required.

GEOG 101 INTRODUCTION TO COLLEGE GEOGRAPHY
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 297 WORLD GEOGRAPHY - DEVELOPING REGIONS
3 credits. The course surveys the developing regions of the world in the context of post-cold war economic and political change, the so-called new global order. 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. (Experimental)

GEOG 298 WORLD GEOGRAPHY - DEVELOPED REGIONS
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. (Experimental)

GEOG 299 CULTURAL GEOGRAPHY
3 credits. 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. (Experimental)

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 205 should be taken concurrently.

GEOL 205 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 MINERALOGY AND CRYSTALLOGRAPHY
(2-1) 3 credits. Prerequisites: CHEM 112, 113 and 114. 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 231 HISTORICAL GEOLOGY
(2-1) 3 credits. Prerequisites: GEOL 201 and 205 or GEOE 298. Study of the geologic history of North America. The distribution of sedimentary deposits, history of geology as a science, and the organisms, orogenic movements, and economic products for each geologic period are studied. Laboratory includes study of index fossils, sediment distribution, cross sections and correlation, and field trips to type sections in the Black Hills.

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 296 EARTH, MOON & PLANET
(3-0) 3 credits. This course provides an introduction to planetary geology of the Earth, Moon, Mars, Mercury, and Venus. The geologic features on different planets will be compared and used to explore the processes behind planetary formation and evolution. Findings of different planetary research missions such as Mars Pathfinder and Magellan will be discussed. (Experimental).

GEOL 331 STRATIGRAPHY AND SEDIMENTATION
(2-1) 3 credits. Prerequisites: GEOL 201, 205, 231 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.

GEOL 341 ELEMENTARY PETROLOGY
(2-1) 3 credits. Prerequisites: GEOL 205 or GEOE 298, 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 342 INTRODUCTION TO THE PETROGRAPHIC MICROSCOPE

(0-1) 1 credit. Prerequisites: To be taken concurrently with GEOL 341 by GEOL and GEOE majors. An introduction to the petrographic microscope and the study of rock thin sections. Emphasis is on identification of common silicate minerals and rock textures without extensive optical theory. Laboratory only.

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

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 396 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 dsignated locations. This course is cross-listed with PALE 396. (Experimental)

GEOL 403/503 REGIONAL FIELD GEOLOGY

(0-1) 1 credit. Prerequisites: GEOL 201. 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/ GEOLOGY OF THE BLACK HILLS 507

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 5-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 416 INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS

(2-1) 3 credits. Prerequisites: GEOE 211 or GE 112 or permission of instructor. Introduction to principles and application of geographic information systems, with emphasis on earth systems. Laboratory work will involve introduction to PC-based GIS software, and data sets. A semester GIS project and presentation is required.

GEOL 442/542 OPTICAL PETROLOGY

(2-1) 3 credits. Prerequisites: GEOL 341, 342. 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 446 QUALITATIVE XRD ANALYSIS
(1-2) 3 credits. Prerequisites: PHYS 213 and permission of instructor. Introduction of powder and single-crystal x-ray analysis. Basic diffraction phenomena with application to materials identification, cell constant and symmetry determination; particle size and strain analysis.

GEOL 471 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 PALE 471.

GEOL 483 MUSEUM METHODS I
GEOL 484 MUSEUM METHODS II
(0-1) (0-1) 1 credit each. Techniques of mold making and casting of vertebrate fossils; fossil vertebrate preparation for study and display. Discussion of exhibit and design procedures. NOTE: These two courses may be taken separately, or the student may take 484 before 483. These courses are cross-listed with PALE 483/484.

GEOL 490 SPECIAL TOPICS IN GEOLOGY
1 to 3 credits. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor. A description of the work to be performed must be filed in the Geology office. This course is cross-listed with PALE 490.

GEOL 491 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 PALE 491.

GEOL 492 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 PALE 492.

GEOL 494 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 may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 3 credit hours. This course is cross-listed with PALE 494.

GEOL 496 MUSEUM CONSERVATION AND CURATION
(2-1) 3 credits. Ethics, theories, and methodology behind conservation and curation in natural history museum. 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 PALE 496. (Experimental)

GEOL 498/598 ADVANCED GIS ANALYSIS
(3-0) 3 credits. Prerequisite: GEOL 416 or permission of instructor. This course will introduce those already familiar with GIS systems to advanced spatial analysis techniques, including advanced vector and raster analysis, 3-D surface modeling, and network modeling. A semester of GIS project will be required. Students enrolling in GEOL 598 will be held to a higher standard than those enrolling in GEOL 498. (Experimental)

GEOL 499/599 GIS PROGRAMMING
(3-0) 3 credits. Prerequisites: CSC 105 and GEOL 416 or permission of instructor. This course will introduce those already familiar with GIS systems to programming languages and techniques for creating and customizing GIS applications. Both Avenue and Arc Macro Language (AML) will be covered. A semester GIS project will be required. Students enrolling in GEOL 599 will be held to a higher standard than those enrolling in GEOL 499. (Experimental)

GEOL 613 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.

GEOL 615 GIS FOR RESEARCH
(2-1) 3 credits. Prerequisites: GEOL 416 or permission of instructor. Building on basic principles of Geographic Information Systems developed in GEOL 416, this course launches

students into using GIS 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 with data processing and analysis using maps, photos, satellite images and other types of digital data. Basic remote sensing and image processing techniques are also covered. Students are expected to complete a semester GIS project that relates to their own research interests.

GEOL 621 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 and ocean basins and mountain building.

GEOL 631 ROCKY MOUNTAIN STRATIGRAPHY I

GEOL 632 ROCKY MOUNTAIN STRATIGRAPHY II

(3-0)(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 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 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 3-hour laboratory demonstration per week.

GEOL 644 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 645 PETROLOGY OF THE METAMORPHIC ROCKS

(2-1) 3 credits. Prerequisites: GEOL 341 and 442 or permission of instructor. The identification, classification, and genesis of metamorphic rocks. Lectures will cover the physiochemical aspects of metamorphic rock environments. Laboratory work will consist of thin section studies using the petrographic microscope.

GEOL 647 QUANTITATIVE XRD ANALYSIS

(1-2) 3 credits. A review of physics of x-ray production and history of diffraction applied to materials; diffraction instruments and their operation for powder diffraction and Laue analysis, both qualitative and quantitative; theory of diffraction and absorption of x-rays; applications to geology (especially crystallography, mineralogy and petrology), chemistry, metallurgy, soil science and materials engineering. The laboratory exercises included "hands-on" use of EMES instruments in component identification, solid solution member determination, Laue crystal applications, mass absorption applications, RIR multicomponent quantitative analysis, and fabric (texture) analysis.

GEOL 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. This course is cross-listed with PALE 671.

GEOL 672 MICROPALEONTOLOGY

(2-1) 3 credits. A study of the morphology, ecology, and stratigraphic significance of selected groups of protozoans and invertebrate and plant microfossils with special emphasis on Foraminifera and conodonts. This course is cross-listed with PALE 672.

GEOL 673 COMPARATIVE OSTEOLOGY
(2-2) 4 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 fuction 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.

GEOL 684 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.

GEOL 685 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 694 INDEPENDENT STUDIES IN GEOLOGY
1 to 3 credits. Prerequisite: Senior standing or graduate standing. Directed independent study of a topic in field of interest. This may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between 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 694.

GEOL 700 GRADUATE RESEARCH (THESIS)
Credit to be arranged; not to exceed 6 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 is required. This course is cross-listed with PALE 700.

GEOL 704 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 722 REGIONAL TECTONICS
(2-1) 3 credits. Prerequisite: GEOE 322. Detailed study by the student of a region, preferably in the U.S., in order to synthesize existing maps and reports into a tectonic map. Analysis of structures and litho-tectonic rock packages leads to a final report outlining structural development of the region. Lectures detail techniques of synthesis, analysis and report preparation.

GEOL 748 FLUID INCLUSION TECHNIQUES
(1-1) 2 credits. The course will provide theoretical and practical preparation in the use of the fluid inclusion heating/freezing stage. Meetings include one 1-hour lecture and one 3-hour laboratory per week. Whenever possible, individual students will supply thesis-related samples for measurements during the practical portion of the course. Prerequisites are a need for fluid inclusion data for the thesis and an interview with the instructor. Additional equipment usage charge.

GEOL 750 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 752 PROBLEMS OF 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 770 SEMINAR IN VERTEBRATE PALEONTOLOGY

1 to 3 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 774 STRATIGRAPHIC PALEONTOLOGY OF THE CONTINENTAL MESOZOIC AND PALEOGENE
(2-1) 3 credits. Prerequisite: GEOL 772. 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 774.

GEOL 775 STRATIGRAPHIC PALEONTOLOGY OF THE CONTINENTAL NEOGENE
(2-1) 3 credits. Prerequisite: GEOL 772. 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 775.

GEOL 776 VERTEBRATE PALEONTOLOGY
6 (4, 2) 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 776.

GEOL 778 VERTEBRATE BIOSTRATIGRAPHY
(4-2) 6 credits. Prerequisite: GEOL 776. 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 778.

GEOL 790 ADVANCED TOPICS IN GEOLOGY
1 to 3 credits. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between 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 PALE 790.

GEOL 793 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 793.

GEOL 794 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 may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 3 credit hours. This course is cross-listed with PALE 794.

GEOL 800 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 is required.

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.

GERM 101 INTRODUCTORY GERMAN I
GERM 102 INTRODUCTORY GERMAN II
4 credits each. GERM 101 is open to any student except those who have had two or more years of high school German or equivalent; pre-requisite for GERM 102: GERM 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 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 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
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 (1500-1872).

HIST 152 AMERICAN HISTORY
3 credits. A survey of American history in all its phases - political, social, cultural, economic, and intellectual - from 1872 to the present.

HIST 360 STUDIES IN HISTORY
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 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 101 JAPANESE CULTURE AND LANGUAGE I
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.

HUM 102 JAPANESE CULTURE AND LANGUAGE II
3 credits. Prerequisite: HUM 101 or equivalent. A continuation of HUM 101 with emphasis on ancient and medieval Japanese history and culture. Includes additional fundamentals of the Japanese language beyond those included in HUM 101.

HUM 200 CONNECTIONS: HUMANITIES AND TECHNOLOGY
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 211 DEVELOPMENT OF WESTERN THOUGHT
3 credits. Presents a thematic and chronological approach to the ideas and values of Western Culture as exemplified in significant literary, philosophical, and scientific works from ancient to modern times.

HUM 212 DEVELOPMENT OF WESTERN THOUGHT
3 credits. Continues a thematic study of the ideas and values of Western Culture over the centuries.

HUM 230 INTRODUCTION TO THE BIBLE
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.

HUM 234 HISTORY OF CHRISTIANITY
2 credits. Focuses on the history of Christianity and the way modern scholars understand this faith. Studies include the founding of the Christian faith as well as the history of the Church, as expressed in its art, architecture, liturgy, and worship.

HUM 250 WORLD RELIGIONS
2 credits. A comparison of contemporary religious systems of the world with emphasis upon their interactions and influence upon current affairs.

HUM 290 SPECIAL TOPICS IN HUMANITIES
1 to 3 credits. Lecture course or seminar on a topic or field of special interest, as determined by faculty. A maximum of six (6) credits of special topics will be allowed for degree credit.

HUM 300 MATERIALS AND CIVILIZATION
3 credits. Prerequisite: Junior or senior standing or permission of instructor. 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 credits. Prerequisite: Junior or senior standing or permission of instructor. A study of the lives, customs, and beliefs of ordinary Americans, including the architectural and technological environments they have lived in. Uses fiction and nonfiction from various periods as well as modern writings about selected topics.

HUM 375 COMPUTERS IN SOCIETY
3 credits. Prerequisite: Junior or senior standing or permission of instructor. 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 credits. Prerequisite: Junior or senior standing. Interdisciplinary study of human values related to one or more of these disciplines: literature, philosophy, and history.

HUM 490 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 faculty. A maximum of six (6) credits of special topics will be allowed for degree credit.

HUM 494 INDEPENDENT STUDIES IN HUMANITIES
1 to 3 credits. Prerequisite: Permission of department chair. Independent study in Humanities.

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 WORK METHODS AND MEASUREMENT
(2-1) 3 credits. Prerequisite: IENG 381. This course presents the underlying theory and basic methodology for work methods and measurement techniques. Emphasis is placed on knowledge of the basis for selection of a technique appropriate for the individual as related to the task to be performed.

IENG 321 HUMAN FACTORS ENGINEERING
(2-1) 3 credits. Prerequisite: PSYC 101 and IENG 381. Topics covered include: Engineering anthropometry methods, workplace design, electrophysiologic models and measurement, biomechanical modeling, work kinesiology, and hand-tool evaluation.

IENG 345 ENTREPRENEURSHIP
(4-0) 4 credits. Prerequisites: GE 250 or 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 361 INTRODUCTION TO QUALITY ASSURANCE
(3-0) 3 credits. Prerequisite: Permission of instructor. Quality assurance for manufacturing and assembly operations is discussed. The rationale for improving product quality is covered from the aspects of design, manufacturing techniques, and administration. (Manufacturing Elective) This course is cross-listed with ME 361

IENG 362 STOCHASTIC MODELS
(3-0) 3 credits. Prerequisite: Math 231 or Math 315 or permission of instructor. This course covers stochastic models in operations research and is a complementary course to CSC 361. 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 PROBABILITY THEORY AND STATISTICS I
(3-0) 3 credits. Prerequisite: MATH 225 concurrent. Content: Introduction to probability, discrete and continuous distributions, sampling distributions, central limit theorem, and general principles for

statistical inference. This course is cross listed as MATH 381.

IENG 382 PROBABILITY THEORY AND STATISTICS II
(3-0) 3 credits. Prerequisite: IENG 381. Content: 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 as MATH 382.

IENG 399 SAFETY ENGINEERING
(3-0) 3 credits. Prerequisite: Junior or senior standing. Topics include concepts of designing, operating and maintaining optimally safe systems, risk management, economic impact, legislation, professional certification, performance measurement, accident investigation and analysis, principles and practices in industrial hygiene engineering, and introduction to system stafety engineering. (Experimental)

IENG 425 PRODUCTION & OPERATION
(3-0) 3 credits. 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 382 concurrent. 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 471 FACILITIES PLANNING
(3-0) 3 credits. Prerequisite: ME 261 and 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 COMPUTER-CONTROLLED MANUFACTURING SYSTEMS AND ROBOTICS
(3-0) 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 478 SENIOR DESIGN PROJECT I
(0-3) 3 credits. Prerequisite: IENG 471 concurrent. 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 479 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 478.

IENG 485 STATISTICAL QUALITY AND PROCESS CONTROL
(3-0) 3 credits. Prerequisites: IENG 381 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 as MATH 485.

IENG 490 SPECIAL TOPICS IN INDUSTRIAL ENGINEERING
Credit: Variable (1 to 3). Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special independent study which may involve readings, library research, laboratory or field work, and/or preparation of papers, as agreed in advance between student and instructor.

IENG 494 INDEPENDENT STUDIES IN INDUSTRIAL ENGINEERING
Credit: Variable (1 to 3). Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special independent study which may involve readings, library research,

laboratory or field work, and/or preparation of papers, as agreed in advance between student and instructor.

IS 170 RESEARCH METHODS USING COMPUTER SYSTEMS

1 credit. This course on research methods analyzes electronic database systems. Resources to be examined include the Internet, CD-ROM products and/or private bulletin board systems. Methods of study may include guest lectures, hands-on work on the computer, and field trips to Internet providers.

IS 370 APPLICATIONS OF RESEARCH METHODS USING COMPUTER SYSTEMS

1 credit. Prerequisite: IS 170 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 399 RESEARCH METHODS FOR THE INTERDISCIPLINARY SCIENCES

3 credits. Prerequisite: Junior class standing or permission of instructor. One of the purposes of this course is to provide 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. A second purpose of the course is to assist students in learning how to formulate and present a research proposal/project. The course presents both qualitative and quantitative research techniques to the students. Approximately 40% of the course time is devoted to active research on the part of the student. The evaluation of student performance is based on active research projects, readings and homework, and several exams. (Experimental)

IS 490 SENIOR PROJECT

1 to 3 credits. Prerequisite: Senior standing or permission of instructor. This course includes directed study of a topic of special interest and may involve readings and/or laboratory or field work. During this course the senior project or capstone experience will be completed on the topic agreed upon by the student and the advisor. Classroom topics will also include such areas as professionalism and entry to the world of professional work. A maximum of three (3) IS 490 credits of special topics will be allowed for degree credit. This class is required in the IS degree program.

IS 498/598 INTRODUCTION TO TRANSITION PLANNING AND SERVICES

(1-0) 1 credit. The purpose of the course is to provide an overview of transition planning and services applied to education and human services. Topics to be covered include: legal and historical basis, functional programming, development and implementation of transition plans, family and consumer roles in transition, and identification and utilization of community resources. Students enrolling in IS 598 will be held to a higher standard than those enrolling in IS 498. (Experimental)

IS 499/599 ASSISTIVE TECHNOLOGY

1 credit. Exploring the opportunities, availability, and potential Assistive Technology (AT) provides people with disabilities. Students enrolled in IS 599 will be held to a higher standard than those enrolled in IS 499. (Experimental)

IS 690 SPECIAL TOPICS IN INTERDISCIPLINARY SCIENCES

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or seminar in science which may involve readings, library research, laboratory or field work, and preparation of papers.

IS 694 INDEPENDENT STUDIES IN INTERDISCIPLINARY SCIENCES

1 to 3 credits. Prerequisite: Permission of department chair. Independent study in Interdisciplinary Sciences.

LAK 101 LAKOTA LANGUAGE I

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 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 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 095 ELEMENTARY 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 cannot be offered for credit for any SDSM&T degree. This course is not adequate preparation for calculus, and those students preparing for calculus should take MATH 1023, or MATH 115.

MATH 1021 COLLEGE ALGEBRA I
(1-0) 1 credit. Prerequisite: One year of high school algebra or Math 095. This is the first in a sequence of three one-credit mini-courses in College Algebra. Completion of all three courses is the equivalent of a traditional course in College Algebra. This course focuses on polynomial and linear functions, equations of a line and systems of equations, factoring, equations and inequalities with absolute values, and rational expressions and rational equations. It is offered through the PRIME (Personalized Resources for Individualized Math Education) program. Details of this program are available from the Department of Mathematics and Computer Science.

MATH 1022 COLLEGE ALGEBRA II
(1-0) 1 credit. Prerequisite: Math 1021. This course is the second in a sequence of three one-credit mini-courses in College Algebra. Completion of all three courses is the equivalent of a traditional course in College Algebra. This course focuses on roots and radicals, fractional exponents and radical expressions, solving quadratic equations, combinatorics and the binomial expansion, and radical equations. It is offered through the PRIME (Personalized Resources for Individualized Math Education) program. Details of this program are available from the Department of Mathematics and Computer Science.

MATH 1023 COLLEGE ALGEBRA III
(1-0) 1 credit. Prerequisite: MATH 1022. This course is the third in a sequence of three one-credit mini-courses in College Algebra. Completion of all three courses is the equivalent of a traditional course in College Algebra. This course focuses on functions and graphs, inverse functions, manipulation of logarithmic functions, solving exponential and logarithmic equations, and applications of exponential and logarithmic functions. It is offered through the PRIME (Personalized Resources for Individualized Math Education) program. Details of this program are available from the Department of Mathematics and Computer Science.

MATH 1201 TRIGONOMETRY I
(1-0) 1 credit. Prerequisite: Completion of MATH 1023(college algebra)or a satisfactory score on the Algebra Placement Exam. This course is the first in a sequence of two one-credit mini-courses in Trigonometry. Completion of both courses is the equivalent of a traditional course in Trigonometry. This course focuses on numerical trigonometry: angles and trigonometric functions, evaluating trigonometric functions, solving right triangles, laws of sines and cosines, and graphs of trigonometric functions. It is offered through the PRIME (Personalized Resources for Individualized Math Education) program. Details of this program are available from the Department of Mathematics and Computer Science.

MATH 1202 TRIGONOMETRY II
(1-0) 1 credit. Prerequisite: MATH 1201. This course is the second in a sequence of two one-credit mini-courses in trigonometry. Completion of both courses is the equivalent of a traditional course in Trigonometry. This course focuses on analytical trigonometry: inverse trigonometric functions, trigonometric identities, and solving trigonometric equations. It is offered through the PRIME (Personalized Resources for Individualized Math Education) program. Details of this program are available from the Department of Mathematics and Computer Science.

MATH 115 PRE-CALCULUS MATHEMATICS
(4-0) 4 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.

MATH 123 CALCULUS I
(4-0) 4 credits. Prerequisite College Algebra Prerequisite or Corequisite Trigonometry. The College Algebra prerequisite can be met by completing MATH 1023 (College Algebra III) with a grade of "C-" or better or by an acceptable score on the Algebra Placement Examination. The Trigonometry corequisite can be met by completing MATH 1202 (Trigonometry II) with a grade of "C-" or better, or by achieving an acceptable score on the Trigonometry Placement Examination, or by concurrent enrollment in MATH 1201 and MATH 1202. Differentiation, antidifferentiation, and integration of algebraic and trigonometric functions with applications in each area.

MATH 124 CALCULUS II

(4-0) 4 credits. Prerequisites: Completion of MATH 1202 (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 1202 or the departmental Trigonometry Placement Examination before enrolling in MATH 124). 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: Completion of MATH 1023 (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 124 completed with a grade of "C-" or better. Polar coordinates, vector functions, functions of several variables, multiple and line integrals. MATH 225 and 231 may be taken concurrently or in either order.

MATH 231 ORDINARY DIFFERENTIAL EQUATIONS

(4-0) 4 credits. Prerequisite: MATH 124 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 231 may be taken concurrently or in either order.

MATH 241 MATHEMATICS OF FINANCE

(3-0) 3 credits. Prerequisite: Completion of MATH 1023 (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 of MATH 1023 (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 290 SPECIAL TOPICS 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. Lecture course devoted to the study of a topic or field of special interest. May be repeated to a total of 5 credit hours.

MATH 294 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. Independent study may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 5 credit hours.

MATH 313 ABSTRACT ALGEBRA

(3-0) 3 credits. Prerequisite: CSC 251 or permission of instructor. Mathematical systems including the elementary theory of groups, rings, and fields.

MATH 315 MATRICES AND LINEAR ALGEBRA

(4-0) 4 credits. Prerequisite: Permission of instructor. Vector spaces, linear transformations and matrices.

MATH 332 PARTIAL DIFFERENTIAL EQUATIONS

(3-0) 3 credits. Prerequisite: MATH 225 and 231. Fourier series, partial differential equations, Frobenius series, Bessel functions, and transform methods

MATH 333 FOURIER ANALYSIS AND STATISTICS

(3-0) 3 credits. Prerequisites: MATH 225 and 231. The course includes Fourier series, solution of linear partial differential equations by separation of variables, Fourier integrals and Fourier transforms. The statistics portion of the course includes elementary theory of probability and probability distributions. Only one of MATH 332 and MATH 333 may be counted as credit toward graduation requirements, and only one of MATH 333 and MATH 481 may be counted toward graduation requirements. Mathematics and Computer Science Majors cannot use this course to satisfy graduation requirements.

MATH 374 APPLIED NUMERICAL ANALYSIS
(3-0) 3 credits. Prerequisites: MATH 231 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 PROBABILITY THEORY AND STATISTICS I
(3-0) 3 credits. Prerequisite: MATH 225 (concurrently). Content: Introduction to probability, discrete and continuous distributions, sampling distributions and central limit theorem, general principles for statistical inference. This course is cross-listed as IENG 381.

MATH 382 PROBABILITY THEORY AND STATISTICS II
(3-0) 3 credits. Prerequisites: MATH 381. Content: 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 as IENG 382.

MATH 390 SPECIAL TOPICS 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. Lecture course devoted to the study of a topic or field of special interest. May be repeated to a total of 5 credit hours.

MATH 391 STUDIES IN MATHEMATICS I
(3-0) 3 credits. Prerequisites: Junior or senior standing, and permission of instructor. In this course, students will study an advanced topic not otherwise offered in the Mathematics curriculum. For information about the specific topic to be covered in a given semester, students should contact their advisors or the Mathematics and Computer Science Department office.

MATH 394 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. Independent study may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 5 credit hours.

MATH 400 UNDERGRADUATE RESEARCH
(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. The student must produce a written report on the research, and must make an oral presentation at a departmental colloquium.

MATH 421 INTRODUCTION TO COMPLEX ANALYSIS
(3-0) 3 credits. Prerequisite: MATH 225. The algebra of complex numbers; complex functions; contour integration and Cauchy integral theorems; Taylor and Laurent series and the residue theorem; the evaluation of real definite integrals; elementary mapping problems.

MATH 423 ADVANCED CALCULUS I
MATH 424 ADVANCED CALCULUS II
(4-0) 4 credits each. Prerequisite: MATH 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 481 ENGINEERING STATISTICS I
(2-0) 2 credits. Prerequisite: MATH 225. An introduction to the core ideas in probability and statistics. Computation of probabilities using, for instance, counting techniques and Bayes' rule. Introduction to discrete and continuous random variables, joint and conditional distributions, expectation, variance and correlation, random sampling from populations, hypothesis tests and confidence intervals, and least squares. This course is the first in a sequence of two 2-credit mini-courses in probability and statistics offered in a single term, the second being MATH 482.

MATH 482 ENGINEERING STATISTICS II
(2-0) 2 credits. Prerequisite: MATH 481. In part, covers topics from MATH 481 in more depth including additional standards distributions used to model real-world phenomena, additional standard hypothesis tests and confidence intervals. Other topics include building multiple regression models, parameter estimation, and reliability. Selected non-parametric and computer-intensive methods may also be covered. This course is the second in a sequence of two 2 credit mini-courses in probability and statistics offered in a single term, the first being MATH 481.

MATH 485 STATISTICAL QUALITY AND PROCESS CONTROL

(3-0) 3 credits. Prerequisites: 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. Cross-listed with IENG 485.

MATH 490 SPECIAL 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 devoted to the study of a topic or field of special interest. May be repeated to a total of 3 credit hours.

MATH 491 STUDIES IN MATHEMATICS II

(3-0) 3 credits. Prerequisites: Junior or senior standing and permission of instructor. In this course, students will study an advanced topic not otherwise offered in the Mathematics curriculum. For information about the specific topic to be covered in a given semester, students should contact their advisors or the Mathematics and Computer Science Department office.

MATH 494 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 may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 3 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 as 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 690 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 devoted to the study of a topic or field of special interest. May be repeated to a total of 6 credit hours.

MATH 694 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 may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 3 credit hours.

ME 110 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, academic success skills.

ME 211 INTRODUCTION TO THERMODYNAMICS

(3-0) 3 credits. Prerequisites: MATH 124 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 124. 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 260 INTRODUCTION TO

ENGINEERING DESIGN
(1-0) 1 credit. Prerequisites: Sophmore standing. Introduction to the engineering design process. Presents tools and methodologies for taking abstract information required to realize the need for a product or process and generating concrete information required to realize that product or process. Broader aspects of design are also introduced, such as the relationship of technology to society, and engineering ethics and professionalism.

ME 261 INTRODUCTION TO MANUFACTURING
(2-1) 3 credits. Prerequisite: ME 260 (concurrent) Sophomore standing. Introduction to the engineering and management aspects of material forming processes used in manufacturing. Traditional and new methods for material removal, deformation processing, inspection, and quality control will be discussed. Introduction to the concepts of automated manufacturing.

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 374 (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. Prerequisite: ME 316, ME 260, ME 261. 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 352 INTRODUCTION TO DYNAMIC SYSTEMS
(3-0) 3 credits. Prerequisites: MATH 231, 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 361 INTRODUCTION TO QUALITY ASSURANCE
(3-0) 3 credits. Prerequisite: Permission of instructor. Quality assurance for manufacturing and assembly operations is discussed. The rationale for improving product quality is covered from the aspects of design, manufacturing techniques, and administration. Cross-listed with IENG 361.

ME 376 MECHANICAL MEASUREMENTS
(3-1) 4 credits. Prerequisites: ME 316 or permission of instructor, CSC 150. An introduction to the ME Laboratory; theory and application of instrumentation techniques employed in the measurement of frequency, strain, force, pressure, fluid flow, and temperature; signal conditioning and data acquisition.

ME 390 SPECIAL TOPICS IN MECHANICAL ENGINEERING
Credit: Variable (1 to 3) Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor.

ME 397 MECHATRONICS AND MEASUREMENT SYSTEMS
(3-1) 4 credits. Co-requisite: ME 316, EE 211 and CSC 150. 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, 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 397. (Experimental)

ME 398 MECHANICS AND MATERIALS IN DESIGN I
(3-0) 3 credits. Prerequisites: EM 216, ME 221, ME 260, and ME 261. Part 1 of a fundamental design course integrating the 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. (Experimental)

ME 399 MECHANICS AND MATERIALS IN DESIGN II
(3-0) 3 credits. Prerequisite: ME 398. Part II of a fundamental design course integrating the basic engineering concepts of solid mechanics, materials science, and failure mechanics. These integrated concepts are applied to the "total" design of engineering structures, for example, aerospace and terrestrial vehicles, electronic packages, and machinery. (Experimental)

ME 400 UNDERGRADUATE 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.

ME 411 INTERNAL COMBUSTION ENGINES I
(3-1) 4 credits. Prerequisites: ME 311 (concurrent), ME 313 (concurrent), ME 331, ME 376. 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 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 376, ME 311, ME 313, ME 331. A hands-on experience with experimental methods in mechanical engineering thermoscience; measurement techniques for temperature, pressure, flow and velocity; data acquisition systems and uncertainty analysis will be covered. Group projects to illustrate design of experiments will be assigned, in addition to conducting various heat transfer, fluid mechanics and thermodynamics experiments.

ME 419 THERMO-FLUID SYSTEMS DESIGN
(3-0) 3 credits. Prerequisites: ME 311 (concurrent), ME 313 (concurrent), ME 331. 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. Prerequisites: 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 376, 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 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 APPLIED FINITE ELEMENT ANALYSIS

(3-0) 3 credits. Prerequisites: ME 316 or permission of instructor. Basic concepts will be covered including: determining shape functions using potential energy method, and constructing element matrices. Applications covered will include bars, beams, and solids.

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. 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 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 461 BUSINESS ORGANIZATION AND MANAGEMENT

(3-0) 3 credits. Junior or senior standing prefer. 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. Cross-listed with IENG 461.

ME 477 MECHANICAL ENGINEERING DESIGN I

(0-2) 2 credits. Prerequisite: Senior standing or graduation within 3 semesters, ME 322, ME 376 (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 479 MECHANICAL ENGINEERING DESIGN II

(0-2) 2 credits. Prerequisite: Senior standing or graduation within 3 semesters, ME 322, ME 376 (concurrent). The second semester continuation of ME 477. 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 498 WELDING ENGINEERING AND DESIGN OF WELDED STRUCTURES

(3-0) 3 credits. Prerequisites: EM 216 or equivalent and MET 232. The course introduces the state-of-the-art in welding processes and technology and discusses fundamentals of the fabrication and design of welded structures by introducing basics of solidification in welds, metallurgy of welds, fatigue and fracture in welds, joint design, design practices, and weld defects and inspection. This course is cross-listed with MET 498. (Experimental)

ME 616 COMPUTATIONAL METHODS IN TRANSFER PHENOMENA

(3-0) 3 credits. Prerequisite: MATH 374 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 T0 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 690 ADVANCED TOPICS IN MECHANICAL ENGINEERING

1 to 3 credits. Designed to permit a senior or graduate student to undertake an investigation of a problem of special interest in the field of mechanical engineering under the guidance of an instructor.

ME 694 INDEPENDENT STUDIES IN MECHANICAL ENGINEERING

1 to 3 credits. Designed to permit a senior or graduate student to undertake an investigation of a problem of special interest in the field of mechanical engineering under the guidance of an instructor.

ME 700 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.

ME 712 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 712.

ME 713 TRANSPORT PHENOMENA: HEAT

(3-0) 3 credits. Prerequisites: ME 313, MATH 374 (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 713.

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 ADVANCED TOPICS IN MECHANICAL ENGINEERING

1 to 3 credits. Designed to permit a graduate student to undertake an advanced investigation of a problem of special interest in the field of mechanical engineering under the guidance of a faculty member.

ME 793 GRADUATE SEMINAR

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 794 INDEPENDENT STUDIES IN MECHANICAL ENGINEERING

1 to 3 credits. Designed to permit a graduate student to undertake an advanced investigation of a problem of special interest in the field of mechanical engineering under the guidance of a faculty member.

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. The course is taught when the required seven student minimum is reached.

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), mass transfer (diffusion, interphase transport).

Module 2: (1-0) 1 credit. Physical Chemistry of Surfaces. Material covered: chemical kinetics, surface diffusion, surface energy, adsorption, analysis.

Module 3: (1-0) 1 credit. Chemical Thermodynamics. Material covered: heat balances, one component equilibrium, multicomponent equilibrium, Gibbs Phase Rule, 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, 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, chemical kinetics.

MES 603 ATOMIC/MOLECULAR STRUCTURE OF MATERIALS

(0.1 to 7) 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. The course is taught when the required seven student minimum is reached.

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 STRUCTURE-PROPERTY RELATIONSHIPS OF MATERIALS

(1 to 5-0.5) Prerequisite: admission to MS/MES or MES Ph.D. program or premission of instructor. Modules listed below will be selected based on the students written and oral interview. The MS/MES Steering committee decision is binding. The course is taught when the required seven student minimum is reached.

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 700 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 702 GRADUATE RESEARCH (NON-THESIS)

Credit to be arranged; not to exceed 2 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 is required.

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, 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 709 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. Prerequisite: MET 310 or permission of instructor. 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
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 714 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 714 and GEOE 714.

MES 721 THEORY OF MATERIALS BEHAVIOR I
MES 722 THEORY OF MATERIALS BEHAVIOR II
(3-0) 3 credits each. 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. Prerequisite: MET 310 or permission of instructor. 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
MES 739 SOLID STATE PHYSICS II
(3-0) 3 credits each. 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 760/860 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 760.

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 790 ADVANCED TOPICS IN MATERIALS ENGINEERING AND SCIENCE
1 to 3 credits. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor.

MES 800 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 is required.

MET 220 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.

MET 230 STRUCTURE AND PROPERTIES OF MATERIALS
(3-0) 3 credits. Prerequisite: Sophomore standing. A course in engineering materials and their applications for metallurgy majors. 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 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 211. 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 & 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.

MET 311 AQUEOUS EXTRACTION, CONCENTRATION RECOVERY 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.

MET 320 METALLURGICAL THERMODYNAMICS
(4-0) 4 credits. Prerequisites: PHYS 211, CHEM 114, MATH 124. 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.

MET 321 HIGH TEMPERATURE EXTRACTION, CONCENTRATION 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.

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 331 PHYSICS OF METALS LAB
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) optical 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 320 or concurrent registration, MET 330, MET 331. 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
1 credit. Prerequisites: MET 220 and MET 232. Introduction to engineering design. Compare the scientic 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. Focus on the design process, and the design method. Form teams and begin a two year design project. The development of interdisciplinary teams is a high priority.

MET 352 ENGINEERING DESIGN II
(1-0) 1 credit. Prerequisites: MET 351 or ME 260. Introduction to engineering design. Subjects as they pertain to engineering design: Modeling and simulation, optimization, material selection and interaction of materials, materials processing and design. Continue team's two-year design project. The development of interdisciplinary teams is a high priority.

MET 421 REFRACTORIES AND CERAMICS
1 to 3 variable credit. Prerequisites: MET 232 and MET 320 or permission of instructor. This fundamental course on the properties of refractory and ceramic materials covers the production of ceramic and refractory materials including concentration, purification, and forming. Refractory selection, practice, and service in high-temperature thermochemical processes and environments; thermal anal electrical properties; the relationship among structure, bonding imperfections, and properties; and failure diagnosis and avoidance is included.

MET 422 TRANSPORT PHENOMENA
(4-0) 4 credits. Prerequisite: MET 320, MATH 231. 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. 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 433 PROCESS CONTROL
(3-0) 3 credits. Prerequisite: MATH 231 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 434 PROCESS CONTROL LABORATORY
(1-0) 1 credit. Co or Prerequisite: MET/CHE 433, MATH 231 and senior standing. Analysis and design

of process control systems for industrial processes, including control tuning and design of multi-variable control scheme.

MET 440/540 MECHANICAL METALLURGY
(3-1) 4 credits. Prerequisites: MET 232 and MET 332. 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 442 METALS PROCESSING
(3-0) 3 credits. Prerequisite: MET 440. A course designed to cover mathematical models and applications of metal forming, powder metallurgy, forging, and casting. Metal forming will concentrate on rolling, drawing and extrusion processes. The powder metallurgy portion of the course will center on characteristics of metal powders, compaction and sintering processes. In the area of forging, the design of hammers and presses for both open- and closed-die forging will be covered. The emphasis in casting will be solidification theory and modeling to promote directional solidification in complex castings.

MET 443 COMPOSITE MATERIALS
(3-0) 3 credits. Prerequisites: MET 440, ME 316. 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 451 ENGINEERING DESIGN III
(2-0) 2 credits. Prerequistes: MET 352 or ME 260. Applying engineering design concepts. Build a prototype in the form of equipment, or a computer model. Present the equipment or computer model at the end of the semester in a written report and seminar. In addition the following topics are presented during the semester: Quality engineering, risk and reliability, economic decision-making and cost evaluation. The development of interdisciplinary teams is a high priority.

MET 452 ENGINEERING DESIGN IV
(1-0) 1 credit. Prerequisites: Met 451 or ME 477. Communicating the engineering design. Prepare posters or appropriate display material for the SDSM&T Design Fair. Write a design report for submission to national student paper contests.

MET 453/553 OXIDATION AND CORROSION OF METALS
(3-0) 3 credits. Prerequisites: MET 320 and MET 232 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 MET 553 will be held to a higher standard than those enrolling in MET 453.

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 490 SPECIAL TOPICS IN METALLURGICAL ENGINEERING
1 to 3 variable credit. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor.

MET 494 INDEPENDENT STUDIES IN METALLURGICAL ENGINEERING
1 to 3 variable credit. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor.

MET 498 WELDING ENGINEERING AND DESIGN OF WELDED STRUCTURES
(3-0) 3 credits. Prerequisites: EM 216 or equivalent and MET 232. The course introduces the state-of-the-art in welding processes and technology and discusses fundamentals of the fabrication and design of welded structures by introducing basics of

solidification in welds, metallurgy of welds, fatigue and fracture in welds, joint design, design practices, and weld defects and inspection. This course is cross-listed with ME 498. (Experimental)

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 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 713 APPLIED INTERFACIAL PHENOMENA
(3-0) 3 credits. Prerequisite: Permission of instructor. Applications of interfacial phenomena to industrial processes including froth flotation, detergency, flocculation, corrosion inhibition and coupling agents for reinforced plastic composites. The theory of intermolecular and surface forces operable in these systems will be detailed. The final portion of the course will focus upon advanced spectroscopic techniques for evaluation of interfacial processes.

MET 714 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 732 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 736 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 738 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 790 ADVANCED TOPICS IN METALLURGICAL ENGINEERING
1 to 3 variable credit. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor.

MET 794 INDEPENDENT STUDIES IN METALLURGICAL ENGINEERING
1 to 3 variable credit. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and 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.

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 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.

MINE 316 ENGINEERING AND CONSTRUCTION MATERIALS
(2-1) 3 credits. Prerequisite: Preceded by or concurrent with EM 216, and CEE 285. 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.

MINE 326 INTRODUCTION TO ENVIRONMENTAL ENGINEERING
(3-0) 3 credits. Prerequisites: CHEM 114, EM 223 and CEE 285. An introduction to the theories, principles, and design of environmental engineering systems. Topics include water chemistry, water and wastewater treatment, solid and hazardous waste management, and the mass balance approach to systems analysis. This course is cross-listed with CEE 326.

MINE 346 GEOTECHNICAL ENGINEERING I
(2-1) 3 credits. Prerequisite: EM 216 and CEE 285 (GEOL 201 recommended). 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.

MINE 398 INTRODUCTION TO GEOSTATISTICS
(2-1) 3 credits. Prerequisites: GEOL 201, GEOL 205, and completion of MATH 1023 (college algebra), MATH 115 or equivalent. The course will study the basic principles of statistics and spatial statistics as appropriate for geological applications. Topics will include sampling, distributions, testing, regression, variograms and Kriging. Problems given in the computer laboratory will relate directly to geology and mining, with emphasis on ore reserve estimation, flood statics, and reservior calculations. Introduction to mineral related computer methods will be integral part of the course. (Experimental)

MINE 399 QUARRY MINING
(3-0) 3 credits. Prerequisites: Junior or senior standing. This course covers basic concepts in quarry mining, including geology and exploration; specialized techniques and equipment in underground and surface mining; crushing and screening; drilling and blasting; properties of aggregates and crushed stone; uses of aggregates and quarry mined materials; major markets, uses, and producers; computer applications and reclamation. (Experimental)

MINE 411 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 431 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 432 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 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.

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 MINE VENTILATION AND AIR CONDITIONING
(2-1) 3 credits. Prerequisite: 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 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 490 SPECIAL TOPICS IN MINING ENGINEERING
1 to 3 credits. Lecture course or study of a topic or field of special interest. Study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor.

MINE 493 UNDERGRADUATE SEMINAR
(1-0) 1 credit. Preparation, oral and/or written presentation, and discussion of mining related problems.

MINE 494 INDEPENDENT STUDIES IN MINING ENGINEERING
1 to 3 credits. Directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor.

MINE 612/712 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 712 will be held to a higher standard than those enrolling in MINE 612.

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 633 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.

MINE 641 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.

MINE 643 ECONOMICS OF MINING I

(3-0) 3 credits. Prerequisite: MINE 441. The fundamental factors critical to the evaluation of a mineral deposit. Evaluation of objectives, selection of capacity and cutoff grade, operating and capital costs, profitability, risks in the investment, forecasting and production planning.

MINE 645 HEALTH AND SAFETY LAW IN THE MINING INDUSTRY

(3-0) 3 credits. Prerequisite: Senior. A study of the federal and state health and safety regulations and the problems that occur in the enforcement of and compliance with these regulations in the mining industry. A development of management skills needed to develop and supervise a safety program.

MINE 650/750 ROCK SLOPE ENGINEERING

(3-0) 3 credits. Prerequisite: CEE 346 or MINE 411. Modes of slope failure. Economic consequences of instability in mining and construction. Geological factors controlling stability of rock slopes. Shear strength of highly jointed rock mass and discontinuities. Projection methods. Vectoral analysis of 3-D problems by means of the sterographic projection method. Analytical, graphical and computer analysis of planar, wedge and toppling failures. Probabilistic methods. Stuents enrolling in MINE 750 will be held to a higher standard than those enrolling in MINE 650.

MINE 651/751 STATISTICAL APPLICATIONS FOR THE MINERAL INDUSTRY

(3-1) 4 credits. Prerequisite: A statistics course or permission of instructor. The course will present the statistical techniques of geochemical and geophysical data collection, drill-hole analysis, sampling, structural geology, ore deposits, sedimentology, remote sensing, ore reserve calculations and mine planning. The statistical techniques will include statistical distributions, confidence intervals, statistical tests, trend surface analysis, multivariate analysis, factor analysis, and geostatistics including variograms, Kriging, and design of sampling. Students enrolling in MINE 751 will be held to a higher standard than those enrolling in MINE 651.

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 690 ADVANCED TOPICS IN MINING ENGINEERING

1 to 3 credits. Lecture course or study of a topic or field of special interest. Study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor.

MINE 694 INDEPENDENT STUDIES IN MINING ENGINEERING

1 to 3 credits. Directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between student and instructor.

MINE 699 ROCK SLOPE STABILIZATION, MONITORING AND INSTRUMENTATION

(0-1) 1 credit. Prerequisites: MINE 411 and CEE 346 or equivalent. This lab will be taken concurrently with MINE 650/750. It emphasizes techniques used in rock slope stabilization, including monitoring and instrumentation. Laboratory projects will include discontinuity field mapping,; laboratory testing, including direct shear strength testing, the tilt test, and empirical methods; and computer methods. Field trips will be taken to study various stabilization and monitoring techniques applied at mining and construction sites locally. (Experimental)

MINE 700 GRADUATE RESEARCH (THESIS)

Credit to be arranged; not to exceed 6 credits toward fulfillment of M.S. degree requirements. Open only to students pursing the M.S. thesis option. Supervised original or expository research culminating in an acceptable thesis. Oral defense of thesis and research findings is required.

MINE 702 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 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 engineering management, supervision, administrative policies, human-factors engineering, and labor-management relationships. This course is cross-listed with TM 742.

MINE 793 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 APPLICATIONS IN 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.

MSC 112 APPLICATIONS IN ORGANIZATIONAL SKILLS II
(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.

MSC 120 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 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.

MSC 212 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.

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 which 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 150 APPLIED MUSIC

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 150 CONCERT CHOIR

1 credit. The study and performance of accompanied and unaccompanied choral music of all styles. (Any combination of P.E. and MUEN 100-level course may be allowed toward fulfillment of the physical education credit for graduation.)

MUEN 160 SDSM&T SYMPHONIC BAND

1 credit. The study and performance of contemporary and traditional band repertory. The symphonic band performs in campus concerts and for other campus 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 credit. Prerequisite: Permission of instructor. Development of vocal or instrumental skills and aesthetic perception through the study and performance of music.

MUEN 260 NON-CREDIT MUSIC ENSEMBLE

No credit. Prerequisite: Permission of instructor. Development of vocal or instrumental skills and aesthetic perception through the study and performance of music.

MUEN 330 MUSIC IN PERFORMANCE

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 IN OUR LIVES

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 201 MUSIC THEORY AND COMPOSITION
3 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 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.

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 396 VERTEBRATE PALEONTOLOGICAL TECHNIQUES AND EXHIBIT DESIGN
3 credits. Techniques in vertebrate fossil preparation and museum exhibit design will be the focus in the course. Students will be required to prepare fossils and design an exhibit for actual display in the Museum or other designated locations. This course is cross-listed with GEOL 396. (Experimental)

PALE 471 INVERTEBRATE PALEONTOLOGY
(2-1) 3 credits. Prerequities: 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.

PALE 483 MUSEUM METHODS I
PALE 484 MUSEUM METHODS II
1 credit. Techniques of mold making and casting of vertebrate fossils; fossil vertebrate preparation for study and display. Discussion of exhibit and design procedures. NOTE: These two courses may be taken separately, or the student may take 484 before 483. These courses are cross-listed with GEOL 483/484.

PALE 490 SPECIAL TOPICS IN GEOLOGY
1 to 3 credits. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advanced between 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 490.

PALE 491 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 491.

PALE 492 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 492.

PALE 494 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 may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 3 credit hours. This course is cross-listed with GEOL 494.

PALE 496 MUSEUM CONSERVATION AND CURATION
(2-1) 3 credits. Ethics, theories, and methodology behind conservation and curation in natural history museum. 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 496. (Experimental)

PALE 671 ADVANCED FIELD PALEONTOLOGY
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. This course is cross-listed with GEOL 671.

PALE 672 MICROPALEONTOLOGY
(2-1) 3 credits. A study of the morphology, ecology, and stratigraphic significance of selected groups of protozoans and invertebrate and plant microfossils with special emphasis on Formaminifera and conodonts. This course is cross-listed with GEOL 672.

PALE 673 COMPARTIVE OSTEOLOGY
(2-2) 4 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 fuction 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.

PALE 684 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.

PALE 694 INDEPENDENT STUDIES IN GEOLOGY
1 to 3 credits. Prerequisite: Senior standing. Directed independent study of a topic in field of interest. This may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between 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 694.

PALE 700 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 is required. This course is cross-listed with GEOL 700.

PALE 770 SEMINAR IN VERTEBRATE PALEONTOLOGY
1 to 3 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 774 STRATIGRAPHIC PALEONTOLOGY OF THE CONTINENTAL MESOZOIC AND PALEOGENE
(2-1) 3 credits. Prerequisite: GEOL 772. 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 GEOL 774.

PALE 775 STRATIGRAPHIC PALEONTOLOGY OF THE CONTINENTAL NEOGENE
(2-1) 3 credits. Prerequisite: GEOL 772. 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 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 GEOL 775.

PALE 776 VERTEBRATE PALEONTOLOGY
(4-2) 6 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 776.

PALE 778 VERTEBRATE BIOSTRATIGRAPHY
(4-2) 6 credits. Prerequisite: GEOL 776. 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 778.

PALE 790 ADVANCED TOPICS IN GEOLOGY
1 to 3 credits. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, laboratory or field work, and preparation of papers, as agreed in advance between 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 790.

PALE 793 GRADUATE SEMINAR
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 793.

PALE 794 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 may involve readings, library research, laboratory or field work, and the preparation of papers, as agreed in advance between student and instructor. May be repeated to a total of 3 credit hours. This course is cross-listed with GEOL 794.

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. Fee required. 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 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 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. Fee required. 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 146 FITNESS & LIFETIME ACTIVITIES FOR WOMEN
PE 147 FITNESS & LIFETIME ACTIVITIES FOR WOMEN

(-3-) 1 credit. Administered in the light of general education. Specific objectives: (1) Participating in physical activities that require vigorous exercise. (2) Developing coordination skills including catching, throwing, and hitting a ball. (3) Creating a life-style that will contribute to a healthy, active life. PE 146 includes speedball, flickerball, soccer, basketball, and aerobic exercise. PE 147 includes bowling, swimming, volleyball, softball, and aerobic exercise. These courses can only be taken once for credit.

PE 148 FITNESS & LIFETIME ACTIVITIES FOR MEN
PE 149 FITNESS & LIFETIME ACTIVITIES FOR MEN

(-3-) 1 credit. Administered in the light of general education. Specific objectives: (1) Participating in physical activities that require vigorous exercise. (2) Developing coordination skills including catching, throwing, and hitting a ball. (3) Creating a life-style that will contribute to a healthy, active life. PE 148 includes speedball, flickerball, soccer, and basketball. PE 149 includes bowling, swimming, volleyball, and softball. These courses can only be taken once 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 199 PRACTICUM IN SPORTS RELATED HEALTH SCIENCES

1-3 variable. This course is designed to introduce students to sports related health science fields such as Physical Therapy and Sports Medicine. Students in this course will learn First Aid and CPR, and will receive practical experience in the modalities of evaluation, treatment, and rehabilitation of injuries. Students will also be exposed to their field of interest by observing professionals in that field and recording observations. 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 five 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 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 299 KAYAKING

(1-0) 1 credit. This course will teach the skills involved in the sport of kayaking. It may also introduce other related outdoor water activities such as canoeing or rafting. A strong background in swimming is a prerequisite.

PHIL 100 INTRODUCTION TO PHILOSOPHY

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 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 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 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 MATH 1023(college algebra) (or equivalent) and permission of advisor; 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. This course cannot be used as credit for engineering majors.

PHYS 112 INTRODUCTION TO PHYSICS I LABORATORY
(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 cannot be used as credit for engineering majors. This course is not required with PHYS 111.

PHYS 113 INTRODUCTION TO PHYSICS II
(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. This course cannot be used as credit for engineering majors.

PHYS 185 INTRODUCTION TO ASTRONOMY
(3-0) 3 credits. A contemporary beginning level course. Origin of the universe, extraterrestrial life, UFOs, space travel, galaxies, nebula, stellar evolution, interstellar medium, star clusters, Bok globules, solar system, planets, asteroids, meteors, comets, constellations, mythology, astrophotography, etc. Weekly sky observation with the Celestron Eight telescope (500 mag) is an integral part of the course.

PHYS 211 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 124. 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 UNIVERSITY PHYSICS II
(3-0) 3 credits. Prerequisites: PHYS 211 and MATH 124 and concurrent registration in either MATH 225 or MATH 231. 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 214 is suggested as an optional laboratory to be taken concurrently with this course.

PHYS 214 UNIVERSITY PHYSICS II LABORATORY
(0-1) 1 credit. Prerequisite: Concurrent registration in or completion of PHYS 211. Introduction to physical phenomena and measurements. Recording and processing data, determining uncertainties, reporting results. The experiments supplement the work in PHYS 211 and PHYS 213.

PHYS 215 SCIENCE PHYSICS
(4-1) 5 credits. Prerequisites: PHYS 111 or high school physics and concurrent registration in MATH 124. This course provides a thorough foundation in the general principles of physics for science and engineering students. Topics in mechanics (statics, dynamics, hydrostatics, hydrodynamics, conservation laws) and optics are covered. Basic concepts and the principles common to all areas of physics are stressed. Credit toward graduation cannot be given for PHYS 211 and PHYS 215. Number of credits allowed toward degree requirement determined by each department.

PHYS 221 PHYSICS III
(3-0) 3 credits. Prerequisite: PHYS 213. The study of wave motion is continues with applications to waves in elastic media, sound waves and light. Quantum physics is introduced. PHYS 222 is suggested as an optional laboratory to be taken concurrently with this course.

PHYS 222 PHYSICS III LAB
1 credit. Prerequisite: PHYS 214. Supplements the work in PHYS 221. Provides additional experience in experimental techiques and the physical measurement process.

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 290 SPECIAL TOPICS IN PHYSICS
1 to 3 credits. Prerequisite: Permission of department chair. Opportunity to pursue, under faculty guidance, the study of selected topics. The course contents will be determined by student interest and credit will depend upon extent of work done.

PHYS 294 INDEPENDENT STUDY IN PHYSICS
1 to 3 credits. Prerequisite: Permission of department chair. Independent study under the supervision of a faculty member. Course content will be determined by the student and the instructor, and credit will be determined by the scope of the project.

PHYS 312 EXPERIMENTAL PHYSICS I
PHYS 314 EXPERIMENTAL PHYSICS II
(1-1) 2 credits each. Prerequisites: PHYS 222 or CENG 241, or permission of instructor. Designed to acquaint the student with the experimental method. The experiments are chosen to cover as many fields as possible in keeping with the backgrounds and abilities of the students. Uses PC-based DAS.

PHYS 331 INTRODUCTION TO MODERN PHYSICS
(3-0) 3 credits. Prerequisite: PHYS 213 or PHYS 113 and permission of instructor. Atomic and nuclear structure with emphasis on impact of 20th century developments on science and engineering.

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 each. Prerequisite: PHYS 213 and concurrent registration in MATH 231 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 390 SPECIAL TOPICS IN PHYSICS
1 to 3 credits. Prerequisite: Permission of department chair. Opportunity to pursue, under faculty guidance, the study of selected topics. The course contents will be determined by student interest and credit will depend upon extent of work done.

PHYS 394 INDEPENDENT STUDIES IN PHYSICS
1 to 4 credits. Prerequisite: Permission of department chair. Independent study under the supervision of a faculty member. Course content will be determined by the student and the instructor, and credit will be determined by the scope of the project.

PHYS 412 ADVANCED PROJECTS I
PHYS 414 ADVANCED 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 ELECTRICITY & MAGNETISM I
(4-0) 4 credits. Prerequisite: PHYS 213 and concurrent registration in MATH 231 or equivalent. Maxwell's equations, electrostatics, magnetostatics, introduction to propagating electromagnetic waves.

PHYS 423 ELECTRICITY & MAGNETISM II
(3-0) 3 credits. Prerequisite: PHYS 213; concurrent registration in MATH 231 or equivalent. Fundamental laws of static electricty 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 & PARTICLE PHYSICS
(3-0) 3 credits each. Prerequisite: PHYS 213; concurrent registration in MATH 231 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 AND SEMICONDUCTOR PHYSICS
(4-0) 4 credits. Prerequisite: PHYS 213; concurrent registration in MATH 231. 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 231. 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 231 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 pertubation theory.

PHYS 490 SPECIAL TOPICS IN PHYSICS
1 to 3 credits. Prerequisite: Permission of department chair. Opportunity to pursue, under faculty guidance, the study of selected topics. The course contents will be determined by student interest and credit will depend upon extent of work done.

PHYS 494 INDEPENDENT STUDIES IN PHYSICS
1 to 4 credits. Prerequisite: Permission of department chair. Independent study under the supervision of a faculty member. Course content will be determined by the student and the instructor, and credit will be determined by the scope of the project.

PHYS 671 MATHEMATICAL PHYSICS I
(3-0) 3 credits each. 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, eigenfuctions and an introduction to perturbation theory.

PHYS 673 MATHEMATICAL PHYSICS II
(3-0) 3 credits each. 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 690 SPECIAL TOPICS IN PHYSICS
1 to 3 credits. Prerequisite: Permission of department chair. Opportunity to pursue, under faculty guidance, the study of selected topics. The course contents will be determined by student interest and credit will depend upon extent of work done.

PHYS 694 INDEPENDENT STUDIES IN PHYSICS
1 to 3 credits. Prerequisite: Permission of department chair. Independent study under the supervision of a faculty member. Course content will be determined by the student and the instructor, and credit will be determined by the scope of the project.

PHYS 721 ADVANCED ELECTRICITY & MAGNETISM I
(3-0) 3 credits each. 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 355 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, Schroedinger's equation and its solution, matrix mechanics, operator methods, approximate methods with an introduction to the relativistic wave equation.

PHYS 790 ADVANCED TOPICS IN PHYSICS
1 to 3 credits. Prerequisite: Permission of department chair. The purpose of the course is to give the student an opportunity to pursue, under faculty guidance, the study of selected topics. The course contents will be determined by student interest and credit will depend upon extent of work done.

PHYS 794 INDEPENDENT STUDIES IN PHYSICS
1 to 3 credits. Prerequisite: Permission of department chair. Independent study under the supervision of a faculty member. Course content will be determined by the student and the instructor, and credit will be determined by the scope of the project.

POLS 100 AMERICAN GOVERNMENT
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 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 330 CONSTITUTIONAL LAW
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 credits. Prerequisite: POLS 100 or equivalent. A comparative study of the political institutions and processes of major world governments.

POLS 350 INTERNATIONAL RELATIONS
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 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 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 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 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 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 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 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 credits. Prerequisite: PSYC 101. A study of the major theories of personality and their applications to personality development.

PSYC 390 SPECIAL TOPICS IN PSYCHOLOGY
1 to 3 credits. Prerequisite: Junior or senior standing and at least one other course in Psychology/Sociology. This course focuses on contemporary issues with varying topics. May be repeated twice with different topics for a maximum of six credits.

PSYC 451 PSYCHOLOGY OF ABNORMAL BEHAVIOR
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.

SOC 100 INTRODUCTION TO SOCIOLOGY
3 credits. Fundamental characteristics of social relationships, culture, personality, population and ecology, social institutions and processes, and cultural change.

SOC 150 SOCIAL PROBLEMS
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 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 320 CRIMINOLOGY
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 390 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 faculty. A maximum of six (6) credits of special topics will be allowed for degree credit.

SOC 394 INDEPENDENT STUDIES IN SOCIAL SCIENCES
1 to 3 credits. Prerequisite: Permission of department chair. Independent study in social sciences.

SOC 399 DEVIANT BEHAVIOR
3 credits. Prerequisite: SOC 100 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. (Experimental)

SOC 410/510 LICIT AND ILLICIT DRUGS
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 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 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 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 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 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 credits. Introduction to the principles of oral communication with emphasis on the preparation and presentation of public speeches.

TM 621 MANAGEMENT INFORMATION SYSTEMS
(3-0) 3 credits. Prerequisite: GE 111 or permission of instructor. A formal approach to the concept, design and implementation of computer-based Management Information Systems (MIS), systems programming, and database design and management techniques.

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 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 700 GRADUATE RESEARCH (Thesis)
Credits to be arranged; not to exceed 6 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 is required.

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 & TECHNOLOGY
(3-0) 3 credits. This course provides an introduction to the quantitative and qualitative tools which 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 750 TECHNOLOGY ASSESSMENT

(3-0) 3 credits. Perquisite: Permission of instructor. An inquiry into a broad range of issues of current relevance to technology management, including: growth and finite resources; professional and environmental ethics; technological evolution; nonlinear perspective of organizations; technocracy; and appropriate technology. A variety of mediums and resources will be used. Special projects will be assigned. Concepts are sought that unify the students knowledge of technology management.

TM 790 ADVANCED TOPICS IN TECHNOLOGY MANAGEMENT

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, presentation of papers, or other academic endeavor as agreed in advance between student and instructor. Student may enroll in this course only twice and for no more than a total of 6 credits.

TM 794 INDEPENDENT STUDIES IN TECHNOLOGY MANAGEMENT

1 to 3 credits. Prerequisite: Permission of instructor. Lecture course or directed independent study of a topic or field of special interest. Independent study may involve readings, library research, presentation of papers, or other academic endeavor as agreed in advance between student and instructor. Student may enroll in this course only twice and for no more than a total of 6 credits.

1999 -2000 ACADEMIC YEAR
(As of July 1999)

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 of Business and Administration. B.S., University of South Dakota.

LANGE, DOUGLAS K. (1992) Vice President of Student Affairs/Dean of Students. B.S., M.A., Ball State University; Ed.D., Peabody College of Vanderbilt 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 of 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

ANDERSEN, PATRICIA M. (1984) Director, Devereaux Library. B.S., University of South Dakota; M.L.I.S., Louisiana State University.

ANTONEN, KATHY (1988) Associate 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 & Technology, M.S., University of South Dakota.

ARRINGTON, DALE E. (1980) Professor, Department of Chemistry. B.S., University of Washington; Ph.D., University of Kansas.

ASHWORTH, E. (1977) Professor, Mining Engineering Program. B.Sc. Honors, M.Sc., University of Manchester, England; M.S., South Dakota School of Mines and Technology; Ph.D., University of Arizona.

ASHWORTH, T. (1968) Professor, Department of Physics. B.Sc. Honors, Ph.D., University of Manchester, England; Associateship of the Manchester College of Science and Technology.

BANG, SANGCHUL (1985) 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) Associate Professor, Biology Program. 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; Executive Director, Center of Excellence for Advanced Manufacturing and Production. B.S., M.S., Oklahoma State University; Ph.D., Virginia Polytechnic Institute and State University.

BAUER, LARRY G. (1973) Professor, Department of Chemistry and Chemical Engineering. B.S., M.S., University of Missouri at Rolla; Ph.D., Iowa State University.

BENDLER, JOHN T. (1994) Associate Professor, Department of Chemistry and Chemical Engineering. A.B., College of the Holy Cross; M.Ph., Ph.D., Yale University.

BERDANIER, BRUCE W. (1996) Assistant Professor, Department of Civil and Environmental Engineering. B.S., The Ohio State University; M.S., Purdue University; Ph.D., The Ohio State University.

BJORK, PHILIP R. (1975) Professor, Paleontologist, and Director, Museum of Geology at the Journey Museum. B.S., University of Michigan; M.S., South Dakota School of Mines and Technology; Ph.D., University of Michigan.

BOYLES, DAVID A. (1980) Associate 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.

BRYSON, DEAN A. (1976) Dean and Professor, College of Interdisciplinary Studies; Department of Social Sciences. B.S., M.S., Northern State College; Ed.D., University of Nebraska.

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 and 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, J. WILLIAM (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) Associate 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) 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.

COTE, JAMES W. (1996) Assistant Professor, Department of Electrical and Computer Engineering. B.S., University of Michigan-Ann Arbor; M.S., University of Southern California; Ph.D., University of Washington. Registered Professional Engineer (California).

CROSS, WILLIAM (1984) 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) Mickelson 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. 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; Director of Academic Programs, 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.

FARWELL, SHERRY O. (1995) Dean, Graduate Education and Research. B.S., M.S. South Dakota School of Mines and Technology; Ph.D., Montana 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) Assistant Professor, Department of Civil and Environmental Engineering. B.S., M.S., Ph.D., University of Wisconsin.

FOX, JAMES E. (1976) Chair and Professor, Department of Geology & Geological Engineering. B.S., Gustavus Adolphus; M.A., University of South Dakota; Ph.D., University of Wyoming.

FOYGEL, MIKHAIL (1991) Chair and Professor, Department of Physics. M.S., Ph.D., Odessa University; D.Sc., Leningrad Polytechnic Institute.

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.

GROW, DAVID H. (1987) Assistant Professor, Department of Electrical and Computer Engineering. B.S., M.S., South Dakota School of Mines and Technology.

HAN, KENNETH KOOK-NAM (1981) Distinguished and Fuerstenau Professor, Department of Materials and Metallurgical Engineering. B.S., M.S., Seoul National University, Korea; Ph.D., University of California, Berkeley.

HANSEN, MARION R. (1985) Associate Professor, Department of Civil and Environmental Engineering (Mining Engineering). B.S., M.S., South Dakota School of Mines and Technology; Ph.D., North Carolina State University; Registered Professional Engineer (South Dakota, Wyoming, Washington, Oregon); Registered Structural Engineer (Washington, Oregon); Registered Land Surveyor (South Dakota).

HASAN, ABUL R. (1988) 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. 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 & Technology.

HERBEL, CARRIE L. (1995) 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 and Mining Engineering Program Coordinator; Director, Mining and Mineral Resources Research Institute (MMRRI). M.S., Technical University, Gliwice, Poland; Ph.D., Central Mining Institute, Katowice, Poland.

HOVEY, WENDELL H. (1980) Professor, Department of Civil and Environmental Engineering. B.S., M.S., Tufts University; Ph.D., University of California, Davis; Registered Professional Engineer (South Dakota).

HOWARD, STANLEY M. (1971) Chair and 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.

IYER, SRINIVASA L. (1974) Professor, Department of Civil and Environmental Engineering; Director of Industry Programs, Center of Excellence for Advanced Manufacturing and Production. B.S., M.S., College of Engineering, Trivandrum, India; Ph.D., South Dakota School of Mines and Technology; Registered Professional Engineer (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, Oklahoma and 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.

JOHNSON, L. RONALD (1970) Associate Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., Kearney State; M.S., South Dakota School of Mines and Technology.

KALANOVIC, VOJISLAV D. (1991) Associate Professor, Department of Mechanical Engineering. B.S., M.S., University of Belgrade; Ph.D., Clemson University.

KELLAR, JON J. (1990) Associate Professor, Department of Materials and Metallurgical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Utah.

KELLOGG, STUART D. (1990) Pietz Professor and Program Coordinator, Industrial Engineering. B.S., South Dakota State University; M.B.A., University of South Dakota; M.S., South Dakota School of Mines and Technology; Ph.D., University of Texas, Austin; Registered Professional Engineer (South Dakota).

KENNER, SCOTT J. (1987-1988) (1993) Associate Professor, Department of Civil and Environmental Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Florida; Registered Professional Engineer (Colorado, South Dakota, Wyoming.)

KERK, CARTER J. (1997) Assistant Professor, Industrial Engineering. B.S., M.S., University of Nebraska; Ph.D., University of Michigan.

KHANNA, SANJEEV K. (1997) Assistant Professor, Department of Mechanical Engineering, B.Tech, M.Tech, Indian Institute of Technology-Kanpur, India; Ph.D., University of Rhode Island.

KJERENGTROEN, LIDVIN (1990) Professor, Department of Mechanical Engineering. B.S., University of Wyoming; Ph.D., University of Arizona.

KLASI, MELVIN L. (1969-1973) (1982) Associate Professor, Department of Civil and Environmental Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., Iowa State University; Registered Professional Engineer (South Dakota).

KLICHE, CHARLES A. (1980-1990) (1991) Associate Professor, Mining Engineering Program. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Arizona.

KLICHE, DONNA (1994) PRIME Coordinator, Department of Mathematics and Computer Science, B.S., Faculty of Physics, Bucharest Romania; M.S., Georgia Institute of Technology, South Dakota School of Mines and Technology.

KRAMER, RANDALL P. (1996) Assistant Professor, Department of Military Science, ROTC. B.S., South Dakota State University; M.S., University of South Dakota; Major, Quartermaster Corps.

KRAUSE, WAYNE B. (1970-1978) (1983) Interim Dean, College of Systems Engineering; Professor, Department of Mechanical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Nebraska; Registered Professional Engineer (South Dakota).

LANGE, SUZANNE S. (1993) Instructor, Department of Social Sciences. B.A., Iowa State University; M.B.A., Belmont University.

LANGERMAN, MICHAEL A. (1992) Chair and Professor, Department of Mechanical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Idaho.

LEE, JOSEPHINE M. (1973) Associate Professor, Department of Humanities. B.A., University of Southern Mississippi; M.A., Arizona State University.

LIPKE, ROBIN J. (1995) Assistant Professor, Department of Social Sciences. B.S., M.A. Northern Arizona University; Ph.D. University of Montana.

LISENBEE, ALVIS L. (1972) Professor, Department of

Geology and Geological Engineering. B.S., M.S., University of New Mexico; Ph.D., Pennsylvania State University.

LOGAR, ANTONETTE, M. (1983) Associate Professor, Department of Mathematics and Computer Science. B.A., Lehigh University; B.S., South Dakota School of Mines and Technology; J.D., University of Louisville; M.S., University of Minnesota; Ph.D., Texas Tech University.

MARQUIS, FERNAND D.S. (1980) Professor, Department of Materials and Metallurgical Engineering. B.S., University of Coimbra; Diploma Engineering, University of Lisbon; Ph.D., DIC, University of London, Imperial College of Science and Technology; Ph.D., University of Lisbon; C. Eng., Council of Engineering Institutions, London; Registered Professional Engineer (South Dakota); Fellow Royal Microscopical Society, London.

MARTIN, JAMES E. (1979) Professor, Department of Geology and Geological Engineering; Curator of Vertebrate Paleontology, Museum of Geology. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Washington.

MATEJCIK, FRANK J. (1993) Associate Professor, Industrial Engineering. B.S., Cleveland State University; M.S., Western Michigan University; Ph.D., The Ohio State University.

McDOWELL, M. STEVEN (1990) Chair and Associate Professor, Department of Chemistry and Chemical Engineering. B.S., Miami University; Ph.D., Iowa State University.

McGOUGH, JEFFREY S. (1998) Assistant Professor, Department of Mathematics and Computer Science. B.S., Ph.D., University of Utah.

McREYNOLDS, JAMES K. (1994) Associate Professor, Department of Social Sciences. B.S., M.A., Chapman College; Ph.D., United States International University.

MEINERS, LARRY G. (1990) Professor, Department of Electrical and Computer Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., Colorado State University.

MITCHELL, DEBORAH J. (1999) Assistant Professor, Department of Humanities; Director, APEX Gallery. BFA, MFA, University of Utah State University.

MORGAN, BRADFORD A. (1982) Professor, Department of Humanities. A.B., University of California at Berkeley; M.A., Ph.D., University of Denver.

MOTT, HENRY V. (1988) Associate Professor, Department of Civil and Environmental Engineering. B.S., South Dakota School of Mines and Technology; M.S., Washington State University; Ph.D., University of Michigan. Registered Professional Engineer (Idaho, Minnesota, North Dakota and South Dakota).

MUNRO, JAMES M. (1977) Interim Dean, College of Materials Science and Engineering; Professor, Department of Chemistry and Chemical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Utah; Registered Professional Engineer (South Dakota).

MURRELL, RICHARD J. (1997) Chair and Professor, Department of Military Science, ROTC. B.S. University of Oregon, M.S. Troy State University.

OPP, ROGER L. (1966) Professor, Department of Mathematics and Computer Science. B.S., Northern State College; M.S., South Dakota School of Mines and Technology.

PALMER, SALLY B. (1999) Assistant Professor, Department of Humanities. B.A., M.A., Brigham Young University, Ph.D., University of California, Davis.

PALTASHEV, TIMOUR (1988) Assistant Professor, Department of Computer Engineering. B.Sc., Kazakhstan Polytechnic Institute; Ph.D., D.S., Institutue of Fine Mechanics and Optics.

PATERSON, COLIN J. (1983) Professor, Department of Geology and Geological Engineering. B.Sc., Ph.D., University of Otago, New Zealand.

PENALOZA, MANUEL (1989) Associate Professor, Department of Mathematics and Computer Science. B.S., M.S., University of New Mexico; Ph.D., Arizona State University.

PETUKHOV, ANDREY (1994) Associate Professor, Department of Physics. M.S., Odessa State University; Ph.D., St. Petersburg Technical University.

PRATT, STEPHEN R. (1995) Chair and Associate Professor, Department of Social Sciences. B.A., B.S., Ball State University; Ph.D., Colorado State University.

PREBER, TERJE (1984) Chair and Professor, Department of Civil and Environmental Engineering. B.S., M.S., Ph.D., University of Wisconsin; Registered Professional Engineer (Illinois, South Dakota, Wyoming).

PRICE, MARIBETH H. (1995) Assistant Professor, Department of Geology and Geological Engineering. B.A., Dartmouth College; M.A., Ph.D., Princeton University.

PUSZYNSKI, JAN A. (1991) Professor, Department of Chemistry and Chemical Engineering. M.S., Technical University, Wroclaw, Poland; Ph.D., Institute of Chemical Technology, Prague, Czechoslovakia.

RAMAKRISHNAN, VENKATASWAMY (1969) Distinguished Professor, Department of Civil and Environmental Engineering. B.E., D.S.S., University of Madras; D.I.C. (Conc. Tech.), D.I.C. (Hydro-Power), Imperial College of Science and Technology, London; Ph.D., University of London, University College.

REDD, SCOTT W. (1998) Assistant Professor, Department of Military Science, ROTC. B.A., Dakota Wesleyan University; M.Ed., South Dakota State University; Captain, Corps of Engineers.

REID, SUSAN L. (1995) Assistant Professor, Department of Humanities. B.M. Westminster Choir College; M.S., Oklahoma State University; M.M., University of Surrey; D.M.A., Arizona State University.

RICE, RODNEY P. (1999) Associate Professor, Department of Humanities. B.A., Moorhead State University, M.A., University of Minnesota, Ph.D., University of Nebraska.

RILEY, KYLE (1999) Assistant Professor, Department of Mathematics and Computer Science. B.S., University of Wyoming, M.S., Ph.D., Montana State University.

ROGGENTHEN, WILLIAM M. (1977) Professor, Department of Geology and Geological Engineering. B.S., South Dakota School of Mines and Technology; M.S., University of Colorado; Ph.D., Princeton University.

SANDINE, MARGARET A. (1974) Associate Librarian, Devereaux Library. B.A., Buena Vista College; M.A., University of Minnesota.

SANKEY, JULIA T. (1999) Haslem Post-doctoral Fellow, Museum of Geology. B.S., Albertson College of Idaho, M.S., Northern Arizona University, Ph.D., Louisiana State University.

SCHAFER, JERALD R. (1984) Chair and Associate Professor, Department of Physical Education, Assistant Director, Intercollegiate Athletics, Head Cross Country and Track Coach. B.A., M.A., Adams State College.

SHIRLEY, SUSAN (1991) Chair and Associate Professor, Department of Humanities. B.A., University of Utah; M.A., Utah State University; Ph.D., Washington State University.

SIMONSON, LARRY A. (1976) Chair and Professor, Department of Electrical and Computer Engineering. B.S., M.S., Ph.D., South Dakota School of Mines and Technology; Registered Professional Engineer (South Dakota).

SNELLER, JUDY E. (1992) Associate Professor, Department of Humanities. B.A., University of Central Florida; M.A., Ph.D., Emory University.

STETLER, LARRY D. (1997) Assistant Professor, Department of Geology and Geological Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., Washington State University.

STONE, GLEN A. (1973) Professor, Department of Materials and Metallurgical Engineering. B.S., Drexel University; M.S., Ph.D., University of California, Berkeley.

STONE, MITCHELL S. (1995) Assistant Professor, Department of Social Sciences. B.A., M.A., University of San Diego; Ph.D., University of London.

TALLEY, RICHARD (1993) Associate Professor, Department of Social Sciences. B.S., M.S., Ph.D., Michigan State University.

TEETS, DONALD A. (1988) Chair and Associate Professor, Department of Mathematics and Computer Science. B.A., University of Colorado; M.S., Colorado State University; D.A., Idaho State University.

VIERLING, KERRI L. (1998) Assistant Professor, Biology Program. B.A., Colorado College, M.A., Ph.D., University of Colorado, Boulder.

VIERLING, LEE A. (1999) Assistant Professor, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.A., Colorado College; Ph.D., University of Colorado, Boulder.

WEBB, CATHLEEN J. (1990) Associate Professor, Department of Chemistry and Chemical Engineering. B.S., Ph.D., University of Washington.

WEISS, JOHN M. (1991) Associate Professor, Department of Mathematics and Computer Science. B.A., Yale University; M.S., Ph.D., Vanderbilt University.

WELSH, D. HUGH (1986) Associate Professor, Department of Physical Education, Director, Intercollegiate Athletics; Head Men's Basketball Coach. B.S., Valley City State College; M.S. University of Mary.

WINTER, ROBB M. (1988) R.L. Sandvig Professor, Department of Chemistry and Chemical Engineering. B.A. Dickinson State University; M.S., Ph.D., University of Utah.

WOLFF, GERALD W. (1995) Assistant Professor, Department of Social Sciences. B.S., M.A., Bowling Green State University; Ph.D., University of Iowa.

ZIMMERMAN, PATRICK R. (1997) Director, Institute of Atmospheric Sciences; Chair and Professor, Department of Atmospheric Sciences. B.S., M.S., Washington State University; Ph.D. Colorado State University.

EMERITI FACULTY

ARNESON, JOHN R. (1966-68) (1974-1994) Professor Emeritus, Department of Social Sciences. B.S., Northern State College; M.A., Ph.D., University of Northern Colorado.

BAYLOR, LESLIE M. (1962-1987) Associate Professor Emeritus, Department of Humanities. B.S., Northwestern University; Th.M., Iliff School of Theology; M.A., Idaho State University.

BENSON, DEAN C. (1954-1956) (1960-1980) Professor Emeritus, Department of Mathematics and Computer Science. B.A., Sioux Falls College; M.S., Ph.D., Iowa State University.

BOSWORTH, FRANCIS D. (1963-1995) Associate Professor Emeritus, Department of Civil and Environmental Engineering. B.S., North Dakota State University; M.S., Washington State University; Registered Professional Engineer (South Dakota); Registered Land Surveyor (South Dakota).

CHIANG, CHAO-WANG (1974-1992) Professor Emeritus, Department of Mechanical Engineering. B.S., National Chiao-Tung University; Ph.D., University of Wisconsin; Registered Professional Engineer (Colorado).

COX, CYRUS W. (1951-1992) Professor Emeritus, Department of Electrical and Computer Engineering. B.S., Rose Polytechnic Institute; M.S., Purdue University; Registered Professional Engineer (South Dakota).

COYLE, WILLIAM V. (1947-1988) Professor Emeritus, Department of Civil and Environmental Engineering. B.S., South Dakota School of Mines and Technology; M.S., University of Missouri; Registered Professional Engineer (South Dakota); Registered Land Surveyor (South Dakota).

DAVIS BRIANT L. (1962-1996) Professor Emeritus, Department of Atmospheric Sciences. B.S., M.S. Brigham Young University; Ph.D. University of California, Los Angeles.

DUNN, JOHN J. (1961-1992) Professor Emeritus, Department of Humanities. B.A., St. John's University; M.A., Ph.D., University of Minnesota.

ERICKSON, JOHN DUFF (1978-1995) Professor Emeritus, Department of Civil and Environmental Engineering of (Mining Engineering). B.S. South Dakota School of Mines and Technology; M.S., Massachusetts Institute of Technology.

FEDELL, RICHARD L. (1963-1987) Associate Professor Emeritus, Department of Civil and Environmental Engineering. B.S., Kansas State University; M.S., University of Wisconsin; Registered Professional Engineer (South Dakota).

FRASER, HARVEY R. (1965-1975) President Emeritus. B.S., United States Military Academy; M.S., California Institute of Technology; Ph.D., University of Illinois.

GAINES, JACK R. (1957-1995) Professor Emeritus, Department of Chemistry and Chemical Engineering. B.S., M.S., Ph.D., Montana State College; Certified with U.S. Drug Enforcement Administration.

GOODMAN, JAMES R. (1992-1997) Professor Emeritus, Department of Civil and Environmental Engineering. Vice President Emeritus for Academic Affairs. B.S., University of Wyoming; M.S., Colorado State University; Ph.D., University of California, Berkeley; Registered Professional Engineer (Colorado, Wyoming).

GREEN, MORTON (1950-1980) Professor Emeritus, Biology Program. A.B., M.A., University of Kansas; Ph.D., University of California.

GRIES, JOHN PAUL (1936-1976) Professor Emeritus, Department of Geology and Geological Engineering. A.B., Miami University; M.S., Ph.D., University of Chicago; Certified Professional Geological Scientist.

GRIMM, CARL ALBERT 1952-1988) Professor Emeritus, Department of Mathematics and Computer Science. B.A., M.A., University of Cincinnati.

GROVES, WILLIAM N. (1960-1989) Professor Emeritus, Department of Mechanical Engineering. B.S., University of Illinois; M.S., Washington University; Registered Professional Engineer (South Dakota).

HARBISON, CLYDE L. (1941-1979) Professor Emeritus, Department of Mathematics and Computer Science. A.B., Wabash College; M.A., Indiana University.

HIRSCH, JOHN H. (1965-1996) Associate Professor Emeritus, Department of Atmospheric Sciences, and Institute of Atmospheric Sciences. B.S., M.S., Pennsylvania State University Main Campus.

HOPKINS, DON C. (1968-1993) Professor Emeritus, Department of Physics. B.S., Eastern Illinois University; M.S., Ph.D., University of Illinois.

HOWE, SISTER MARMION (1968-1985) Professor Emerita, Biology Program. B.S., College of St. Scholastica; M.N.S., University of South Dakota; Ph.D., World Open University. Registered with American Society of Radiological Technologies.

HUGHES, STELLA (1989-1996) Professor Emerita, Department of Social Sciences. B.S., M.S., Ph.D., Oklahoma State University.

HUGHES, WILLIAM L. (1988-1993) Professor Emeritus, Department of Electrical and Computer Engineering. B.S., South Dakota School of Mines and Technology; M.S., Ph.D., Iowa State University.

HUNT, ROBERT P. (1946-1981) Professor Emeritus, Department of Physical Education. B.A., Iowa State Teachers College; M.A., University of Nebraska.

JONTE, J. HAWORTH (1966-1985) Professor Emeritus, Department of Chemistry and Chemical Engineering. A.B., University of Pacific; M.S., Washington State University; Ph.D., University of Arkansas.

KINYON, JEANNETTE E. (1966-1980) Professor Emerita Department of Humanities. B.S., University of Minnesota; M.A., Fresno State College.

KLEMM, WILLIAM A. (1975-1990) Professor Emeritus, Department of Chemistry and Chemical Engineering. B.S., University of Illinois; Sc.D., Massachusetts Institute of Technology.

LINGARD, AMOS L. (1953-1977) Research Professor Emeritus, Department of Materials and Metallurgical Engineering. Sc.B., Ottawa University; M.A., Ph.D., University of Kansas.

LOOYENGA, ROBERT W. (1972-1997) Professor Emeritus, Department of Chemistry and Chemical Engineering. B.A., Hope College; Ph.D., Wayne State University; Registered with U.S. Drug Enforcement Administration.

McNEIL, RICHARD D. (1958-1993) Professor Emeritus, Department of Electrical and Computer Engineering. B.S., U.S. Naval Academy; M.S., South Dakota School of Mines and Technology; Registered Professional Engineer (South Dakota).

MICKELSON, JOHN C. (1961-1985) Professor Emeritus, Department of Geology and Geological Engineering. A.B., Augustana College; M.A., Ph.D., University of Iowa; Certified Professional Geological Scientist.

MILLER, JAMES R. (1971-1998) Associate Professor Emeritus, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., Ohio State University; M.S., South Dakota School of Mines and Technology.

MOE, GEORGE R. (1966-1983) Professor Emeritus, Department of Humanities and Social Sciences. B.S., U.S. Military Academy; M.A., University of Maryland; Ph.D., American University.

MOORE, GEORGE E. (1969-1986) Assistant Professor Emeritus, Department of Electrical and Computer Engineering. B.S., M.S., South Dakota School of Mines and

Technology; Registered Professional Engineer (South Dakota).

MUSIL, DENNIS J. (1967-1990) Research Associate Professor Emeritus, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., University of Wisconsin, Superior; B.S., Pennsylvania State University; M.S., South Dakota School of Mines and Technology.

NEWSTROM, BOOTS (1967-1994) Associate Professor Emerita, Department of Humanities. B.S., M.Ed., Black Hills State College; M.A., University of California.

ORVILLE, HAROLD D. (1965-1996) Distinguished Professor Emeritus, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.A., University of Virginia, M.S., Florida State University; Ph.D., University of Arizona.

PALMERTON, LEIGHTON R. (1935-1973) Professor Emeritus, Department of Social Sciences and Dean of Students Emeritus. B.S., General Beadle State College; M.A., University of Minnesota; Ed.D., University of Colorado.

PENDLETON, RICHARD L. (1973-1997) Professor Emeritus, Department of Mechanical Engineering. B.S., M.S., Missouri School of Mines; Ph.D., University of Missouri, Rolla; Registered Professional Engineer (South Dakota, Wyoming).

PETERSON, HOWARD C. (1957-1992) Dean of Students Emeritus. B.S., South Dakota School of Mines and Technology; M.S., Northern State College; Ed.D., University of South Dakota.

PROPSON, THOMAS P. (1968-1996) Professor Emeritus, Department of Civil and Environmental Engineering. B.S.E., M.S.E., Ph.D., University of Michigan.

RAHN, PERRY H. (1968-1997) Professor Emeritus, Department of Geology and Geological Engineering; Director, Black Hills Natural Science Field Station. B.A., B.S., Lafayette College; Ph.D., Pennsylvania State University; Certified Professional Geological Scientist; Registered Professional Engineer (South Dakota).

REDDEN, JACK A. (1969-1991) Professor Emeritus, Department of Geology and Geological Engineering. A.B., Dartmouth College; M.S., Ph.D., Harvard University.

REDIN, ROBERT D. (1962-1995) Professor Emeritus, Department of Physics. B.S., M.S., Ph.D., Iowa State University.

RIEMENSCHNEIDER, A. LOUIS (1967-1974) (1980-1998) Professor Emeritus, Department of Electrical and Computer Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Wyoming; Registered Professional Engineer (South Dakota).

SANDVIG, ROBERT L. (1946-1987) Professor Emeritus, Department of Chemistry and Chemical Engineering. B.S., South Dakota School of Mines and Technology; M.S., University of Cincinnati; Ph.D., University of Colorado.

SCHILZ, CARL E. (1946-1973) Professor Emeritus, Department of Chemistry and Chemical Engineering. A.B., Albion College; M.S., University of Illinois.

SCHLEUSENER, RICHARD A. (1965-1987) President Emeritus. B.S., University of Nebraska; M.S., Kansas State University; Ph.D., Colorado State University.

SMITH JR., PAUL L. (1966-1996) Professor Emeritus, Department of Atmospheric Sciences and Institute of Atmospheric Sciences. B.S., M.S., Ph.D., Carnegie Institute of Technology.

SNYDER, LESTER W., JR. (1959-1984) Professor Emeritus, Department of Mechanical Engineering. B.S., Louisiana Polytechnic Institute; M.S., Carnegie Institute of Technology; Registered Professional Engineer (Louisiana).

SPELTS, CATHRYN A. (1967-1990) Associate Professor Emerita, Department of Humanities. B.S., Nebraska State College; M.Ed., Black Hills State College; Ed.D., University of South Dakota.

STEVENS, LAVERN R. (1965-1996) Associate Professor Emeritus, Department of Civil and Environmental Engineering. B.S., South Dakota School of Mines and Technology; M.S., University of Connecticut; Registered Professional Engineer (South Dakota).

THIELEN, A. CHARLES (1964-1993) Professor Emeritus, Department of Social Sciences. B.S., M.S., Northern State College; Ed.D., University of Wyoming.

THORSON, DONALD A. (1947-1985) Professor Emeritus, Department of Civil and Environmental Engineering. B.S., South Dakota School of Mines and Technology; M.S., Colorado A&M; Registered Professional Engineer (South Dakota); Registered Land Surveyor (South Dakota).

WEGER, RONALD C. (1967-1991) Professor Emeritus, Department of Mathematics and Computer Science; Research Associate, Institute of Atmospheric Sciences. B.A., William Jewell; M.S. Ph.D., University of Illinois, Urbana.

WHITEHEAD, AUDREY G. (1928-1967) Professor Emerita, Department of Humanities. B.S., M.A., The Ohio State University.

WILSON, ROBERT W. (1961-1975) Professor Emeritus, Department of Geology and Geological Engineering. B.S., M.S., Ph.D., California Institute of Technology.

ADMINISTRATION

OFFICE OF THE PRESIDENT

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.

GRAY, JILL (1999) Senior Secretary. B.A., Unversity of Colorado; M.A., Colorado State University.

ALUMNI LIAISON

VOTTERO, TIMOTHY J. (1998) Director, SDSM&T Alumni Association. B.S., South Dakota School of Mines and Technology.

SDSM&T FOUNDATION LIAISON

PAPPEL, L. ROD (1991) President, SDSM&T Foundation. B.S., M.S., South Dakota School of Mines and Technology; Registered Professional Engineer (South Dakota).

ACADEMIC AFFAIRS

WHITEHEAD, KAREN L. (1981) Vice President for Academic Affairs. B.A., Ph.D., University of Minnesota.

LOFBERG, JOHN C. (1993) Administrative Assistant II, Vice President's Office. B.S., Black Hills State University; M.S., South Dakota School of Mines and Technology.

STOLTZ, VIOLET M. (1988) Senior Secretary, Vice President's Office. A.A., Black Hills State University; Certified Professional Secretary.

ACADEMIC AND ENROLLMENT SERVICES

JONES, WILLIAM W. (1971) Director of Academic Services. B.S., Black Hills State College; M.S., Northern State College.

COLOMBE, LEONARD C. (1988) Coordinator of Academic Support Services. B.A., B.S., Black Hills State University; M.S., South Dakota State University.

COLOMBE, SHARON K. (1987) Director, Financial Aid. B.A., Benedictine College, formerly known as Mount Saint Scholastica College; M.Ed., South Dakota State University.

DOLAN, BARBARA F. (1987) Coordinator of Academic Support Development. B.A., South Dakota State University; B.S., South Dakota School of Mines and Technology; M.B.A., University of South Dakota.

GLADFELTER, GEORGE W. (1965) Director, Student Information System. B.S., Massachusetts Institute of Technology.

IVERSON-HALL, HOLLY R. (1996) Assistant Manager of Admissions. B.A., Dakota Wesleyan University.

MATHISON, JENNY (1998) Admissions Counselor. B.S., South Dakota School of Mines & Technology.

MANAGER OF ADMISSION - Vacant

BLACK HILLS NATURAL SCIENCES FIELD STATION

RAHN, PERRY H. (1968-1997) Director and Professor Emeritus, Department of Geology and Geological Engineering. B.A., B.S., Lafayette College; Ph.D., Pennsylvania State University; Certified Professional Geological Scientist; Registered Professional Engineer (South Dakota).

CENTER OF EXCELLENCE FOR ADVANCED MANUFACTURING AND PRODUCTION

BATCHELDER, MICHAEL J. (1974-1984) (1986) Executive Director and Professor, Department of Electrical and Computer Engineering. M.S., Oklahoma State University; Ph.D., Virginia Polytechnic Institute and State University.

ALLEN, CASEY D. (1998) Integrated Manufacturing Specialist. B.S., South Dakota School of Mines and Technology.

DOLAN, DANIEL F. (1981) Director of Academic Programs and Professor, Department of Mechanical Engineering. B.S., M.S., Ph.D., University of Minnesota.

IYER, SRINIVASA L. (1974) Director of Industry Programs and Professor, Department of Civil and Environmental Engineering. B.S., M.S., College of Engineering, Trivandrum, India; Ph.D., South Dakota School of Mines and Technology; Registered Professional Engineer (South Dakota).

CHEMICALS AND MATERIALS MANAGEMENT

CRANSTON, JAQUE M. (1994) Chemical and Materials Manager, Department of Chemistry and Chemical Engineering. B.S., South Dakota School of Mines and Technology.

COLLEGE OF EARTH SYSTEMS

BANG, SANGCHUL (1985) Dean, College of Earth Systems and 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).

COLLEGE OF INTERDISCIPLINARY STUDIES

BRYSON, DEAN A. (1976) Dean, College of Interdisciplinary Studies and Professor, Department of Social Sciences. B.S., M.S., Northern State College; Ed.D., University of Nebraska.

COLLEGE OF MATERIALS SCIENCE AND ENGINEERING

MUNRO, JAMES M. (1977) Interim Dean, College of Materials Science and Engineering; Professor, Department of Chemistry and Chemical Engineering. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Utah; Registered Professional Engineer (South Dakota).

COLLEGE OF SYSTEMS ENGINEERING

KRAUSE, WAYNE B. (1970-1978) (1983) Interim Dean, College of Systems Engineering; Professor, Department of Mechanical Engineering. 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, Engineering Mining and Experiment Station. B.S., Montana College of Mineral Science and Technology.

GRADUATE EDUCATION AND RESEARCH

FARWELL, SHERRY O. (1995) Dean of Graduate Education and Research. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., Montana State University.

CAI, ZHONG TAO (1999) Research Scientist I.

REID, SHARON L. (1974) Proposal/Grant Services Manager.

INSTITUTE OF ATMOSPHERIC SCIENCES

ZIMMERMAN, PATRICK R. (1997) Director, Institute of Atmospheric Sciences; 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.

FEIND, RAND E. (1993) Research Scientist II. B.S., South Dakota School of Mines and Technology; M.S. New Mexico State University; M.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.

KOPP, FRED J. (1971) Research Scientist III. B.S., M.S., South Dakota School of Mines and Technology.

LALONDE, KARL A. (1999) Research Scientist I. B.S., M.S., South Dakota School of Mines and Technology.

MO, QIXU (1998) Research Scientist I. B.S., M.S. Wuhan University - Wuhan, P.R. China; Ph.D., New Mexico Institute of Mining 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.

INSTRUCTIONAL 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.

SCHUMACHER, BRYAN J. (1991) Assistant Director, Computer Networking Services. B.S., South Dakota School of Mines and Technology.

LIBRARY

ANDERSEN, PATRICIA M. (1984) Director. B.S., University of South Dakota; M.L.I.S., Louisiana State University.

DAVIES, CINDY L. (1987) Associate Catalog Librarian. B.A., University of South Dakota; M.L.I.S., Louisiana State University.

SANDINE, MARGARET A. (1974) Associate Librarian. B.A., Buena Vista College; M.A., University of Minnesota.

TAYLOR, JANET L. (1973) Coordinator of Library Operations. B.S., National College of Business.

MINING AND MINERAL RESOURCES RESEARCH INSTITUTE (MMRRI)

HLADYSZ, ZBIGNIEW (1981) Professor and Mining Engineering Program Coordinator. M.S., Technical University, Gliwice, Poland; Ph.D., Central Mining Institute, Katowice, Poland.

MUSEUM OF GEOLOGY

BJORK, PHILIP R. (1975) Professor, Paleontologist and Director, Museum of Geology at the Journey Museum. B.S., University of Michigan; M.S., South Dakota School of Mines and Technology; Ph.D., University of Michigan.

HERBEL, CARRIE L. (1995) Collections Manager and Preparator. B.S., M.S., University of Nebraska, Lincoln.

GREENWALD, MICHAEL T. (1997) (1998) 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 and Professor of Geology. B.S., M.S., South Dakota School of Mines and Technology; Ph.D., University of Washington.

SANKEY, JULIA T. (1999) Haslem Post-doctoral Fellow. B.S., Albertson College of Idaho, M.S., Northern Arizona University, Ph.D., Louisiana State University.

DEPARTMENT OF MILITARY SCIENCE

MURRELL, LT. COL. RICHARD J. (1997) Professor. B.S., University of Oregon; M.S., Troy State University, Lieutenant Colonel, Air Defense.

KRAMER, RANDALL P. (1996) Assistant Professor, Department of Military Science, ROTC. B.S., South Dakota State University; M.S. University of South Dakota; Major, Quartermaster Corps.

REDD, SCOTT W. (1998) Assistant Professor, Department of Military Science, ROTC. B.A., Dakota Wesleyan University; M.Ed., South Dakota State University; Captain, Corps of Engineers.

STUDENT AFFAIRS

LANGE, DOUGLAS K. (1992) Vice President of Student Affairs and Dean of Students. B.S., M.A., Ball State University; Ed.D., Peabody College of Vanderbilt University.

CAMPONE, FRANCINE (1992) Associate Dean of Students. B.A., Richmond College, CUNY; M.A., New York University; M.S., Wagner College; Ed.D., Teacher's College, Columbia University.

ROMANO, MARIE A. (1999) Senior Secretary.

CAMPUS MINISTRY

HUGHES-HARGRAVES, DONNA (1996) Minister, United Campus Ministry. B.S., SulRoss State University; M.Ag., Texas A&M University; M.Div., Asbury Theological Seminary.

CAREER PLANNING AND PLACEMENT

SAWYER, DARRELL R. (1997) Director, Career Planning, Placement, and Cooperative Education. B.A., M.A., University of South Dakota.

COUNSELING SERVICES

McCOY, JOLIE A. (1997) Counselor. B.S., M.S., University of Texas at Austin.

HEALTH SERVICES

Services contracted through Creekside Family Practice.

IVANHOE INTERNATIONAL CENTER

AADLAND, SUSAN R. (1989) Director. B.S., Northern State University.

RESIDENCE LIFE

ALLEGER II, ARTHUR (1984) Director. B.S., Rutgers University; M.S., University of North Dakota.

SHARUM, CECELIA A. (1994) Assistant Director, Residence Life for Physical Environment/Residence Hall Director for Palmerton. B.S., M.S., Oklahoma State University.

STEINBERG, BRIAN C. (1999) Assistant Director, Residence Life for Programs/Residence Hall Director for March/Dake. B.S., Central Michigan University; M.A., University of Northern Iowa.

WILSON, MAUREEN C. (1999) Assistant Director, Residence Life for Services/Residence Hall Director for Connolly. B.A. Northern State University, M.A., Eastern New Mexico University, Portales

SCIENTIFIC KNOWLEDGE FOR INDIAN LEARNING AND LEADERSHIP (SKILL)

DIRECTOR - Vacant

SURBECK STUDENT CENTER/STUDENT ACTIVITIES

HOWELL, MICHELLE C. (1997) Director. B.A., University of Nebraska - Lincoln. M.Ed., University of Maryland at College Park.

BUSINESS AND ADMINISTRATION

HENDERSON, TIMOTHY G. (1981) Vice President of Business and Administration. B.S., University of South Dakota.

PAINTER, AUDREY L. (1981) Senior Secretary.

ADMINISTRATIVE SERVICES (ACCOUNTING)

HOUDEK, ROBERT A. (1988) Director. B.S., Northern State College.

UNIVERSITY 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.

KLICHE, JANET K. (1979) Assistant Director.

DINING SERVICES

Services contracted through ARAMARK.

HIGH PLAINS CENTER FOR TECHNOLOGY

BENDER, VICKIE M. (1986) Software Development Manager. A.A. Northern 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 and Associate Professor, Department of Physical Education and Head Men's Basketball Coach. B.S., Valley City State College, M.S., University of Mary.

COBLE, LORI D. (1984) Assistant Women's Basketball Coach. B.S., Dakota State College; M.A. University of

Minnesota.

CUTLER, VARICK F. (1994) Assistant Men's Basketball Coach. B.A., LaSalle University; M.S.W., Eastern Washington 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.

MECHLING, SHAWN M. (1999) Certified Athletic Trainer/Athletic Equipment Manager. B.S., South Dakota State University, M.Ed., University of Virginia.

METTILLE, CONNIE A. Intramural Director, Head Women's Volleyball Coach. B.S., Winona State University; M.S., University of Wyoming.

RICHARDS, RONALD J. (1998) Assistant Professor/Head Football Coach. B.A., University of Montana; M.A., Western Montana College.

RUDEBUSCH, THOMAS R. (1980) Sports Information Director.

SCHAFER, JERALD R. (1984) Assistant Director, Intercollegiate Athletics; Chair and Associate Professor, Department of Physical Education; Head Cross Country and Track Coach. B.A., M.A., Adams State College.

STEPHEN, SHANE J. (1998) Assistant Football Coach/Defensive Coordinator/Assistant Intramural Director/Weight Room Supervisor. B.A., University of Northern Colorado; M.S., University of Wyoming.

PHYSICAL PLANT

MUELLER, MICHAEL R. (1988) Interim Director. B.S., South Dakota School of Mines and Technology.

TECH PRINT CENTER

FROELICH, RENEE M. (1997) Reproduction Services Supervisor.

UNIVERSITY SCHEDULING AND CONFERENCES

KINZER, MARLIN L. (1993) Director. B.S., Black Hills State University.

SCHOENHARD, KATHY J. (1992) Assistant Director.

UNIVERSITY AND PUBLIC RELATIONS

SMORAGIEWICZ, JULIE A. (1994) Vice President of University Relations. B.A., M.Ed., University of Toledo.

WISHARD, KRISTI L. (1998) Senior Secretary. B.S. Black Hills State University.

CHILDREN'S SCIENCE CENTER

DIRECTOR - Vacant

PUBLIC INFORMATION

LARESE, KARI M. (1999) Public Information Manager. B.A., University of Colorado, Boulder.

PUBLICATIONS

SCHOFIELD, RACHEL A. (1997) Publications Manager. B.A. Central Michigan 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. The Executive Council is the principal administrative unit at the university and includes the Vice President of Academic Affairs, the Vice President of Student Affairs and Dean of Students, the Vice President of Business and Administration, the Vice President of University Relations, the President of the SDSM&T Foundation, and the Assistant to the President.

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, the Vice President for Academic Affairs, the Vice President of Student Affairs and Dean of Students, the Vice President of Business and Administration, the Vice President of University Relations, the President of the SDSM&T Foundation, the Deans of the four colleges, the Dean of Graduate Education and

Research, the Chair of Faculty Advisory Council, and the Assistant to the President.

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 Career Service Advisory Council is elected by Career Service Employees.

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.

The Chair of the Faculty, the president of the Student Association, the Chair of the Career Service Advisory Council and the Chair of the Exempt Employees Advisory Council meet monthly with the President and the Assistant to the President as the Institutional Council to consider and coordinate recommendations for policy and other matters of interest to the constituencies of the university.

Executive Council
Dr. Richard J. Gowen, President; Gail Boddicker, Assistant to the President; Dr. Karen L. Whitehead, Vice President for Academic Affairs; Dr. Douglas K. Lange, Vice President of Student Affairs and Dean of Students; Timothy G. Henderson, Vice President of Business and Administration; L. Rod Pappel, SDSM&T Foundation President; and Julie A. Smoragiewicz, Vice President of University Relations.

University Cabinet
Dr. Richard J. Gowen, President; Gail Boddicker, Assistant to the President; Dr. Karen L. Whitehead, Vice President for Academic Affairs; Dr. Douglas K. Lange, Vice President of Student Affairs and Dean of Students; Timothy G. Henderson, Vice President of Business and Administration; L. Rod Pappel, SDSM&T Foundation President; Julie A. Smoragiewicz, Vice President of University Relations; Dr. James Munro, Interim Dean of the College of Materials Science & Engineering; Dr. Sangchul Bang, Dean of the College of Earth Systems; Dr. Dean A. Bryson, Dean of the College of Interdisciplinary Studies; Dr. Wayne B. Krause, Interim Dean of the College of Systems Engineering; Dr. Sherry O. Farwell, Dean of Graduate Education and Research; and Dr. Steve McDowell, Chair of the Faculty Advisory Council.

Career Service Council
Jeanette Nilson, Chair; Diane Fraser, Vice President; Deb Tompkins, Secretary; Steve Phelps, and Rebecca Cronin.

Exempt Employees Council
Suzi Aadland and Kata McCarville, Co-Chairs; Charles Colombe, Darrell Sawyer, and Rachel Schofield.

Faculty Advisory Council
Dr. M. Steven McDowell, Chair; Dr. Bruce Berdanier, Dr. David Boyles, Dr. Ed Corwin, Dr. James Cote, Dr. Arden Davis, Dr. John Helsdon, Dr. Robin Lipke, and Dr. Brad Morgan.

I**nstitutional Council**
Dr. Richard J. Gowen, President; Steve McDowell, Faculty Advisory Council Chair; Jeanette Nilson, Career Service Council Chair; Chuck Cox, Student Association President; and the Exempt Employees Council Chair.

Student Association
Charles Cox, President; Paul Chilson, Vice President.

INDEX

5,000 copies of this document were printed by SDSM&T
at a cost of $1.59 each.