

Welcome to the 2017-2018 Online Undergraduate/Graduate Catalog of the South Dakota School of Mines and Technology (SDSM&T)



The academic catalog is the official source of information for the university's undergraduate and graduate academic programs, courses, policies, degree requirements, and procedures. In the past the catalog has been available only in print format or online in a PDF format. In 2012, SDSM&T implemented an online catalog management system (acalog™) to make the catalog more "user friendly" for students and faculty. **This new system provides many functions/features we hope you will find helpful. They include:**

- **ARCHIVED CATALOGS** - Archived catalogs are available from the drop-down list in the top right-hand corner of the page by clicking the academic year you want to view.
- **EXPORT** - An export function which allows us to export the course descriptions, program information, or the entire catalog for you upon request.
- **HELP** - A help function which is available by clicking on the "Help" icon located in the top right-hand corner of each page.
- **MOBILE ACCESS** - Mobile access to SDSM&T's online catalog through your smartphone or iPhone is available through the following URL: m.ecatalog.sdsmt.edu
- **PERSONALIZED CATALOG** - A portfolio function - My Portfolio - which allows you to browse the online catalog and store courses and program information you find interesting or useful for later retrievable.
- **PRINTING** - A print-friendly view on each section of the catalog which allows you to print pages which interest you by clicking on the "Print Friendly Page" icon located in the top right-hand corner of each page.

- **NAVIGATION and LINKS** - In addition to the navigation pane at the left of the screen, many pages have navigation menus at the top of the page. Just click on the topic and the link will take you directly to that topic on the page. Use the arrow on the right of the screen to move back to the top of the page.
- **Navigation in Course Descriptions** -The course titles are "show/hide" links to the complete course descriptions. Click on the course title once to "show" the complete course description. Click on the course title again to "hide" the complete course description.
- **SEARCH** - An advanced search function which allows you to search for course information by course prefix, course number, exact match, or descriptive phrases.

Should you have questions or concerns about this catalog, please contact the Registrar and Academic Services (RAS) office at 605-394-2400.

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 published. 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. BOR Policy 2:20

University Information

SDSM&T Vision, Mission and Strategic Priorities

Our **vision** is for the South Dakota School of Mines & Technology to be recognized as an exceptional engineering and science university.

Our **mission** is to prepare leaders in engineering and science; to advance knowledge and its application, and to serve the state of South Dakota, our region, and the nation.

Our Strategic Priorities to be achieved by 2022:

GOAL ONE

Student Success: Prepare more undergraduate students for leadership in engineering and science

GOAL TWO

Research: Increase research to prepare science and engineering experts, advance knowledge, and catalyze economic development

GOAL THREE

Facilities: Redevelop and expand needed living, learning, and research spaces.

GOAL FOUR

People: Recruit, develop, and retain excellent faculty and staff.

GOAL FIVE

Administration: Responsibly steward financial and physical resources.

GOAL SIX

Development: Establish a robust culture of philanthropy to enable the university to sustain excellence.

2017-2018 Academic Year

The South Dakota School of Mines & Technology is one of six universities operating under the authority assigned by the Constitution of the State of South Dakota to the nine member Board of Regents. The mission of the university is established by the Legislature of the State of South Dakota with programs and organization approved by the Board of Regents. The president is delegated to administer the operation of the university. The traditional collegial process of shared governance for the formation of policies and oversight includes representative organizations to provide recommendations to the president for implementation as appropriate.

South Dakota Board of Regents

Mr. Bob Sutton, President
Mr. Kevin Schieffer, Vice President
Mr. John Bastian, Secretary
Mr. Jim Thares
Mr. Jim Morgan
Mr. Randy Schaefer
Ms. Pam Roberts
Mr. Conrad Adam

Executive Director

Dr. Michael G. Rush

South Dakota Public Higher Education Institutions

Black Hills State University, Spearfish;
Capital University Center, Pierre;
Dakota State University, Madison;
Northern State University, Aberdeen;
South Dakota School of Mines & Technology, Rapid City;
South Dakota State University, Brookings;
Black Hills State University-Rapid City, Rapid City;
University Center, Sioux Falls;
University of South Dakota, Vermillion

SD Mines Councils

Executive Council

The Executive Council is the principal administrative unit at the university. The council members are the president, provost and vice president for academic affairs, vice president for finance and administration, director of marketing and communications, vice president for student affairs and dean of students, vice president for research, director of athletics, director of human resources, director of facilities and risk management, dean of graduate education, faculty senate chair, and SDSM&T Foundation president. The special projects coordinator for the president will serve as the secretary to the Executive Council.

University Cabinet

The University Cabinet 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, special projects coordinator to the president, provost and vice president for academic affairs, vice president for finance and administration, director of marketing and communications, vice president for student affairs and dean of students, vice president for research, director of athletics, SDSM&T Foundation president, chair of the faculty senate, director of the Alumni Association, dean of graduate education, chair of the non-faculty exempt employees council, chair of the civil service advisory council, president of the student association, directory of information technology services, and the director of facilities and risk management

Civil Service Advisory Council

The civil service employees elect the Civil Service Advisory Council members. This council shall consist of five members, with the offices of chair, vice chair, secretary, and two general board members.

Non-Faculty Exempt Employees Council

The Non-Faculty Exempt Employees Advisory Council is elected by the administrative employees who are exempt from the Civil Service Act of the state of South Dakota.

Faculty Senate

The Faculty Senate consists of nine voting members, two non-voting (ex-officio) members and is chaired by the chair of the Faculty Senate. The ex-officio members are the vice president for research and the provost and vice president for academic affairs. All faculty members may vote in the election of representatives from their discipline and each is eligible for election as a discipline representative.

Student Association

The Senate of the Student Association is the elected representative council for the formation of recommendations on behalf of enrolled students, including the fees charged to students and the operation of student activities funded through student fees.

SDSM&T Executive Council

PUSZYNSKI, JAN A. (1991) President and Vice President, Research. M.S., Technical University, Wroclaw, Poland; Ph.D., Institute of Chemical Technology, Prague, Czechoslovakia.

KOURIS, DEMITRIS (2015) Provost/Vice President, Academic Affairs. Diploma, National Technical University of Athens; M.S., Illinois Institute of Technology, Ph.D., Northwestern University.

LUEKEN, JOEL (2014) Director of Athletics. A.A., Ellsworth Community College; B.A., Ottawa University; M.S., Northwest Missouri State University.

MAHON, PATRICIA G. (2000) Vice President, Student Affairs and Dean of Students. B.S., M.S., Montana State University-Billings; Ph.D., Kansas State University.

MALOTT, STEPHEN (2014) Vice President for Finance and Administration. B.S. and B.A., Georgetown University; M.P.A., University of Southern California.

ROBERTS, JERILYN (2006) Director of Facilities and Risk Management. B.S. and M.S., South Dakota School of Mines & Technology.

KINCART, JOEL (2015) President, South Dakota School of Mines & Technology Foundation.

SHUMAN, KELLI (2005) Vice President, Human Resources. B.S., Black Hills State University; M.S., University of South Dakota.

BRENTLINGER, ANN (2015) Director of Marketing and Communications. B.A., University of South Dakota; M.A., National American University.

PRICE, MARIBETH (1995) Dean of Graduate Education. B.A., Dartmouth College; M.A., Ph.D., Princeton University.

RICE, RODNEY (1999) Faculty Senate Chair. B.A., Moorhead State University; M.A., University of Minnesota; Ph.D., University of Nebraska - Lincoln.

Academic Organization

Academic departments at South Dakota School of Mines & Technology are organized as follows:

- Chemical and Biological Engineering
- Chemistry and Applied Biological Sciences
- Civil and Environmental Engineering
- Electrical and Computer Engineering
- Geology and Geological Engineering
- Humanities
- Industrial Engineering and Engineering Management
- Math and Computer Science
- Mechanical Engineering
- Materials and Metallurgical Engineering
- Military Science
- Mining Engineering and Management
- Physical Education
- Physics
- Social Sciences

Accreditation

The South Dakota School of Mines & Technology is accredited by the Higher Learning Commission of the North Central Association of Colleges and Secondary Schools, the recognized accrediting agency for the north central states, through the Academic Quality Improvement Program (AQIP) process. For more information call (800) 621-7440 or visit: www.ncahigherlearningcommission.org.

In addition, the curriculum in chemistry is approved by the American Chemical Society.

All undergraduate engineering programs are accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.

The computer science program is accredited by the Computing Accreditation Commission of ABET, Inc., <http://www.abet.org>.

Equal Opportunity Policy

South Dakota School of Mines & Technology does not discriminate on the basis of race, color, national origin, military status, gender, religion, age, sexual orientation, political preference, or disability in employment or the provision of service.

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

Academic Calendar

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

Fall Semester 2017

Classes begin	August 21
Last day to add or drop a course and adjust fees	August 31
Last day for pass/fail and audit options	August 31
Labor Day Holiday	September 4
Native Americans' Day Holiday	October 9
Midterm (First half of semester ends)	October 13
Graduation application due for undergraduate students (planning to graduate in May or August)	October 16
Midterm deficiencies grades due by midnight	October 18
Early Registration Weeks (Tentative)	October 23-November 10
Last day to drop classes	November 3
Thanksgiving Holiday begins at end of class day	November 21
Classes resume	November 27
No class day	December 6
Final examinations	December 7-13
Semester ends	December 13
Fall Graduation	December 16
Final grades are due by midnight	December 18

Spring Semester 2018

Classes begin	January 8
Martin Luther King Jr. Day Holiday	January 15
Last day to add or drop a course and adjust fees	January 17
Last day for pass/fail and audit options	January 17
Presidents' Day Holiday	February 19
Spring vacation begins at end of class day	March 2
Midterm (First half of semester ends)	March 12
Classes resume	March 12
Midterm deficiencies grades due by midnight	March 15
Graduation application due for undergraduate students (planning to graduate in December)	March 19
Early Registration Weeks (Tentative)	March 19-April 13
Easter Break begins at end of class day	March 29
Classes resume	March 12
Last day to drop classes	April 3
Final examinations	April 30-May 4
Semester ends	May 4
Spring Graduation	May 5
Final grades are due by midnight	May 9

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

Holidays

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

New Years Day

January 1*.

Martin Luther King Jr. Day

Third Monday in January.

Presidents Day

Third Monday in February.

Memorial Day

Last Monday in May.

Independence Day

July 4*.

Labor Day

First Monday in September

Native American Day

Second Monday in October.

Veterans Day

November 11*.

Thanksgiving Day

Fourth Thursday in November.

Christmas Day

December 25*

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

Drop and Add Period

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

Course Abbreviations

Abbreviation	Definition
AES	Atmospheric and Environmental Sciences
ANTH	Anthropology
ART	Art
ARTH	Art History
BIOL	Biology
BME	Biomedical Engineering
CBE	Chemical and Biological Engineering
CEE	Civil and Environmental Engineering
CENG	Computer Engineering
CHEM	Chemistry
CHIN	Chinese
CEM	Construction Management
CP	Career Planning
CSC	Computer Science
EE	Electrical Engineering
EM	Engineering Management
ENGL	English
ENGM	Engineering Management
EXCH	Student Exchange - International
EXPL	Study Abroad
GE	General Engineering
GEOE	Geological Engineering
GEOG	Geography

GEOL	Geology
GER	German
GES	General Engineering and Science
GS	General Studies
HIST	History
HUM	Humanities
IENG	Industrial Engineering
IS	Interdisciplinary Sciences
MATH	Mathematics
ME	Mechanical Engineering
MEM	Mining Engineering and Management
MES	Materials Engineering and Science
MET	Metallurgical Engineering
MSL	Military Science
MUAP	Applied Music
MUEN	Music Ensemble
MUS	Music
NANO	Nanoscience and Nanoengineering
PALE	Paleontology
PE	Physical Education
PHIL	Philosophy
PHYS	Physics
POLS	Political Science
PSYC	Psychology
SOC	Sociology
SPAN	Spanish
SPCM	Speech

Admission - Undergraduate

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.

Admissions Requirements

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

In addition, The Board of Regents approved the following requirements for admission to the School of Mines:

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

- obtain an ACT composite score of at least 25 AND obtain an ACT math subscore of at least 25 (or SAT-I composite score of 1200 and SAT-I Math subscore of 590)

AND

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

OR

- South Dakota Regents' Scholar

School of Mines will **review and consider for acceptance** students who meet the following requirements:

- obtain an ACT composite score of at least 20 (or SAT-I equivalent composite score of 1020)

AND

- obtain an ACT math subscore of at least 20 or (SAT-I math subscore of at least 520)

AND

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

All applicants not meeting the admission requirements listed above will be reviewed by the Admissions Committee. The committee considers high school curriculum (special consideration is given to math and science coursework), grades, and test scores.

School of Mines ACT CODE - 3922

School of Mines SAT CODE - 6652

South Dakota Board of Regents Minimum Undergraduate Course Requirements

1. Minimum Course Requirements

All baccalaureate or general studies students under twenty four (24) 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. One 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 noncredit fine arts activity will be accepted for students graduating from high schools in states that do not require completion of courses in fine arts for graduation.

2. Alternate Criteria for Minimum Course Requirements

- a. Students who do not successfully complete four years of English may meet minimum course requirements through one of the following:
 - i. An ACT subtest score of 18 or above;
 - ii. An Advanced Placement Language and Composition or Literature and Composition score of 3 or above.
- b. Students who do not successfully complete three years of advanced mathematics may meet minimum course requirements through one of the following:
 - i. An ACT mathematics subtest score of 20 or above;
 - ii. An Advanced Placement Calculus AB or Calculus BC score of 3 or above.
- c. Students who do not successfully complete three years of laboratory science may meet minimum course requirements through one of the following:
 - i. An ACT science reasoning subtest score of seventeen (17) or above;
 - ii. An Advanced Placement Biology, Chemistry, or Physics B score of 3 or above.
- d. Students who do not successfully complete three years of social studies may meet minimum course requirements through one of the following:
 - i. An ACT Social Studies/Reading subtest score of seventeen (17) or above;
 - ii. An Advanced Placement Microeconomics, Macroeconomics, Comparative or United States Government and Policies, European or United States History, or Psychology score of 3 or above.

- e. Students graduating from South Dakota high schools that do not successfully complete one year of fine arts may demonstrate fine arts knowledge or competency through the following:
 - i. An Advanced Placement History of Art, Studio Art drawing, or general portfolio or Music Theory score of 3 or above.

Non-Traditional Students

For purposes of admission, a degree seeking student who has attained the age of 24 and has not previously attended any post-secondary institution is classified as a non-traditional student. Non-traditional students who are high school graduates or have completed the general equivalency diploma (GED) and can demonstrate college algebra readiness will be considered for admission.

It is the policy of the South Dakota School of Mines and Technology to recognize that there is a great diversity in the background and goals of non-traditional students seeking college admissions. Each individual is evaluated for admission to the School of Mines based on the minimum admission requirements as prescribed by the Board of Regents **and who demonstrate college algebra readiness**. Additional consideration will be given to non-traditional students who do not meet the BOR undergraduate admission requirements.

Non-traditional students who are high school graduates and meet the university minimum requirements **and demonstrate college algebra readiness** will be admitted.

Non-High School Graduates

An applicant for baccalaureate or associates admissions who is not a high school graduate must: Be 18 years or older to meet the compulsory school attendance requirement in South Dakota; and completed the general equivalency diploma (GED) with the following minimum test scores: The total cumulative standard test scores for all five tests items must total 2250 with no standard test score below 410 or complete the High School Equivalency test (HiSET) and obtain a minimum score on each of the five subsections; OR complete the Test Assessing Secondary Completion (TASC) and obtain a minimum score of 500 on each of the five subtest categories.

Regents Scholars

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

- **4 units of English:** Courses with major emphasis upon grammar, composition, or literary analysis; one year of debate instruction may be included to meet this requirement.
- **4 units of algebra** or higher mathematics: algebra, geometry, trigonometry, or other advanced mathematics including accelerated or honors mathematics (algebra) provided at the eighth grade level; not included are arithmetic, business, consumer or general mathematics, or other similar courses.
- **4 units of science including 3 units of approved laboratory science:** Courses in biology, chemistry, or physics in which at least one (1) regular laboratory period is scheduled each week. Accelerated or honors science (biology, physics, or chemistry) provided in the eighth grade shall be accepted. Qualifying physical science or earth science courses (with lab) shall be decided on a case-by-case basis.

- **3 units of social studies:** History, economics, sociology, geography, government-including U.S. and South Dakota, American Problems, and so on.
- **2 units of a modern (including American Sign Language) or classical language**
- **1 unit of fine arts:** Effective fall 2002 for students graduating from South Dakota high schools in: Art, theatre, or music appreciation, analysis, or performance.
- **1/2 unit of computer science:** Students will have basic keyboarding skills and have had experience in using computer word processing, database and spreadsheet packages, and in using the Internet or other wide-area networks.

Readmission Procedures

A student who has interrupted attendance by three (3) or more semesters must submit an application for readmission and pay the application fee. Any student not under academic or disciplinary suspension will be automatically readmitted.

Undergraduate Transfer Admission

A. Transfers to Baccalaureate Programs

Students under twenty-four (24) years of age transferring into baccalaureate degree programs with fewer than twenty-four (24) transfer credit hours must meet the baccalaureate degree admission requirements. Students with twenty-four (24) or more transfer credit hours with a GPA of at least 2.75 and proof of college algebra readiness are automatically accepted into baccalaureate degree programs. Transfer students with GPAs less than 2.75 will be considered on a case-by-case basis by the SDSM&T Admissions Committee. Transfer applicants with a cumulative college GPA below 2.0 will not be admitted degree-seeking. If students are applying for federal financial aid, they must meet federal guidelines for transfer students.

B. Students who Transfer to Associate Programs

Students who are under the age of twenty four (24) at the start of the term and who are transferring into associate degree programs with fewer than 12 transfer credits hours must meet the associate degree admissions requirements. Students with 12 or more transfer credit hours with a cumulative GPA of at least 2.75 may transfer into associate's degree programs. Specific degree programs may include additional admissions requirements.

C. Students from Accredited Colleges or Universities

Students may be accepted by transfer from other non Regental universities outside of the SD system: preferential consideration shall be given to applicants from institution which are accredited by their respective regional accrediting association. Advanced standing shall be allowed within the framework of existing rules in each college. (Refer to BOR policy 2:5, Transfer of Credit)

D. Students from Non-Accredited Colleges

A university is not required to accept credits from a non-accredited college or university. The university may admit the applicant on a provisional basis and provide a means for the evaluation of some or all of the credits. Credits from colleges or universities which are not accredited by a regional accrediting association may be considered for transfer subject to all other provisions in BOR Policy 2:5 and any conditions for validation which may be prescribed by the accepting institution.

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 required to pay the application fee and, he or she must also submit an application for readmission and other required documents if he or she has interrupted attendance by two (2) or more semesters. A former student shall be considered as a transfer student if he or she has attended another institution during the period of interruption of attendance.

F. Suspended Students

A transfer applicant under academic suspension from the last college attended shall not be considered for admission during the period of suspension or, if suspended for an indefinite period, until one (1) semester has passed since the last date of attendance at the previous school. A system transfer student must first be reinstated to their previous institution prior to seeking admission to the School of Mines.

G. Disciplined Students

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

Special (Non-degree Seeking) Students

A prospective student at South Dakota School of Mines and Technology who wishes to be classified as a special student must complete the Application for Non-degree Seeking Student. Non-degree seeking students are ineligible for all federal financial aid programs, **including the GI Bill** and are limited to enrolling in a maximum of 30 credit hours as non-degree seeking. Non-degree seeking students must submit an official copy of their previous college transcript(s) if necessary to verify prerequisites.

Dual Enrollment of High School Students

A high school student wishing to take courses at School of Mines should begin by contacting the Admissions Office at School of Mines and the Principal's Office or Guidance Office at the high school he or she currently attends to receive the high school's approval to participate. This approval should accompany the Board of Regents High School Dual Credit Admissions Application. Please refer to the legislative SDCL 13-28-37, enacted by the South Dakota Legislature in 1990. This bill states the following: "Postsecondary enrollment-Responsibility for cost-Failing grade eliminates eligibility. Any student enrolled in grades ten, eleven, and twelve may apply to an institution of higher education or a postsecondary vocational education institution as a special student in a course or courses offered at the institution of higher education or postsecondary vocational education institution. The student shall obtain the school district's approval of the post-secondary course or courses prior to enrolling. If approved, the student shall receive full credit toward high school graduation as well as post-secondary credit for each postsecondary course. The resident school district may pay all or part of the tuition and fees for a course approved for credit toward high school graduation in accordance with this section. The student is responsible for any tuition and fees not paid by the resident school district and for any other costs involved with attending a postsecondary institution. If a failing grade is received in a postsecondary course under this section, the student receiving the failure is no longer eligible to enroll for post-secondary courses under this section."

Additional Admissions Policies and Practices

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

All entering students seeking an associate or baccalaureate degree must provide valid Enhanced ACT scores, SAT/SAT-I scores, or must take the ACCUPLACER examination in the areas of writing skills, mathematics, and reading. All non-degree seeking students enrolling in English and mathematics courses must provide Enhanced ACT scores, SAT/SAT-I scores, or must take the ACCUPLACER examination in the areas of writing skills and mathematics.

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

The placement process will be consistent for all Regental institutions.

Applications and Procedures

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

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

B. Application Submission

An applicant for admission must submit the required application for admission and the necessary official transcript or transcripts and other required documents to the Office of Admissions (501 E. Saint Joseph Street, Rapid City, SD 57701).

C. Records Required

Applicants who are twenty-one (21) years of age or younger must submit Enhanced ACT (or SAT-I) results, an official high school transcript, if a high school graduate, or proof of GED and an official transcript for all previous college work as part of their application. **In those cases where an admissions decision can be made based on the student's academic record, the requirements to submit ACT/SAT-I results may be waived.** Applicants who are older than twenty-one (21) years of age and who do not have valid ACT / SAT-I exam results (**taken within the last 5 years**), or who have not taken the exams are not expected to take the exam. However, they are required to submit an official high school transcript, if a high school graduate, and an official transcript for all college work. Applicants should also submit any other records, data, or letters required to support eligibility for admission, including competency test scores. SAT scores will be converted to ACT equivalencies according to a conversion table approved by the Board of Regents. Note: An official transcript is one that bears the original seal and signature of the official in charge of records at that institution.

D. Preadmission Immunization Requirements

In accordance with state law, every student (graduate and undergraduate) who has been admitted to a post-secondary institution - either public or private - in the state of South Dakota **who meets established criteria is obliged to demonstrate immunity to measles, mumps, and rubella.** Relevant criteria (the key factors which drive the need for compliance) are delineated below:

1. Age: students born on or after January 1, 1957 must comply; those born prior to this date are excused.
2. Course schedule: students who register for two or more credit-bearing classes - and at least one course involves face-to-face contact on a weekly basis for multiple weeks - are obliged to comply. This includes participation at all campuses, centers (including University Center, Capital University Center, and West River Higher Learning Center), and off-campus meeting locations.
3. Academic background: students who have completed prior collegiate coursework *in the state of South Dakota* (initiated prior to July 1, 2008) are excused from compliance. Note: credits earned through distance learning, dual credit agreements, and exam/validation do not qualify.
4. Acceptable evidence of immunity to *each disease* includes:

Immunization record which specifies administration of two doses of vaccine; Medical laboratory report that verifies presence of disease-specific antibodies in the blood (i.e., positive blood titer); and /or, documentation of disease state as diagnosed by a qualified physician.

The law recognizes that special circumstances may preclude ability to demonstrate compliance as detailed above. Those students for whom vaccination presents a threat to health/well-being and those who adhere to a religious doctrine that opposes immunizations may petition for a permanent exemption or temporary waiver as appropriate. Forms are available at: <http://sdmines.sdsmt.edu/studentlife/forms>. Please note: the statute does *not* allow for philosophical objections.

Freshman Checklist

- Submit application for admission.
- Enclose non-refundable application fee with application for admission (\$20.00).
- ACT or SAT I scores must be on file in the Admissions Office.
- Applicants must arrange to have an official copy of their high school transcript forwarded to the Office of Admissions 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. Transcripts can be sent to the Admissions Office by mail to: 501 E. Saint Joseph Street, Rapid City, SD 57701 or through an approved electronic third party vendor at: etranscripts@sdsmt.edu.
- Prospective freshmen desiring scholarship consideration must be accepted for admission and have completed the scholarship application prior to January 15.

Transfer Checklist

- Application for admission.
- Non-refundable application fee of \$20.00.
- An official transcript from each postsecondary institution attended. (Sent by the institution attended directly to the Office of Admissions **via postal deliver at:** 501 E. Saint Joseph Street, Rapid City, SD 57701 **or approved electronic third-party vendor at:** etranscripts@sdsmt.edu.)
- 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.
- Applicants younger than twenty-one (21) who have completed less than 24 semester credits of college work must submit official copies of SAT I or ACT scores in addition to the above documents.

Applicants who will be less than 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 **also meet freshman admission requirements**.

Transfer applicants will be notified of their admission status at School of Mines shortly after all of the above documents have been submitted.

Undergraduate International Student Admissions

To be considered for undergraduate admission, international applicants must meet the following criteria. See Application Requirements below for details.

1. Applicants should have a minimum GPA of 2.75 at both the secondary (high school) and post-secondary (college) education levels.
2. Applicants must be proficient in English; please review details about our English requirements.
3. Applicants must provide an acceptable SAT or ACT score. Math sub-scores should be a minimum of 570 on the SAT or 25 on the ACT.

Application Requirements

The following items are necessary before a request for admission can be processed. If admitted, the form I-20 is usually necessary for admission to the United States for college attendance. The REQUIRED items for admission are listed below.

1. **Completed online application** and the State of South Dakota application fee of \$20.00. (Your application will not be processed until the \$20.00 fee is paid.)
2. **Academic credentials (translated into English).** This includes high school transcripts and transcripts from ALL post-secondary institutions attended.
 - OFFICIAL TRANSCRIPTS
 - For a transcript to be considered official, it must be sent directly from the issuing institution to our university.
 - All copied documents must be certified by an official school or government seal as originals or certified photocopies.
 - ALL documents must be in a sealed envelope with university or government agency stamping across the seal.
 - If you are attending an institution in the US and they have the official documents, they may send certified copies of these documents to us in the same manner.
 - All documents become the property of the South Dakota School of Mines & Technology.
 - ELECTRONIC TRANSCRIPTS - there are 3 ways we can receive electronic official college transcripts.
 - <http://www.parchment.com/>

- <http://www.studentclearinghouse.org/>
 - eSCRIP-SAFE, the Global Electronic Transcript Delivery Network, supplements traditional paper transcripts by providing high schools, colleges, universities, and third-party recipients with a network through which official transcripts are delivered in a secure and trusted environment. Delivery is instantaneous, fully trackable, and most importantly, easy to use. Business processes need not change and joining the network is simple.
3. **English proficiency** - This is usually the TOEFL or IELTS; please review details about our English requirements.
 4. **SAT or ACT scores** - Math sub-scores should be a minimum of 570 on the SAT or 25 on the ACT. If the SAT or ACT is not readily available in your country, alternatives will be considered. Scores must be sent directly from the issuing organization. The website for SAT is: <http://sat.collegeboard.org/home> and the website for ACT is: <http://www.actstudent.org/>.

SD Mines ACT code: 3922

SD Mines SAT code: 6652

5. **Evaluation of your academic credentials.** An academic department may require submission of academic credentials to an independent credential evaluation service, the charge for which will be paid by the student. SDSM&T only accepts credential evaluations from specified organizations. Those organizations are World Education Services (WES) at <http://www.wes.org/> or Educational Credential Evaluators, Inc. (ECE) at <https://www.ece.org/>. If you use WES, order a course by course report. If you use ECE, order a catalog match report. If you are a transfer student and want your transcripts evaluated for transfer credit, order a catalog match report from ECE, or a course by course report from WES.

Financial information documenting ability to pay.

If you are admitted, the United States Citizenship and Immigration Service (USCIS) requires that a US college or university issuing form I-20 or DS-2019 establish that the person to whom the form is issued is able to pay all educational and incidental expenses (see requirements). The I-20 or DS-2019 form will not be issued without appropriate financial documents. Financial information is not required for admission.

Deadlines

To be considered for merit-based scholarships, you must be ADMITTED by January 15 and complete the scholarship application. The online scholarship application will be available beginning November 1 and is due by January 15. You must be accepted for admission to SD Mines prior to completing the scholarship application.

SD Mines does not have a specific deadline for admission. However, all international applicants should submit their documents at least three months prior to the start of the semester they plan to enroll. This will allow time to apply for the appropriate visa and to make travel arrangements.

Applications and Other Forms

Apply Online (preferred method)

Application form (paper) - Online applications preferred, but paper application forms may be requested by sending an email to international@sdsmt.edu.

Electronic University Consortium

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

Current Reduced Tuition Programs for Non-Residents

The current non-resident tuition rate is \$385.30 per credit hour. For more information, contact the Cashier's Office at (605) 394-2372 or e-mail cashier@sdsmt.edu.

Reduced tuition is available for certain non-resident first-time freshmen, new transfers, and international students. Students already enrolled in the public university system prior to summer 2006 will not be eligible for the new non-resident rate. Tuition assistance is also available to National Guard members, ROTC cadets, South Dakota State Employees, certain elementary and secondary school teachers and vocational instructors, and persons 65 years of age or older. Graduate students who hold a state contract for an assistantship or fellowship may also be entitled to special reduced tuition and should contact the Graduate Education Office at (605) 394-1206. For current tuition information see the website: www.sdsmt.edu.

Minnesota Reciprocity

Students from Minnesota can currently come to the South Dakota School of Mines and Technology at a comparable rate to Minnesota resident tuition under the Minnesota Reciprocity agreement. To apply, or for more information: www.sdbor.edu/policy/5_FinanceBusiness/documents/5-5-1.pdf.

Western Undergraduate Exchange Program (WUE)

The WUE tuition rate is 150 percent of the resident rate: \$369.05 per credit hour compared to \$246.00. For more information, contact the Cashier's Office at (605) 394-2372 or e-mail cashier@sdsmt.edu.

The reduced tuition rate is available for non-resident first-time freshmen and new transfers from Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, Utah, Washington, Wyoming, and the Commonwealth of the Northern Mariana Islands. Students already enrolled in the public university system prior to summer 2016 will not be eligible for the WUE rate. For more information: <http://wiche.edu/wue>.

Hardrock Heritage Award

Nonresident freshman and transfer students who have at least one parent or legal guardian who earned a degree from South Dakota School of Mines and Technology qualify to receive tuition and fees at the in-state rate. Currently enrolled students who are not eligible for this program. To apply, or for more information: <http://www.sdsmt.edu/Admissions/Financial-Aid-and-Scholarships/Hardrock-Heritage-Award/>

Other Reduced Tuition Programs

Tuition assistance is also available to National Guard members, ROTC cadets, South Dakota State Employees, certain elementary and secondary school teachers and vocational instructors, and persons 65 years of age or older. Graduate students who hold a state contract for an assistantship or fellowship may also be entitled to special reduced tuition and should contact the Graduate Education Office at (605) 394-1206. For current tuition information see the website: www.sdsmt.edu.

Resident and Nonresident Classification of Students

Purposes of Classification

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

Information, Burden of Establishing Residency, Reclassification

- A. The decision shall be based upon information provided by the student and all other relevant information.
- B. The institution is authorized to require such written documents, affidavits, verifications, or other evidence as are deemed necessary to establish the residence of the student, including proof of emancipation, adoption, or appointment of a guardian.
- C. Students have the burden of establishing residency by clear and convincing evidence.
- D. Students may appeal the original classification decision by written petition to a reviewing body appointed by the chief executive officer of the institution within thirty (30) days after registration for that semester. The recommendation of the reviewing body shall be submitted to the chief executive officer for a decision. The decision of the chief executive officer shall be final, but students who have been classified as nonresidents retain full rights to petition the executive director of the South Dakota Board of Regents for reclassification after they have remained in South Dakota continuously for 12 months.
- E. After twelve (12) months continuous presence in South Dakota, students who were initially classified as nonresidents may petition for reclassification.
- F. Petitions for reclassification shall be filed with the Executive Director, who shall act upon them. The Executive Director shall report his disposition of such petitions to the Board at its regularly scheduled meetings. These reports shall be summarized in a manner consistent with the Family Educational Rights and Privacy Act.
- G. If a petition for reclassification is granted, the reduced tuition rate shall become effective with the first semester or session following the date on which the petition is granted. Students who fail to request resident status prior to a particular semester or session or to pursue a timely appeal shall be deemed to have waived any claim for reduced tuition for that semester or session.
- H. A student or prospective student who knowingly provides false information or refuses to provide or conceals information for the purpose of improperly achieving resident student status is subject to the full range of penalties, including expulsion, provided for by the Board of Regents.

Establishing Bona Fide Residency

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

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

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

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

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

- C. Physical presence in South Dakota for the predominant purpose of attending an institution of higher education controlled by the Board does not count in determining the 12-month period of residence. Absence from South Dakota to pursue postsecondary education does not deprive a person of resident student status.
- D. A person once properly classified as a resident student shall be deemed to remain a resident student so long as remaining continuously enrolled in the Regental system until the person's degree shall have been earned, subject to the provisions of (B) above.
- E. International students whose visas permit them to establish domiciles in the United States or its territories or protectorates may qualify for resident tuition in the same manner as United States citizens.

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

- A. The following factors shall be considered relevant in evaluating a requested change in a student's nonresident status and in evaluating whether the person's physical presence in South Dakota is for the predominant purpose of attending an institution of higher education controlled by the Board:
- The residence of an un-emancipated student's parents or guardians;
 - The site 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 testate 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.

Tuition and Fees - Undergraduate

Tuition and Fees

The following rates became effective May 6, 2017 and are subject to change by Board of Regents action. For current information see the website: www.sdsmt.edu.

Tuition and Fees	Resident	Non-Resident
Undergraduate on-campus per semester credit	\$246.00	\$385.30*
Graduate on-campus per semester credit	\$320.05	\$642.35
General Activity Fee - per credit	\$ 47.60	\$ 47.60

*New students and transfers for Academic Year 2007 or after

* Does not include Minnesota rates. For more information, please refer to Minnesota Reciprocity information.

See accompanying text for the description of discipline fees.

Resident Hall Rent - per semester	Resident	Non-Resident
Single Occupancy	\$2,141.00	\$2,141.00
Double/Triple Occupancy	\$1,833.00	\$1,833.00
Quad	\$2,050.00	\$2,050.00
Deluxe Quad	\$2,200.00	\$2,200.00

* For residency information, contact the Admissions Office or refer to Board of Regents Policy at:
<https://sdbor.edu/policy/documents/3-2.pdf>.

Reduced tuition is available for non-resident first-time freshmen, new transfers, and international students. Those undergraduate students will qualify for a rate of 150 percent of what residents pay. Students already enrolled in the public university system prior to summer 2006 will not be eligible for the new non-resident rate. Reduced tuition is also elementary and secondary school teachers and vocational instructors, and persons 65 years of age or older. Graduate students who hold a state contract for an assistantship or fellowship may also be entitled to special reduced tuition and should contact the Graduate Education Office at (605) 394-1206.

*Students from Minnesota can currently come to the South Dakota School of Mines and Technology at a comparable rate to Minnesota resident tuition under the Minnesota Reciprocity agreement. To apply, or for more information:
www.sdbor.edu/policy/documents/5-5-1.pdf.

Fees

Application Fee

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

General Activity Fee

A fee is assessed for each state-funded course for activities such as student organizations, cultural events, homecoming, student government, student newspapers, wellness center, intramurals student health services, and the Surbeck Student Center operational and debt expenses. The allocation of general activity fees is recommended to the president by students on the General Activity Fee Committee, and the president is the approving authority on how these fees are spent.

Discipline Fees

The Discipline Fees are assessed by course prefix. They are used to support incremental costs of instructional equipment and other operating costs, including salary enhancement for the benefit of students enrolled in higher cost disciplines.

Credit by Examination Fee

This \$90.75 fee is charged for each course in which a student seeks credit by examination.

International Student Fee

All international students enrolled on campus with an F-1 or J-1 visa shall be charged the International Student Fee each semester they are enrolled. This includes degree-seeking students, English as a Second Language (ESL) students, and foreign students enrolled under a cooperative agreement with a foreign institution.

Vehicle Registration Fee

All motor vehicles parked on campus must be registered with the Campus Safety Office. Contact this office at (605) 394-2251 for options, amounts, and appropriate display of parking permit or <http://www.sdsmt.edu/Campus-Services/Facilities/Campus-Parking/>.

Transcript Fee

A transcript of credits is an authentic copy of the student's academic record. The charge for each transcript is \$9.00.

Payment Process

All tuition and fees are required to be paid in full or other financial arrangement made with the Cashier's Office no later than September 2, 2016 for fall 2016 classes and January 19, 2017 for spring 2017 classes. For the student's convenience, electronic bill and payment services are provided. If no financial arrangement is made by these dates, a late charge will be assessed on the next day. Examples of other financial arrangements may include payment plans, deferments for financial aid, or third party payments. (For a deferment for financial aid, contact the Financial Aid Office.) Since summer semester add/drop periods vary, check with the Cashier's Office for final financial arrangement dates for add/drop courses. If no financial arrangement is made, enrollments shall be cancelled.

Late Payment Charge

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

Indebtedness

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

Debit Card System

The South Dakota School of Mines Grubby Gold Card is a money management system activated through each student's ID card. This account is similar to a checking account or a debit card. When you present your card to make a purchase at participating locations, on and off-campus, the amount will be immediately deducted from your account. Currently, Grubby Gold is accepted at select beverage and snack machines in Surbeck Center and in the dorms, at the bookstore, Hardrocker Café, Java City, washers and dryers in the dorms, copy machines at Surbeck Center and select vendors off campus.

To add money to your Grubby Gold account or check account balances and account history, just create a Grubby gold account online. Look for the link at

[https://grubbygold-sp.blackboard.com/eaccounts/\(S\(tj1d0gqzb1munryijrpolrzi\)\)/AnonymousHome.aspx](https://grubbygold-sp.blackboard.com/eaccounts/(S(tj1d0gqzb1munryijrpolrzi))/AnonymousHome.aspx)

Self-register by using your student ID number and your name as it is printed on your student ID. If your parents, family or friends know your student ID number, they can also add money to your Grubby Gold account by using the guest deposit feature online.

Refunds

Withdrawal Refunds Information

Students who withdraw, drop out, or are expelled from School of Mines within the add/drop period (first 10 percent of term, commonly referred to as the census date) receive a 100 percent refund of tuition and course-related fees. Students who withdraw, drop out, or are expelled from the university after the add/drop period for the enrollment period for which they are assessed charges may be entitled to a refund of tuition, fees, and other institutional charges calculated through 60 percent of the enrollment period. The refund shall be determined by computing the percentage of an enrollment period remaining after the date of withdrawal times the tuition, fees, and other institutional charges originally assessed the student.

A student's withdrawal date is

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

Federal Financial Aid Recipients: The U.S. Department of Education requires institutions to use the Return of Title IV Funds policy for students withdrawing from school and who are receiving Federal Title IV student financial aid. Title IV funds refers to the federal financial aid programs authorized under the Higher Education Act of 1965 (as amended) and includes the following Federal Student Aid programs: Subsidized and Unsubsidized Stafford Loan, Parent PLUS Loan, Grad PLUS Loan, Perkins Loans, Pell Grant, Academic Competitiveness Grant (ACG), National Science and Mathematics to Retain Talent Grant (SMART), Supplemental Educational Opportunity Grant (SEOG) and any other Federal Aid program enacted by Congress. Students are advised to review the information located at: <http://sdmines.sdsmt.edu/finaid/withdrawal>.

Financial Aid - Undergraduate

Overview

The following information is intended to be a brief overview of the financial aid process and programs at the School of Mines. More up to date and detailed information is available on our website at: www.sdsmt.edu/FinAid.

Students at the School of Mines benefit from nearly \$22 million in various forms of financial assistance from both within and outside the university. It is clear that many college students find it necessary to supplement their personal and family financial resources in order to attend college. SD Mines administers a comprehensive financial aid program to enable capable, qualified, and needy students to finance their college education with both need-based aid (grants, subsidized loans, and work-study) and non-need based aid (scholarships, outside agency assistance, unsubsidized loans, private alternative loans, Parent PLUS loans, etc.). However, the student should still be prepared to pay for a portion of college costs through savings from employment, and parents of dependent students are expected to assist with the student's cost of education to the extent to which they are able.

The School of Mines gives priority on a first come, first served basis in the awarding of the Federal Supplemental Educational Opportunity Grant (SEOG) and Federal Work-Study (FWS) to students whose Free Application for Federal Student Aid (FAFSA) has been received by the FAFSA processor on October 1 and thereafter until funds are exhausted. Students who are eligible for the Federal Pell Grant, Federal Direct Loan, Federal Direct Grad PLUS Loan and/or the Federal Direct Parent PLUS Loan are awarded without regard to when the FAFSA is received for the school year. The Financial Aid Office generally begins the Federal Student Aid awarding process for new incoming freshman by late February.

I. General eligibility requirements for awarding Federal Student Aid

- A. Must have applied and been fully admitted to the School of Mines as a degree-seeking student
- B. Complete a new **FAFSA** each year to determine eligibility for Federal Student Aid Programs.
- C. Be a U.S. citizen or eligible non-citizen.
- D. Not be in default on a federal student loan or owe a federal student grant repayment.
- E. Male students born after December 31, 1959, must register with Selective Service.
- F. Follow the steps for reviewing your aid award at: www.sdsmt.edu/FinAid/FA-Award-Notification and for finalizing the aid awarded to you at www.sdsmt.edu/FinAid/FinalizeAid/
- G. Complete the online School of Mines *Additional Information Form* contained within the links in item F in which you should report any aid assistance received that is not listed on the aid award, which includes, but is not limited to scholarships, Voc-Rehab, BIA/Tribal Assistance, etc.
- H. Be enrolled as a full-time student to receive the full amount of aid awarded (indicate enrollment status on the **Additional Information Form** noted above) and notify the Financial Aid Office if the planned and/or actual enrollment changes at any time.
- I. Must maintain Satisfactory Academic Progress toward the completion of a School of Mines degree. Students who meet or exceed the standards as stated at: www.sdsmt.edu/FinAid/T4/SAP can be assured of continued eligibility until the completion of their degree or until maximum loan/Pell limits have been reached, whichever comes first.
- J. Complete the Attendance Confirmation via WebAdvisor at least two weeks prior to every semester of attendance at SD Mines.

II.

The School of Mines is a full participant in the Federal Student Aid Programs. Specific information about each program is available at: www.sdsmt.edu/FinAid/. The student's School of Mines aid award on WebAdvisor identifies the aid he or she is being awarded and provides information for finalizing the processing of the award.

- A. are gift aid based on financial need.
 - 1. **The Federal Pell Grant** is awarded to students who have not yet completed their first bachelor's degree and is based on a federal formula used to analyze the information provided on the FAFSA.
 - 2. **Federal Supplemental Educational Opportunity Grant (SEOG)** is awarded to Pell Grant eligible students based on the availability of funds.

- B. provide an opportunity for students to borrow money for educationally related expenses. However, like any loan, they must be repaid according to the provisions of the promissory note. First time loan recipients are required to complete Loan Entrance Counseling as shown at: www.sdsmt.edu/LoanEntrance.
1. **The Federal Direct Subsidized and Unsubsidized Loan** programs are obtained from the Federal Government as the lender. For the Subsidized Direct Loan, the Federal Government pays accrued interest on behalf of the student during periods of at least half-time enrollment or other eligible deferment periods. However, with the Unsubsidized Direct Loan, the Federal Government does not pay the accrued interest on behalf of the student while enrolled in school or during available deferment periods, with interest accrual beginning at disbursement. For both the Sub and Unsub Direct Loans, payment on the principal balance is required to begin six months after the student graduates or is no longer enrolled at least half-time. Current interest information is available at studentaid.ed.gov/sa/
 2. **The Federal Perkins Loan** is a Federal Loan program which is currently being phased out and is awarded on a limited basis to eligible students.
 3. **The Federal Direct Grad PLUS Loan** is available to graduate students (masters and Ph.D.) who have exhausted their eligibility for the Unsubsidized Stafford and Direct Loan programs.
 4. **The Federal Direct Parent PLUS** is borrowed by the parent on behalf of the parent's dependent student.

- C.
1. **Federal Work-Study awards** are based on financial need as determined by the results of the FAFSA and the awarding policy of the School of Mines. Employment opportunities are available both on and off campus with off campus positions focused on community service. Eligible students will be sent a Work-Study Application and after review of the applications, work-study awards will be finalized.
 2. **Other employment opportunities** are available for students who were not awarded Federal Work Study. Some positions are on-campus and others are submitted by local employers or the South Dakota Job Service and are regularly posted in the Surbeck Student Center:
www.sdsmt.edu/Campus-Life/Student-Resources/Student-Employment/.

- D.
- In order to be considered for incoming freshman scholarships at the School of Mines, prospective students must complete an online scholarship application. The online scholarship application will be available beginning November 1 and is due by January 15. You must be accepted for admission to SD Mines prior to completing the scholarship application. The online admission application is available at: www.sdsmt.edu/Admissions/Apply/. All incoming freshman accepted for admission will need to fill out the online scholarship application to be considered for incoming freshman scholarships. At the School of Mines, students apply for and are awarded a "scholarship" without regard for specific donor funding. In July, the Financial Aid Office then assigns the scholarship recipients to the various donors based on the donor-specific criteria.

1. **Four-Year Scholarships**
The most prestigious scholarship on campus provides assistance for incoming freshmen with renewable support for three additional years provided the recipient is a full time student and completes at least 24 SD Mines credit hours per academic year*, maintains at least a 3.0 SD Mines cumulative grade point average (CGPA), and continues progress toward completion of their degree.
2. **National Merit Finalist Scholarships**
SD Mines is one of a select number of universities which are a sponsor institution of the National Merit Scholarship Corporation (NMSC). Through a combination of NMSC Scholarship and SD Mines National Merit Finalist Scholarship, a \$3,000 scholarship renewable for three additional years is available to National Merit Finalists who notify the NMSC via the PSAT/NMSQT that the School of Mines is their first-choice college by the first business day in February prior to the first year of attendance. Being full time, completing a minimum of 24 SD Mines credit hours per academic year*, maintaining at least a 3.00 SD Mines CGPA and continuing progress toward completion of their degree are requirements for renewal.
3. **Two-Year Scholarships**
The SD Mines Scholarship is awarded to incoming freshman students and is renewable for one

additional year provided the recipient is a full-time student, completes at least 24 SD Mines credit hours per academic year*, maintains at least a 3.0 SD Mines GPA, and continues progress toward completion of their degree.

4. **Annual Scholarships**

One year scholarships are awarded to both incoming freshman and current students. Current students are required to complete an application for annual, non-renewable scholarships awarded by the SD Mines Scholarship Committee that are based on academic performance at the School of Mines and donor specific scholarship criteria. Information on availability of the online scholarship application is provided to students in late October (with a submission deadline of midnight MDT on December 31) for scholarships to be awarded for the following academic year. Scholarship recipients must maintain full time enrollment (must enroll in a minimum of 12 School of Mines credit hours) for each semester of the award and maintain the CGPA as required by the scholarship. If the scholarship is major specific, the recipient must maintain enrollment in the appropriate coursework needed for that major.

* An exception may be granted for up to two degree-related courses at any of the South Dakota Board of Regents (SDBOR) institutions. Students should contact the Financial Aid Office to obtain approval. Students who would like to take classes at a non-SDBOR institution and use SD Mines' financial aid should contact the Financial Aid Office with regards to a potential consortium agreement.

E.

Current students majoring in Mechanical Engineering or Civil Engineering must complete a department scholarship application through their applicable department to be eligible for department scholarships. Incoming freshman interested in Metallurgical Engineering are encouraged to fill out an application with the Metallurgical Engineering Department to be eligible for department scholarships. Interested Metallurgical Engineering students may contact the Metallurgical Engineering Department Head for more scholarship information. Scholarship applications are not required for the other undergraduate degrees at SD Mines.

F. **Graduate Student Support**

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

III. **Review Billing Statement**

The Student Accounts Office will send an e-mail notification to the student's Mines e-mail account informing him or her of availability to access their billing statement before each semester and whenever there is a change to the student's account. Please review the statement and pay attention to the amount owed and the payment guidelines set by the Business Office. Be advised that work-study awards will not appear on the billing statement.

IV.

With the exception of Federal Work-Study, which is paid monthly, and some scholarships, which are paid according to donor criteria, financial aid is credited to the student's account. If the aid applied to the student's account exceeds institutional costs applied to their account, he or she will either receive a cash disbursement (refund check) in the mail or the funds will be deposited directly to the student's bank account via Direct Deposit. Students should contact the Student Accounts Office for further information on the Direct Deposit option. In the event there are delays in disbursing the aid, students should always have enough money available to meet immediate expenses they might incur at the beginning of each semester, such as the purchase of books and supplies or security deposits for off-campus housing.

V.

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

VI. School of Mines scholarship and fellowship recipients must get advisor approval for their non-SD Mines courses prior to the start of the semester in order to use non-School of Mines credit hours to meet the full time School of Mines credit hour requirement for scholarship and fellowship disbursement. Advisors must send an e-mail to the Financial Aid Office verifying the non-SD Mines courses count towards the student's degree program.

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

VIII. Students who are interested in receiving federal financial aid for the summer term must submit a School of Mines Summer Aid Application (available after March 31) to the Financial Aid Office and complete the FAFSA for the coming school year. Their aid award will be based on a summer, fall, and spring academic year. As a result, receiving aid for the summer will directly impact the amount of aid available for the fall and spring semesters. Per SDBOR policy, the number of credit hours taken during the summer term in order to maintain a particular enrollment status (full, 3/4, 1/2 or less than half time) is the same as the fall and spring semesters. Generally, students must carry at least a half-time course load of 6 credits for undergraduate and 4.5 credits for graduate students to be eligible for summer financial aid. Specific exceptions are available to graduate students enrolled in 2 research or dissertation credit hours.

IX. Due to circumstances that may or may not be beyond the student's control, it may become necessary to withdraw from all classes prior to the end of a particular semester. Depending on the withdrawal date, the student may be entitled to a full or partial refund of tuition and fees, tablet PC rental, and if contracting with the university, for room and board.

To initiate the official withdrawal process, the student needs to first go to the Office of the Registrar and Academic Services, Room 216 of the O'Harra Building. If that is not possible, he or she may call (800) 544-8162, Ext. 2400 or local at (605) 394-2400. In the event that the student leaves school without notifying the Office of the Registrar and Academic Services, or simply never attends classes and receives a 0.00 GPA for the semester, the university has the option of considering the withdrawal date to be 1) the midpoint of the period of enrollment; 2) the last documented date of academically related activity; or 3) if he or she did not notify the Office of the Registrar and Academic Services due to circumstances beyond his or her control, the date relative to that circumstance, whichever is later. It is important that a student clearly state that he or she is withdrawing from all classes. Dropping a class and withdrawing from all classes have a different impact on a student's status with the university. If enrolled at more than one campus within the SDBOR university system, the student must inform the Office of the Registrar and Academic Services staff whether the intent is to withdraw from all campuses or just the School of Mines.

Beginning in the 2015-16 academic year, students are only allowed to drop a total of six classes (not a total withdrawal) while pursuing their undergraduate academic degree. The seventh class in which a student drops will be recorded as an "WFL" rather than a "WD". Courses dropped prior to the 2015-16 academic year are not counted in the six class maximum. Please refer to the Withdrawal Grades Policy and Deadline.

Students who have requested a Financial Aid Consortium Agreement between the School of Mines and a non-SDBOR institution and are using those credit hours to determine their enrollment status for financial aid, must be withdrawing from both institutions in order for their withdrawal from the School of Mines to result in a refund calculation. Please review the withdrawal procedures outlined elsewhere in the college catalog. Information is also available on our website at: www.sdsmt.edu/FinAid/T4-WD. Examples are provided regarding what refund a student could expect to receive based on when he or she withdraws.

X. Requests for additional information should be directed to the Financial Aid Office, South Dakota School of Mines and Technology, 501 E Saint Joseph St., Rapid City, SD 57701-3995, or call locally (605) 394-2274, or toll free (877) 877-6044 or via e-mail at FinancialAid@sdsmt.edu.

Policies/Definitions

Academic Amnesty

Eligibility:

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

To be eligible, the student must:

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

Conditions:

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

The form to appeal for academic amnesty can be found at the following URL: registrar.sdsmt.edu/docs/145192.pdf

Academic Calendar

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

Academic Freedom (Student) Rights

The School of Mines and the South Dakota Board of Regents have a longstanding commitment to protecting those freedoms of inquiry and learning that are essential to the expansion of knowledge and the correction of error. This includes protections for student freedom in learning. In its relevant parts, Board of Regents policy, which applies to the School of Mines and to all other public universities, provides the following:

- A. To secure student freedom in learning, faculty members in the classroom and in seminar should encourage free and orderly discussion, inquiry and expression of the course subject matter. Student performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards.
- B. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.
- C. Each institution shall establish an academic appeals procedure to permit review of student allegations that an academic evaluation was tainted by prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards. These procedures shall prohibit retaliation against persons who initiate appeals or who participate in the review of appeals.
- D. Students are responsible for maintaining standards of academic performance established for each course in which they are enrolled. www.sdbor.edu/policy/documents/1-11.pdf.

The School of Mines policy implementation of item C above reads as follows:

Academic Recognition for Undergraduate, Part-Time Students

Undergraduate, part-time students taking fewer than 12 credits per term may be designated for academic recognition for part-time students at the end of the fall and spring terms. The academic recognition for part-time students designation is determined by the home university. The academic recognition for part-time students designation does not appear on the transcript.

To be awarded the academic recognition for part-time students designation, students must meet the following guidelines:

- Students must have completed at least 12 credits hours prior to the current semester at one or more Regental institution.
- The student must have earned at least 3 and up to 11 credit hours of 100-699 level courses during the term.
- Students must achieve a System Term GPA of at least 3.50.
- Students with F, I, U, RI or RU grades are not eligible regardless of System Term GPA attained.

Academic Terms Defined

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

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

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

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

Placement Testing - ACCUPLACER

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

The ACT is the required initial test used to place students who attend a South Dakota regental university into their mathematics and English courses. A student can be placed in classes via the ACT sub-scores for math and English, or, for more accurate placement, using the College Board Accuplacer test, which is administered at South Dakota universities such as the School of Mines or online via remote proctor. The Accuplacer test is administered on a computer and takes approximately 30 to 40 minutes for each section (math, writing, and reading). Students who need to take the Accuplacer test should sign up for and attend an Accuplacer Day by going to the New Student Checklist from the Mines homepage or contact the Testing and Tutoring Coordinator, Tom Mahon, at 605-394-2428.

Students will need to take all or part of the Accuplacer test if:

1. They have not taken the ACT within five years from date of enrollment and have not taken and passed any college level English or math courses.
2. They have a Math Index Score below 1150.
3. They have a Math Index Score of 1150 or higher and are seeking higher math placement than College Algebra.
4. They have a Math Index Score of an 1150 or higher and want to challenge their course placement. Students are permitted to take Accuplacer twice and have the option of taking the higher of the two scores. Be advised that a deficiency warrants serious contemplation and students should consider the class that best reflects the requirements of math success. At School of Mines, advanced math, especially calculus, is a mainstay in the curriculum, regardless of major.
5. They scored 17 or less on their ACT English.

Accuplacer results are designed to assist the institution in placing students into appropriate math and English courses or, if necessary, into developmental or preparatory courses. We caution students that successful completion of a high school course (e.g., trigonometry) does not guarantee that this course has been mastered at the college level. Placement is confirmed by passing the appropriate Accuplacer test area. See section on Math Index Score and math placement below.

Math Index Score

Add/Drop (Courses) Period

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

Adding Courses Deadline

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

Alcohol and Drug Policy

The South Dakota School of Mines & Technology adheres to the SDBOR Alcohol and Drug Policy found in the 2017-2018 Alcohol and Drug Policy BOR Code of Conduct which states the following is prohibited: The unauthorized manufacture, sale, possession, use, or consumption of alcohol, marijuana, or controlled substances by students...The unauthorized possession of any drug paraphernalia. Please note that being in the presence of alcohol is considered a violation of the SDBOR alcohol policy. The complete alcohol and drug policy can be found in the BOR Student Code of Conduct. The Community Standards Office is responsible for enforcement of the BOR Code of Conduct, including the Alcohol and Drug Policy. Residential students should consult the Residence Life Handbook for further information on alcohol and drugs in the residence halls.

Anti-Harassment Policy

It is the policy of South Dakota School of Mines and Technology that harassment not be tolerated. It distracts the harasser, the victim, and others from the tasks of the workplace and academic environment; it undermines morale and the psychological well-being of the victim; and it leads to expensive litigation and to possible liability. The university has no tolerance for harassment, whether it occurs on or off campus, during or after normal business hours, at work-related social functions, or during business-related travel. Any employee or student violating this policy will be subject to disciplinary action up to and including termination or dismissal. The South Dakota School of Mines and Technology Anti-Harassment policy IV-A-20, the South Dakota Board of Regents Sexual Harassment policy 1:17, and the South Dakota Board of Regents Human Rights Complaint Procedure 1:18 can be reviewed in their entirety at: <http://sdmines.sdsmt.edu/hr/rules>, or contact the Affirmative Action Officer/Title IX-EEO Coordinator in the Human Resources Office.

Attendance Policy

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.

Audited Courses and Registrations for No Credit

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

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

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

The form to request an audit can be found at the following URL: <https://interact.sdsmt.edu/aes/audit.htm>

Undergraduate Pass-Fail Option

1. Any undergraduate student with a minimum cumulative GPA of 2.00 at South Dakota School of Mines and Technology is eligible to elect one free elective course per semester on a pass or fail basis. Courses taken under the Pass/Fail option cannot be used to satisfy the sixteen (16) credit hours of humanities/social science requirement for the bachelor of science degree.
2. The student shall notify the Office of the Registrar and Academic Services in writing of his or her request that the course be graded on a pass or fail basis. Only the Office of the Registrar and Academic Services and the student's advisor are to be notified of the intention of the student to be graded on a pass or fail basis. A student will have the option during the drop and add period of each semester to change from pass or fail to traditional grading, or vice versa.

3. The instructor will report the student's grade based on the college's regular grading system. If a grade of "D" or better is recorded, the student will receive a "Satisfactory," a grade of "U" will be recorded as a "Fail," and the "U" grade will count in calculating credits attempted.
4. Credits earned under this option may be used toward a student's graduation requirements, if appropriate and applicable, but only if a grade of "S" is recorded. A passing grade will be recorded as "S" and will not be used in the calculation of the student's GPA. A course taken on a pass or fail basis will not be converted, after a grade has been recorded, to a traditional grade for the purpose of improving a GPA.
5. The pass or fail option shall apply only to the student's first registration in a course.

The form to request the pass/fail option can be found at the following URL: <https://interact.sdsmt.edu/aes/passfail.htm>

Campus Clearing Policy

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

Catalog of Graduation for Undergraduate Students

- The catalog of graduation begins with the summer term and ends with the subsequent spring term.
- Every student is required to have a catalog of graduation. New and transfer students are assigned the catalog in effect at the time of their initial enrollment at the university from which they are seeking a degree. Students may elect a catalog of graduation that is later than their initial catalog but may not elect a catalog of graduation that is earlier than their initial catalog.
- In order to receive a degree, a student must meet the program requirements listed in his/her catalog of graduation.
- Students who discontinue enrollment at any Regental university for more than two consecutive semesters are assigned the catalog in effect at the time of their re-enrollment as their catalog of graduation.
- Students are considered to be in continuous enrollment for purposes of the catalog of graduation so long as any break in enrollment at any Regental university is for two or fewer consecutive semesters (excluding summer) and students maintain their degree seeking status at the same Regental university.
- Students who change their degree seeking status from one Regental university to another Regental university are assigned the catalog of graduation that corresponds to the term they are admitted to their new degree granting university.
- Students who are not currently enrolled and who petition to graduate based on coursework previously completed at a Regental university are assigned the catalog in effect during the term they wish to graduate.

Cheating (Academic Integrity) Policy

The South Dakota Board of Regents has clearly defined those acts that constitute violations of academic integrity (BOR Policy 2:33 - Student Academic Misconduct and BOR Policy 3:4 - Student Code of Conduct). These acts include, but are not limited to cheating and plagiarism; full definitions are found in BOR 2:33 and BOR 3:4. These acts of dishonesty violate the ethical values the university works to instill in all members of the campus community. The instructor of record for each course is responsible for clarifying the academic integrity standards for that course within the course syllabus.

Academic Misconduct Process

The process for resolution of academic misconduct cases is determined by BOR 2:33. The Community Standards Office is responsible for the adjudication of all academic integrity cases.

Classification of Undergraduate Students

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

1. Regular: An admitted, enrolled student, who is pursuing a degree at the School of Mines.
2. Special: An enrolled student who has not been admitted, and is not pursuing a degree, will be permitted to accumulate more than thirty (30) hours only on an exceptional basis. Special students do not qualify for federal student aid or institutional scholarships.

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

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

- 0 to 29.99 credits - Freshman
- 30 to 59.99 credits - Sophomore
- 60 to 89.99 credits - Junior
- 90 or more credits - Senior

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

See the graduate student general information section of this catalog for the definition of a full-time and half-time graduate student.

Community Standards

Through its rigorous academic programs and co-curricular activities, SD Mines is committed to developing informed and responsible scientists and engineers who behave ethically, value a global perspective, and accept the duties and responsibilities of citizenship.

Policies & Sanctioning

As a student at SD Mines, you are responsible for abiding by policies provided by the SD Board of Regents (BOR), the university, and specific departments/areas as applicable to your situation. As such, it is important for you to be familiar with where policies are posted. The following links provide you access to policies which govern your conduct as School of Mines students.

- [Community Standards Office](#)
- [University Policies](#)
- [BOR Policies](#)
- [Student Code of Conduct](#)
- [Academic Misconduct Policy](#)

Computer and Network Usage Guidelines and Policy

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

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

Individuals should guard their electronic identity. Choose secure passwords, and never reveal them to anyone. Individuals can be held liable for activity carried out by others using their accounts. Keep all passwords and access mechanisms secure and private. Facilities 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.

To connect to the wireless network, we require a wireless equipped laptop and Windows XP/Vista operating system. Instructions on how to connect are located on the ITS website: <http://its.sdsmt.edu>.

All guidelines and terms of use apply to ALL computer usage, wireless as well as wired desktop and laptop.

Unacceptable activities include, but are not limited to:

- Unauthorized file access or file transfer;
- Use of another individual's identification, password, or account;
- Use of computing or networking facilities that interferes with the work of another student, faculty member, or university official, or with the normal operation of computers, terminals, peripherals, or networks at the university or elsewhere;
- Making, acquiring, or using unauthorized copies of computer software or violating terms of applicable software licensing agreements;
- Use of computer or network systems that result in violation of copyright law;
- Running, installing, or distributing any program intended to damage or to place excessive load on a computer system or network;
- Attempting to circumvent data protection schemes through any mechanism, including unauthorized access or tampering with security;
- Electronically posting or distributing materials resulting in any violation of existing laws, regulations, or university or Regental policies;
- Attempting to monitor or tamper with another person's electronic communications, or reading, copying, changing, or deleting another person's files or software without the explicit agreement of that person; and
- Providing access to computer accounts, Internet connectivity, electronic mail, or other significant services to persons not authorized for use of School of Mines facilities, resources, or network services. For example, students with computers hosted on the residence hall network may not permit family or friends to use these services. Although these guidelines cover most aspects of the policy, a full copy of the current university policy on acceptable use of computing and network resources may be found at: <http://its.sdsmt.edu/student/8408/>.

Cooperative Education Program

A partnership with business, industry, and government agencies, the Cooperative Education Program provides students with opportunities to apply their classroom learning to "real world" work experiences in industry. Co-op students are hired by employers to work in positions related to their major. Minimum GPA and other co-op eligibility requirements vary among employers. Interested students should contact the Career Center or their department's Cooperative Education Coordinator. Students are responsible for securing their own co-op positions and are encouraged to register with the Career Center for assistance with identifying and applying for co-op opportunities. After accepting a co-op offer, students are to inform the Career Center of their co-op employer, salary, and dates of employment.

During their co-op work experience, students are expected to apply knowledge learned in the classroom and to grow professionally through development of their interpersonal, communication, teamwork, and workplace etiquette skills.

1. **Academic Credit:** 1 to 3 credits. Prerequisite: Permission of instructor. Credit is available for each semester or summer work experience upon approval by the departmental Cooperative Education Coordinator. Students must satisfy departmental requirements in order to earn credit for their co-op. Requirements include a written report of the work experience and an employer's evaluation of work performance. Because the work performed by a student working full-time while on co-op is equivalent to the workload of a full-time student, a student on co-op who is registered for CP credit shall be considered to have full-time status.
2. **Administration:** The Cooperative Education Steering Committee is comprised of the departmental Cooperative Education Coordinators, the Provost and Vice President for Academic Affairs, and the director of Career Center. The committee is responsible for developing cooperative education industrial or business experiences; assisting students with identifying co-op opportunities; maintaining contact with cooperative education employers; and conducting an on-going evaluation of the program. For additional information, contact the director of Career Center (605) 394-2667 or visit: <http://careers.sdsmt.edu/>.

Course Numbering System

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

Pre-College Courses

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

Undergraduate Courses

100-199 Freshman level

200-299 Sophomore level

300-399 Junior level

400-499 Senior level (may be dual listed with 500 level graduate course)

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

Graduate Courses

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

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

700-799: Graduate level (Graduate students only)

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

Experimental Courses

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

Course Overloads

A normal student load is 18 credit hours or fewer. An overload is a course load in excess of 18 credit hours.

To register for an overload, students must consult with their academic advisors and department heads. To be eligible for a course overload, students must have completed at least 30 semester hours of college credit with a minimum GPA of 2.7. With advisor and department head approval, students may request up to 21 total credit hours per semester. Overloads in excess of 21 total credit hours in a semester or requested prior to completing 30 semester credit hours are discouraged but may be requested and must be approved by the Provost/Vice President for Academic Affairs or his or her appointed designee.

The form to request a course overload can be found at the following URL: registrar.sdsmt.edu/docs/66199.pdf

Course Retake Policy

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

The retake policies approved by the BOR are as follows:

1. A student will be allowed a total of three takes for undergraduate courses (course numbers of 001 to 499) for which credit is only counted toward graduation once. The student must petition in writing to the Vice President for Academic Affairs to be permitted to take an undergraduate course more than three times.

Students wishing to appeal must complete the Application for Academic Appeal form that is available at the Office of the Vice President for Academic Affairs or can be downloaded from: <http://www.sdsmt.edu/Campus-Life/Student-Resources/Applications-and-Forms/>. At the undergraduate level only the LAST attempt (take) of the course will count toward graduation and into the grade point average calculations.

2. A student will be allowed a total of two takes for graduate courses (course numbers of 500 or above) for which credit is only counted toward graduation once. The student must petition the graduate dean for permission to take a graduate course more than two times.
3. A student will be allowed unlimited takes for an undergraduate or graduate course for which credit toward graduation may be received more than once (e.g., Cooperative Education, Independent Study, Thesis). All takes will count into grade point average calculations. Individual departments/majors may limit the number of credits allowed toward graduation in certain courses. Students should check with their advisor.
4. The Audit (AU) grade is the only grade that will not be counted as a take of a course. All other grades, including Withdraw "W" grade, will count as a take of a course.
5. Transfer courses and non-courses (CLEP, credit by exam) will also count as a take of a course.

6. The count for retakes will begin with courses in which students are enrolled fall 2003. Takes of a course prior to fall 2003 will not be counted.

Credit Hours Definition

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

Credit Received through Validation Methods

Advanced Placement Program (AP)

Entering freshman students who have completed an honors course in high school and who have taken and successfully passed appropriate College Entrance Examination Board Advanced Placement test with a score of 3, 4, or 5 may receive course credit. The South Dakota Board of Regents policy on specific courses for which credit is given and other requirements are found at the following URL: www.sdbor.edu/administrative-offices/academics/academic-affairs-guidelines/Pages/7-Dual-Credit-Credit-by-Exam-Placement.aspx

College Level Examination Program (CLEP)

The South Dakota Board of Regents and its universities encourage high school student to pursue rigorous academic programs and to take advantage of opportunities available to them to earn college credit. The College Board's College Level Examination Program (CLEP) provides an opportunity to earn college credit. Colleges and universities award college credit for satisfactory performance on the CLEP examinations. Satisfactory performance on CLEP examinations can reduce the cost of college education by reducing the number of credits a student must take to complete the degree. You may not repeat an exam of the same title within three months of the initial testing date. CLEP exams may be taken to repeat F grades. The initial F grade will be used in the grade point average calculation. South Dakota Board of Regents policy on specific courses for which credit is given and other requirements are found in the CLEP Guidelines.

International Baccalaureate (IB)

School of Mines recognizes the rigor of IB courses and the IB Diploma Program and encourages students to complete higher level courses and exams when ready. Students who complete higher level courses and exams and obtain a score of five (5) or above will be considered for advanced placement credit in the corresponding courses. South Dakota Board of Regents policy on specific courses for which credit is given and other requirements are found at: www.sdbor.edu/policy/documents/2-5.pdf.

Credit by University Examination

The School of Mines faculty has adopted a policy to permit college credit by university examination. Any student enrolled in the college who has studied a subject independently or who has completed equivalent college level course 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 head of the department in which the course is offered, who will conduct a preliminary survey of the work in which the student claims to be prepared and will determine whether an examination is warranted, what topics it should cover, and what credit may be expected.
2. After determining eligibility to take an examination the candidate pays a per-subject fee at the Office of Student Accounts/Cashier's Office and then secures the appropriate form from the Office of the Registrar and Academic Services.
3. If the student successfully completes the examination, the permanent record will show "Credit by Examination" with a grade of "EX". No entry will be made on a permanent record if the examination is failed.
4. Credit by examination is not permitted if the student has previously completed the course for collegiate credit.

Credit by Other Validation Methods

Credits earned through validation methods other than nationally recognized examinations (that is, university administered tests and verification like military credit or prior learning) are not allowed:

1. To exceed 30 credits for baccalaureate degrees
2. To exceed 15 credits for associate degrees
3. If the student previously visited or is currently registered for the class
4. For any graduate level courses (exception for some programs).

Dean's List Designation

Undergraduate, full-time and part-time students may be designated for the Dean's List at the end of the fall and spring terms. The Dean's List designation is determined by the home university and is based on a student's total course registrations for academic credit for the term from any Regental university. The Dean's List designation does not appear on the transcript.

According to the South Dakota Board of Regents policy, undergraduate full-time students must meet the following guidelines to be awarded Dean's List designation:

- Students must have earned a minimum of 12 credit hours in courses numbered 100-699 during the term.
- Students must achieve a System Term GPA of at least 3.50.
- Students with F, I, U, RI, or RU grades are not eligible regardless of System Term GPA attained.

Dropping a Course Deadline

Please see the Academic Calendar for "Last day to drop classes" for deadline information.

Double Major in Science Programs

An undergraduate student who wishes to qualify for a double major in two science programs must complete all requirements for both academic programs of study. This means earning a minimum of 120 credits for one science major plus all additional unique credits for the second science major. The System General Education requirements must be met once. A student will receive a single diploma with both majors notated under a single Bachelor of Science degree.

The dual major option at the School of Mines applies only to science programs (non-engineering programs). Students seeking to qualify for a second engineering degree should consult the section on Two Bachelor of Science Degrees from South Dakota School of Mines and Technology.

Working on dual undergraduate degrees can have implications for students receiving Federal Student Aid and especially for those receiving assistance from the Federal Pell Grant program. Students seeking to qualify for a dual major designation should arrange to complete them both in the same semester. Whether or not a student applies for graduation, once a student has completed a first bachelor's degree, he or she is no longer eligible for Pell Grant, Supplemental Educational Opportunity Grant (SEOG) and other potential Federal Aid programs currently available or available in the future. If you have questions, please schedule an appointment with David Martin or Erin Richards in the Financial Aid Office.

Dual Use of Credit

Many high school students complete college-level courses while enrolled in high school. School of Mines encourages talented high school students to extend their educational background in this manner. South Dakota law provides that students in grades 10, 11 and 12 may enroll in higher education as a special student in a course or courses offered with the school district's approval, and these courses may be applied to high school graduation requirements. See - Admission procedures for further information.

Enrollment in Courses

A. Undergraduate Courses (001-499)

1. All undergraduate and graduate students enrolling at Regental universities in courses numbered 001-499 shall be admitted as undergraduate students (either-degree seeking or non-degree seeking) and registered at the undergraduate level. For all undergraduate and graduate students enrolling at Regental universities in courses numbered 001-499, the courses shall be recorded on the transcript at the undergraduate academic level and included in the calculation of all undergraduate grade point averages.
2. When an undergraduate course is used on a converted credit basis (transferred for one level to another) to meet graduate plan of study requirements at Regental universities, the course shall be recorded on the transcript at the undergraduate academic level with the credit hours approved for the course and then duplicated at the graduate level through an internal transfer policy (Refer to BOR policy 2:5.16). At the undergraduate level, the credit is included in the calculation of the undergraduate institutional grade point average and the undergraduate cumulative grade point average at the full credit rate. At the graduate level, the credit is included in the calculation of the graduate institutional grade point average and the graduate cumulative grade point average at the converted credit rate (transferred for one level to another).
3. Undergraduate courses required as prerequisites in preparation for registration in graduate courses shall be recorded on the transcript at the undergraduate level and will not be duplicated at the graduate level because the courses are not a part of the Regental graduate plan of study.

B. Graduate Courses (500-899)

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

C. Undergraduate Students Taking Graduate Courses

Undergraduate students who have completed a minimum of 90 credit hours may enroll in a limited number of 500 level courses. The Vice President for Academic Affairs may grant an exception for enrollment in a 600 level course. The

student shall pay graduate tuition and the courses shall be recorded on a graduate transcript. These graduate courses may apply to an undergraduate degree.

Excused Absences for School Sponsored Events

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

Procedures:

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

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

Family Educational Rights and Privacy Act (FERPA) of 1974 or Buckley Amendment

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

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

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

Students should be aware that these rights and privileges are available to them. Formal notification regarding FERPA is provided annually. An announcement covering information designated as Public or Directory Information is included on posters, in the Family Matters, First Year Information and Commuter Connection newsletters and on the Academic and Enrollment Family Educational Rights and Privacy Act web page at: registrar.sdsmt.edu/103463/ Directory information includes the student's name, local and permanent address, telephone listing, electronic mail address, photograph (e.g., year book photos), date and place of birth, major field of study, dates of attendance (including graduation date), grade level, enrollment status (e.g., undergraduate or graduate, full or part time), participation in officially recognized activities and sports, weight and height of members of athletic teams, degree, honors and awards received, and the most recent education agency or institution attended (previous to School of

Mines). This information is critical to some obligations and services performed by the university. Students have the right to request that such information concerning them be withheld. For a full description of FERPA, information regarding the location of students' educational records, and procedures at School of Mines for compliance with the law, please contact the Office of the Registrar and Academic Services. US government reporting requirements have been added for international students (F and J status). As a result of the regulations that became effective on January 1, 2003, the Family Educational Rights and Privacy Act (FERPA) is waived for F and J students in respect to these specific reporting requirements. The regulations will be strictly enforced by the appropriate bureau(s) within the US Department of Homeland Security (DHS) and information will be reported electronically to DHS via Student and Exchange Visitor Information System (SEVIS). The consequences to students for non-compliance with the new regulations are severe. Contact the director of the Ivanhoe International Center at Ivanhoe@sdsmt.edu for more information.

Final Examination Policy

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

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

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

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

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

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

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

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

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

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

Grade Point Average Definition

The following grade point averages are calculated each academic term (fall, spring, summer):

Institutional GPA-based on credits earned at a specific Regental university. Utilized to determine if degree requirements have been met and to determine honors designation at graduation.

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

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

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

Calculation of grade point averages when undergraduate courses are repeated

When a course has been repeated for credit, all attempts will be entered on the transcript but the last grade earned will be used in the calculation of the cumulative grade point average (See also 2:5.11).

Class	Credit Hour Range	GPA Standard
Freshman	0-29.99	2.0
Sophomore	30-59.99	2.0
Junior	60-89.99	2.0
Senior	90+	2.0

Graduate Credit for Undergraduate Courses

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

The following conditions or limitations apply:

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

5. Not more than twelve (12) hours of graduate credit taken as a School of Mines undergraduate may be applied toward an advanced degree at the South Dakota School of Mines and Technology. Upon written justification by the head of the student's major department, the Dean of Graduate Education may approve a minor variance from this limit.
6. Petitions from undergraduate students other than those defined above will not be accepted. (See graduate student general information section of this catalog for graduate policy.)

Intellectual Property Statement

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

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

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

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

Minimum Graduation Standards

To be awarded a baccalaureate degree, an associate degree or certificate a student must at a minimum have a cumulative GPA of 2.0 or higher.

Minimum Progression Standards

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

1. A student with a cumulative grade point average of 2.0 or better is considered to be in good academic standing.
2. If a student's cumulative grade point average falls below 2.0 in any academic term (i.e. fall, spring, summer), the student is placed on academic probation the following term.
3. While on academic probation, the student must earn a system term grade point average of 2.0 or better.
4. When a student on academic probation achieves a cumulative grade point average of 2.0 or better, the student is returned to good academic standing.
5. A student on academic probation who fails to maintain a system term grade point average of 2.0 or better is placed on academic suspension for a minimum period of two academic terms.
6. Students on academic suspension will not be allowed to register for any coursework at any Regental university except when an appeal has been approved by the Regental university from which the student is pursuing a degree. An approved appeal granted by one Regental university will be honored by all Regental universities. Also refer to policy 2:3.G Probation/Suspension of Students.
7. Only Academic Suspension will be entered on the student's transcript. Academic probation will be noted in the internal academic record only.

Progression and graduation are contingent on satisfactory performance on the Proficiency Examination. Refer to policy 2:28.

Re-admission following Withdrawal

A student who has withdrawn from the university may be readmitted in that same semester by permission of the Vice President for Academic Affairs if the student has paid the appropriate tuition and fees.

Refunds of Tuition and Fees for Dropped Course(s)

A student receives a 100 percent refund of tuition and per credit hour fees for dropped courses within the drop/add period. The drop/add period for standard and non-standard courses offered in a semester shall be the date the first 10 percent of the term ends or the day following the first class meeting, whichever is later. When calculating 10 percent of the term, breaks of five or more days are not included when counting the total number of days but Saturdays, Sundays and holidays are. Any course meeting during a standard semester which meets for less time than the standard semester shall be treated as a non-standard semester course for refund purposes. **No refund shall be provided for courses dropped after that time by other than administrative action.** Courses offered during summer school terms, correspondence courses, asynchronous internet courses, and all other academic calendar type courses with begin and/or end dates that are different from the officially adopted fall and spring terms are considered non-standard courses. BOR Policy 5.7

Registration Changes

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

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 acknowledgment, right to privacy, and right to determine the form, manner, and terms of publication and distribution.

Software Copyright Statement

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

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

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

Student Appeals Policy

A procedure is provided for situations where a student feels that an institutional or Board of Regents policy affecting terms or conditions of enrollment or academic standing has been improperly applied. Students who believe that an academic evaluation has been unfairly applied should follow this procedure. The South Dakota Board of Regents Student Appeals for Academic Affairs policy 2:9 can be reviewed in its entirety at: www.sdbor.edu/policy/documents/2-9.pdf

Students who wish to discuss their situation and how this process applies should consult with the Vice President for Student Affairs and Dean of Students.

Transcript of Credits

A transcript of credits is an authentic copy of the student's academic record from each Regental university attended. The fee is \$9.00 per copy. A transcript must include all courses attempted. Transcripts are released on written request with the signature of the individual concerned or through Parchment. This order can be placed through Parchment or in person, by mail, or by FAX to the Office of the Registrar and Academic Services. Upon graduation each student is entitled to one complete transcript of the credits earned without charge.

Two Bachelor of Science Degrees from South Dakota School of Mines and Technology

An undergraduate student who wishes to qualify for a second bachelor of science degree must complete all requirements for both degrees granted.

To qualify for a second bachelor of science degree conferred by conferred by School of Mines, a student must complete all additional unique required courses for the second degree above the minimum 130 credits required for an engineering degree or the minimum 120 credits required for a science degree.

Additionally, 30 semester credits must be completed above and beyond the 130 credits (required for an engineering degree) or the 120 credits (required for a science degree). This mean 130 credits plus 30 credits for two engineering degrees or 120 credits plus 30 credits for two science degrees. The residency requirement of a minimum of 30 credit hours completed at the institution granting the degree applies to both degree programs.

If pursuing two (2) bachelor of science degrees simultaneously, a student must report this intent to the Office of the Registrar and Academic Services. This action will initiate the assignment of an advisor in each discipline. If returning to school to pursue a second bachelor of science degree, a student should investigate possible financial aid implications by contacting David Martin or Erin Richards in the Financial Aid Office.

Qualifying for a second bachelor of science degree should not be confused with qualifying for a double major. See section on Double Major in Science Programs.

Undergraduate Grading System

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

A Exceptional

4.00 grade points per semester hour

B Above Average

3.00 grade points per semester hour

C Average

2.00 grade points per semester hour

D Lowest Passing Grade

1.00 grade points per semester hour

F Failure

0.00 grade points per semester hour

S Satisfactory

Does not calculate into any GPA

U Unsatisfactory

Does not calculate into any GPA

RI Incomplete (Remedial)

Does not calculate into any GPA

RS Satisfactory (Remedial)

Does not calculate into any GPA

RU Unsatisfactory (Remedial)

Does not calculate into any GPA

W Withdrawal

For undergraduate students, does not calculate into any GPA, no credit granted prior to fall 2015.

For graduate students, does not calculate into any GPA.

WD

For undergraduate students effective fall 2015, the first six (6) dropped courses after the last day to drop and receive 100% refund. WD grades do not calculate into any GPA.

WW

For undergraduate students effective fall 2015 doing a full university withdrawal. Does not calculate into any GPA.

WFL

For undergraduate students effective fall 2015, any individually dropped course after six (6) maximum WD grades assigned. 0.00 grade points per semester hour.

AU Audit

Does not calculate into any GPA

I Incomplete

Does not calculate into any GPA

IP In Progress

Does not calculate into any GPA

EX Credit by Exam

Does not calculate into any GPA

CR Credit

Does not calculate into any GPA

LR Lab grade linked to recitation Grade

O credit course

NR Grade not Reported by Instructor

Does not calculate into any GPA

NG No grade

O credit tracking course

TR Note for NSE/MEDT

Does not calculate into the GPA

Academic Amnesty*

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

Incomplete Grade Request

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

- a. A student has encountered extenuating circumstances that do not permit him/her to complete the course.
- b. The student must be earning a passing grade at the time the incomplete is necessitated. Anticipated course failure is not a justification for an incomplete.
- c. The student does not have to repeat the course to meet the requirements.
- d. The instructor must agree to grant an incomplete grade.
- e. The instructor and student must agree on a plan to complete the coursework.
- f. The coursework must be completed within one semester; extensions may be granted by the Vice President for Academic Affairs/Provost.
- g. If the student completes the course within the specified time, the grades that may be assigned are A, B, C, D, F, S, RS, RU, or U.
- h. If the student does not complete the course within the specified time, the grade assigned will be F (Failure) or U (Unsatisfactory) or RU (Remedial Unsatisfactory).

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

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

An audit (AU) grade may be granted only when the student has elected the AU option on or prior to the census date of the term.

A credit (CR) grade may be granted only for non course credit that is not related to an examination or to equating transfer grades to the BOR grading system. This grade is not used for any Regental university courses.

An examination for credit (EX) grade may be granted only for non course credit validation obtained through a validation process. This grade is not used for any Regental university course.

A grade of NG will be used only with those course sections that are designated as Tracking/Program Sustaining (Q).

Remedial grades (RI, RS, RU) may be granted only for courses numbered 001 to 099.

S Satisfactory/Unsatisfactory (S/U) grade may be granted only when the entire course requires the S/U grade or the student has elected the S/U option on or prior to census date of the term.

Waiver Request

In extenuating circumstances students may request that a requirement stated in the academic policies of the institution or of the South Dakota Board of Regents be waived. Examples of such requirements include, but are not limited to, the limit on the number of times a course may be attempted, the time limits on completion of pre-general education and general education courses, the academic suspension policy, the proficiency exam policy, and the change of grade from an F to a W. Students wishing to appeal must complete the Application for Academic Appeal form that is available at the Office of the Vice President for Academic Affairs or can be downloaded from: <http://sdmines.sdsmt.edu/studentlife/forms>.

Withdrawal Grades Policy and Deadline

Effective fall 2015, undergraduate students are allowed a maximum of six (6) dropped courses with a grade of "WD," if that action occurs anytime between the day after the census day for that course and the day that corresponds with the completion of 70 percent of the class days for that course. If an undergraduate student withdraws from the system during that time, a maximum of six (6) dropped courses are eligible to receive a grade of "WD." Unless it is a corequisite laboratory course section, any following dropped courses will receive a grade of "WFL."

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

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

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

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

If a student withdraws from a course after the time period specified above, a grade of "F" will automatically be assigned by the Office of the Registrar and Academic Services. (South Dakota Board of Regents Policy 5:7.2)

Withdrawal from the University

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

Effective fall 2015, if an undergraduate student withdraws from the university system from the day after census day through 70 percent of the class meeting days in the term, a grade of "WW" will be issued for all courses. The "WW" grade is not factored into the GPA and these courses are not included in the maximum of 6 undergraduate dropped courses with a grade of "WD."

For graduate students, complete withdrawal from the university from the day after census day through 70 percent of the class meeting days in the term results in the assignment of "W" grades unless the professor-in-charge has previously assigned a final grade. A withdrawal from the university must be initiated in the Office of the Registrar and Academic Services. A withdrawal from the university will be processed only when all courses at all Regental universities are being dropped by a student.

If a student withdraws from the university after completion of 70 percent of class days, grades of "F" automatically are assigned by the Office of the Registrar and Academic Services in all courses for which the student was enrolled unless a final grade has previously been issued by the course instructor. In the event that a final grade has not been assigned, consideration may be given to extenuating circumstances that may warrant the assignment of a grade of "W" or "WD." Should such extenuating circumstances exist, students wishing to appeal must complete the Application for Academic Appeal form that is available at the Office of the Vice President for Academic Affairs or can be downloaded from <http://sdmines.sdsmt.edu/studentlife/forms>. Such appeal must be filed within one term after the term in which the withdrawal occurred.

Graduation Requirements - Undergraduate

Application for Graduation and Commencement

An Application for Graduation and Commencement must be completed by the date indicated on the academic calendar which is located in the academic calendar section of the catalog. If you are completing degree requirements during the summer term you must complete the form for the preceding May graduation. A student is allowed to walk only once in a commencement ceremony. Students must be actively enrolled in the semester that they graduate and meet the requirements of the degree. This form is online at the following URL: interact.sdsmt.edu/aes/graduation.htm

Minimum Graduation Standards

To be awarded a baccalaureate degree, an associate degree or a certificate a student must at a minimum have a cumulative GPA of 2.0 or higher.

Associate Degree

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

With highest honor:

equal to or greater than 3.90

With high honor:

equal to or greater than 3.70 and less than 3.90

With honor:

equal to or greater than 3.50 and less than 3.7

An associate-level graduate must have completed a minimum of 15 credit hours at the institution granting the degree. In addition, 8 of the last 15 credit hours earned preceding completion of the degree must be earned from the institution granting the degree. Courses that are part of a formal collaborative agreement among Regental universities are considered to be earned from the institution granting the degree.

Baccalaureate Degree

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

Summa Cum Laude:

equal to or greater than 3.90

Magna Cum Laude:

equal to or greater than 3.70 and less than 3.90

Cum Laude:

equal to or greater than 3.50 and less than 3.70

The student must have completed a minimum of 30 credit hours at the institution granting the degree. In addition, 15 of the last 30 credit hours earned preceding completion of the degree must be earned from the institution granting the degree. Courses that are part of a formal collaborative agreement among Regental universities are considered to be earned from the institution granting the degree.

Two Bachelor of Science Degrees From South Dakota School of Mines and Technology

An undergraduate student who wishes to qualify for a second bachelor of science degree must complete all requirements for both degrees granted.

To qualify for a second bachelor of science degree conferred by School of Mines, a student must complete all additional unique required courses for the second degree above the minimum 130 credits required for an engineering degree or the minimum 120 credits required for a science degree.

Additionally, 30 semester credits must be completed above and beyond the 130 credits (required for an engineering degree) or the 120 credits (required for a science degree). This means 130 credits plus 30 credits for two engineering degrees or 120 credits plus 30 credits for two science degrees. The residency requirement of a minimum of 30 credit hours completed at the institution granting the degree applies to both degree programs.

If pursuing two (2) bachelor of science degrees simultaneously, a student must report this intent to the Office of the Registrar and Academic Services. This action will initiate the assignment of an advisor in each discipline. If returning to school to pursue a second bachelor of science degree, a student should investigate possible financial aid implications by contacting David Martin or Erin Richards in the Financial Aid Office.

Qualifying for a second bachelor of science degree should not be confused with qualifying for a double major. See section on "Double Major in Science Programs."

General Requirements

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

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

Bachelor of Science Graduation Requirements

General Education Core Requirements

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

Goal #1

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

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

1. Write using standard American English, including correct punctuation, grammar, and sentence structure;
2. Write logically;

3. Write persuasively, with a variety of rhetorical strategies (e.g., expository, argumentative, descriptive);
4. Incorporate formal research and documentation in their writing, including research obtained through modern, technology-based research tools.

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

Credit Hours: 6 hours

Courses:

- ENGL 101 Composition I **Credits: (3-0) 3**
- ENGL 201 Composition II **Credits: (3-0) 3**
-
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**¹

Curriculum Notes

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

Goal #2

Students will communicate effectively and responsibly through speaking and listening.

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

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

Credit Hours: 3 hours

Courses:

- ENGL 279 Technical Communications I **Credits: (3-0) 3**¹
- ENGL 289 Technical Communications II **Credits: (3-0) 3**¹
-
- SPCM 101 Fundamentals of Speech **Credits: (3-0) 3**

Curriculum Notes

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

Goal #3

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

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

1. Identify and explain basic concepts, terminology and theories of the selected social science disciplines from different spatial, temporal, cultural, and/or institutional contents.
2. Apply selected social science concepts and theories to contemporary issues;
3. Identify and explain the social or aesthetic values of different cultures. In addition, as a result of taking course meeting this goal, students will be able to demonstrate a basic understanding of at least one of the following:
 - The origin and evolution of human institutions;
 - The allocation of human or natural resources within societies;
 - The impact of diverse philosophical, ethical or religious views.

Each course meeting this goal includes the following student learning outcomes:

Required: #1, #2, and #3

At least one of the following: #4, #5, or #6

Credit Hours: 6 hours in two disciplines

Courses:

- ANTH 210 Cultural Anthropology **Credits: (3-0) 3**
- GEOG 101 Introduction to Geography **Credits: (3-0) 3**
- GEOG 210 World Regional Geography **Credits: (3-0) 3**
- GEOG 212 Geography of North America **Credits: (3-0) 3**
- HIST 151 United States History I **Credits: (3-0) 3**
- HIST 152 United States History II **Credits: (3-0) 3**
- POLS 100 American Government **Credits: (3-0) 3**
- POLS 250 Introduction to International Relations **Credits: (3-0) 3**
- PSYC 101 General Psychology **Credits: (3-0) 3**
- SOC 100 Introduction to Sociology **Credits: (3-0) 3**
- SOC 150 Social Problems **Credits: (3-0) 3**
- SOC 250 Courtship and Marriage **Credits: (3-0) 3**

Goal #4

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

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

1. Demonstrate knowledge of the diversity of values, beliefs, and ideas embodied in the human experience;
2. Identify and explain basic concepts of the selected disciplines within the arts and humanities. In addition, as a result of taking courses meeting this goal, students will be able to do at least one of the following:
 - Identify and explain the contributions of other cultures from the perspective of the selected disciplines within the arts and humanities;
 - Demonstrate creative and aesthetic understanding;
 - Explain and interpret formal and stylistic elements of the literary or fine arts;
 - Demonstrate foundational competency in reading, writing, and speaking a non-English language.

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

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

Courses:

- ART 111/111A Drawing I **Credits: (3-0) 3**
- ART 112/112A Drawing II **Credits: (3-0) 3**
-
- ARTH 211 History of World Art I **Credits: (3-0) 3**
-
- ENGL 210 Introduction to Literature **Credits: (3-0) 3**
- ENGL 212 World Literature II **Credits: (3-0) 3**
- ENGL 221 British Literature I **Credits: (3-0) 3**
- ENGL 222 British Literature II **Credits: (3-0) 3**
- ENGL 241 American Literature I **Credits: (3-0) 3**
- ENGL 242 American Literature II **Credits: (3-0) 3**
- ENGL 250 Science Fiction **Credits: (3-0) 3**
-
- GER 101 Introductory German I **Credits: (4-0) 4**
- GER 102 Introductory German II **Credits: (4-0) 4**
-
- HIST 121 Western Civilization I **Credits: (3-0) 3**
- HIST 122 Western Civilization II **Credits: (3-0) 3**
-
- HUM 100 Introduction to Humanities **Credits: (3-0) 3**

- HUM 200 Connections: Humanities & Technology **Credits: (3-0) 3**
-
- MUS 100 Music Appreciation **Credits: (3-0) 3**
- MUS 117 Music in Performance I **Credits: (1-0) 1 ***
-
- PHIL 100 Introduction to Philosophy **Credits: (3-0) 3**
- PHIL 200 Introduction to Logic **Credits: (3-0) 3**
- PHIL 220 Introduction to Ethics **Credits: (3-0) 3**
- PHIL 233 Philosophy and Literature **Credits: (3-0) 3**
-
- SPAN 101 Introductory Spanish I **Credits: (4-0) 4**
- SPAN 102 Introductory Spanish II **Credits: (4-0) 4**

Curriculum Notes

* Repeatable for up to 3 credits towards partial satisfaction of Goal 4 Humanities requirement.

Goal #5

Students will understand and apply fundamental mathematical processes and reasoning.

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

1. Use mathematical symbols and mathematical structure to model and solve real world problems;
2. Demonstrate appropriate communication skills related to mathematical terms and concepts;
3. Demonstrate the correct use of quantifiable measurements of real world situations.

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

Credit Hours: 3 hours

Courses:

- MATH 102 College Algebra **Credits: (3-0) 3**
- MATH 115 Precalculus **Credits: (5-0) 5**
- MATH 120 Trigonometry **Credits: (3-0) 3**
- MATH 123 Calculus I **Credits: (4-0) 4**
- MATH 125 Calculus II **Credits: (4-0) 4**
- MATH 225 Calculus III **Credits: (4-0) 4**
- MATH 281 Introduction to Statistics **Credits: (3-0) 3**

Goal #6

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

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

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

Each course meeting this goal includes the following student learning outcomes:

Required: #1, #2, #3, and #4.

Credit Hours: 6 hours

Courses:

- BIOL 151 General Biology I **Credits: (3-0) 3**
- BIOL 151L General Biology I Lab **Credits: (0-1) 1**
-
- BIOL 153 General Biology II **Credits: (3-0) 3**
- BIOL 153L General Biology II Lab **Credits: (0-1) 1**
-
- CHEM 106 Chemistry Survey **Credits: (3-0) 3**
- CHEM 106L Chemistry Survey Lab **Credits: (0-1) 1**
-
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
-
- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
-
- GEOL 201 Physical Geology **Credits: (3-0) 3**
- GEOL 201L Physical Geology Laboratory **Credits: (0-1) 1**
-
- PHYS 111 Introduction to Physics I **Credits: (3-0) 3**
- PHYS 111L Introduction to Physics I Laboratory **Credits: (0-1) 1**
-
- PHYS 113 Introduction to Physics II **Credits: (3-0) 3**

- PHYS 113L Introduction to Physics II Laboratory **Credits: (0-1) 1**
-
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
-
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- PHYS 213L University Physics II Laboratory **Credits: (0-1) 1**

Goal #7

Students will recognize when information is needed and have the ability to locate, organize, critically evaluate, and effectively use information from a variety of sources with intellectual integrity. **Students meet this requirement with GOAL 1 and GOAL 2.**

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

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

Each course meeting this goal includes the following student learning outcomes: Required: #1, #2, #3, #4, and #5

Credit Hours: 9 hours

Courses:

- ENGL 101 Composition I **Credits: (3-0) 3**
- SPCM 101 Fundamentals of Speech **Credits: (3-0) 3**
- ENGL 201 Composition II **Credits: (3-0) 3**
-
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**¹

General Education Globalization/Global Issues and Writing Intensive Requirements

In addition to the seven system-wide general education requirements described above, all students will achieve learning outcomes focused on advancing their writing skills and their knowledge of global issues. Each academic program has designated one or more classes (the equivalent of one credit hour of study) as meeting each of these requirements. The syllabi of the courses designated state the requirement(s) met and explain how student achievement of the outcomes are assessed and factored into the course grade.

Globalization/Global Issues Goal Statement

Students will understand the implications of global issues for the human community and for the practice of their disciplines.

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

1. Identify and analyze global issues, including how multiple perspectives impact such issues; and
2. Demonstrate a basic understanding of the impact of global issues on the practice of their discipline.

Writing Intensive Goal Statement

Students will write effectively and responsibly in accordance with the needs of their own disciplines.

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

1. Produce documents written for technical, professional, and general audiences within the context of their disciplines;
2. Identify, evaluate, and use potential sources of information from within their disciplines for writing assignments that require research and study; and,
3. Use instructor feedback throughout the semester to improve the quality of their writing.

Systemwide General Education Requirements Checklist

For your convenience, below is a link to the **Board of Regents Systemwide General Education Requirements Checklist** which contains a list of courses being currently offered within the system which will meet the individual general education goals.

General Education Requirements Checklist

Pre General Education Courses in English and Mathematics

Pre-general education courses include

- ENGL 033 Basic Writing **Credits: 1 to 3**
-
- MATH 021 Basic Algebra **Credits: (3-0) 3**
- MATH 101 Intermediate Algebra **Credits: (3-0) 3**

Completion of Pre General Education Courses

1. Students placed in pre general education courses must enroll in and complete the courses within the first 30 credits hours attempted.
2. If a student does not complete the pre general education course(s) within the first 30 credit hours attempted, a registration hold is placed on the student's record.

During the next 12 credit hours attempted, the student must enroll in and complete the pre general education course(s).

3. If the pre general education course(s) is not completed within the first 42 credit hours attempted, the only course(s) in which a student may enroll is the pre general education course(s); and the student's status is changed from degree seeking to non degree seeking.
4. Students transferring from non-Regental institutions must enroll in pre-general education courses during the first 30 attempted Regental credit hours. These students may enroll in other courses concurrently with the pre-general education courses. If the student does not complete the pre-general education courses during the first 30 Regental credit hours attempted during the next 12 credit hours attempted, the student must enroll in and complete the pre-general education course(s). If the student does not successfully complete the pre-general education course(s) within 42 attempted Regental credit hours, the only course(s) in which a student may enroll in the pre-general education course(s); and the student's status is changed from degree seeking to non-degree seeking. The Vice President for Academic Affairs/Provost may grant an exception. Credit hours for the pre general education courses are included in the total number of credit hours attempted.

The grades assigned for courses numbered less than 100 will be RI, RS and RU.

Other Curricular Requirements

A. Humanities and social sciences requirements:

All courses numbered 300 and above are upper level courses.

This subject area must include six credits in humanities and 6 credits in social sciences. The number required for each major is listed in the department section of the catalog. Students majoring in engineering must complete at least three of these credits at an advanced level.

Humanities

Art:

- ART 111/111A Drawing I **Credits: (3-0) 3**
- ART 112/112A Drawing II **Credits: (3-0) 3**
- ARTH 211 History of World Art I **Credits: (3-0) 3**
- ARTH 321 Modern and Contemporary Art **Credits: (3-0) 3**

- ARTH 491 Independent Study **Credits: 1 to 9**
- ARTH 492 Topics **Credits: 1 to 6**

English:

- ENGL 210 Introduction to Literature **Credits: (3-0) 3**
- ENGL 212 World Literature II **Credits: (3-0) 3**
- ENGL 221 British Literature I **Credits: (3-0) 3**
- ENGL 222 British Literature II **Credits: (3-0) 3**
- ENGL 241 American Literature I **Credits: (3-0) 3**
- ENGL 242 American Literature II **Credits: (3-0) 3**
- ENGL 250 Science Fiction **Credits: (3-0) 3**
- ENGL 300 The Literary Experience of Nature **Credits: (3-0) 3**
- ENGL 330 Shakespeare **Credits: (3-0) 3**
- ENGL 343 Selected Authors **Credits: (1-0) 1**
- ENGL 350 Humor in American Culture **Credits: (3-0) 3**
- ENGL 360 Studies in European Literature **Credits: (3-0) 3**
- ENGL 374 Studies in American Literature **Credits: 1 to 3**
- ENGL 391 Independent Study **Credits: 1 to 3**
- ENGL 392 Topics **Credits: 1 to 3**

Foreign Language:

- GER 101 Introductory German I **Credits: (4-0) 4**
- GER 102 Introductory German II **Credits: (4-0) 4**
- SPAN 101 Introductory Spanish I **Credits: (4-0) 4**
- SPAN 102 Introductory Spanish II **Credits: (4-0) 4**

History:

- HIST 121 Western Civilization I **Credits: (3-0) 3**
- HIST 122 Western Civilization II **Credits: (3-0) 3**

Humanities:

- HUM 100 Introduction to Humanities **Credits: (3-0) 3**
- HUM 200 Connections: Humanities & Technology **Credits: (3-0) 3**
- HUM 291 Independent Study **Credits: 1 to 4**
- HUM 350 American Social History **Credits: (3-0) 3**
- HUM 375 Computers in Society **Credits: (3-0) 3**
- HUM 491 Independent Study **Credits: 1 to 4**
- HUM 492 Topics **Credits: 1 to 3**

Music:

- MUAP 200 Applied Music-Voice **Credits: 1 to 4**
- MUAP 201 Applied Music-Voice **Credits: 1 to 4**
- MUS 100 Music Appreciation **Credits: (3-0) 3**
- MUS 110 Basic Music Theory I **Credits: 2 to 4**
- MUS 317 Music in Performance II **Credits: (1-0) 1**

Philosophy:

- PHIL 100 Introduction to Philosophy **Credits: (3-0) 3**
- PHIL 200 Introduction to Logic **Credits: (3-0) 3**
- PHIL 220 Introduction to Ethics **Credits: (3-0) 3**
- PHIL 233 Philosophy and Literature **Credits: (3-0) 3**

Social Sciences

Anthropology:

- ANTH 210 Cultural Anthropology **Credits: (3-0) 3**

Geography:

- GEOG 101 Introduction to Geography **Credits: (3-0) 3**
- GEOG 210 World Regional Geography **Credits: (3-0) 3**
- GEOG 212 Geography of North America **Credits: (3-0) 3**
- GEOG 400 Cultural Geography **Credits: (3-0) 3**
- GEOG 492 Topics **Credits: 1 to 3**

History:

- HIST 151 United States History I **Credits: (3-0) 3**
- HIST 152 United States History II **Credits: (3-0) 3**
- HIST 492 Topics **Credits: 1 to 4**

Political Science:

- POLS 100 American Government **Credits: (3-0) 3**
- POLS 250 Introduction to International Relations **Credits: (3-0) 3**
- POLS 350 International Relations **Credits: (3-0) 3**
- POLS 407 Environmental Law & Policy **Credits: (3-0) 3**
- POLS 492 Topics **Credits: 1 to 3**

Psychology:

- PSYC 101 General Psychology **Credits: (3-0) 3**
- PSYC 319 Teams and Teaming **Credits: (1-0) 1**
- PSYC 323 Human Development Through the Lifespan **Credits: (4-0) 4**
- PSYC 331 Industrial and Organizational Psychology **Credits: (3-0) 3**
- PSYC 391 Independent Study **Credits: 1 to 3**
- PSYC 392 Topics **Credits: 1 to 3**
- PSYC 451 Psychology of Abnormal Behavior **Credits: (3-0) 3**
- PSYC 461 Theories of Personality **Credits: (3-0) 3**

Sociology:

- SOC 100 Introduction to Sociology **Credits: (3-0) 3**
- SOC 150 Social Problems **Credits: (3-0) 3**
- SOC 250 Courtship and Marriage **Credits: (3-0) 3**
- SOC 351 Criminology **Credits: (3-0) 3**
- SOC 391 Independent Study **Credits: 1 to 3**
- SOC 392 Topics **Credits: 1 to 3**
- SOC 411 Licit and Illicit Drugs **Credits: (3-0) 3**
- SOC 420 Alcohol Use and Abuse **Credits: (3-0) 3**

B. All degree candidates must complete

- ENGL 101 Composition I **Credits: (3-0) 3**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- These courses cannot be used to meet the humanities and social sciences requirements.

D. Electives:

Free Electives vary with the individual department. Any course may be selected which is at freshman level or higher (i.e. 100 level or higher). ROTC credits may be accepted, depending on the number of degree electives available in each department.

E. Science Electives:

Courses may be selected -from biology, chemistry, geology, physics, or atmospheric and environmental science.

For information regarding the Associate of Arts degree requirements, see [General Studies, A.A.](#) .

Semester Credit and Grade-Point Average

Additional requirements are listed with each departmental curriculum found in a later section of this catalog. All curricula require passing grades in the prescribed courses and a minimum cumulative grade point average of 2.00. Each engineering curriculum requires 130 hours of credit for graduation and each science curriculum requires one 120 hours of credit.

Military Science Credits

Military Science credits may apply to all degrees as free electives. This option varies with the number of free electives available in an individual curriculum. A veteran may petition the Registrar and Director of Academic 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.

Transfer credit for work at a junior, community college (two year) and/or two-year technical college may not exceed one-half of the hours required for completion of the baccalaureate degree at the accepting institution.

Credit Definitions

Credits in Residence

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

Institutional Credits

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

Validated Credits

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

Institutional Credit Requirements for Degree-Seeking Students

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

Baccalaureate	30 hours
Associate	15 hours
2. Number of the last credit hours earned preceding completion of the degree that must be earned from the institution granting the degree:

Baccalaureate	15 of the last 30 hours
Associate	8 of the last 15 hours
3. Minimum number of credit hours specified in the major or minor requirements that must be completed at the degree granting institution: 50 percent. However, this requirement may be waived for students enrolled in the set of majors offered by the system's Centers which include in the established programs of study common courses offered by one of the other Regental universities. In addition, the Vice President for Academic Affairs/Provost may make exceptions to this requirement for individuals based on the student's prior learning experiences.

Required Check-out Procedure

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

Perkins Student Loan recipients must complete an exit interview with a Business Office representative prior to graduation or termination of enrollment at School of Mines. The university reserves the right to withhold a student's diploma and/or transcript of grades for failure to meet any of the above specified requirements.

Graduate Education Policies

Graduate Student General Information

South Dakota School of Mines and Technology (SDSM&T) offers graduate degree programs at the master's and doctoral levels. The graduate programs provide opportunities for advanced study and research in the fields of engineering and science. Each individual degree program of study is designed to broaden and extend the student's knowledge within the chosen field, to develop the power of independent critical thinking, and to promote individual and cooperative research skills.

The first 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 offer the first Ph.D. program was granted in January 1967 to the Department of Geology and Geological Engineering. Seven additional Ph.D. programs have been authorized since that time with the most recent addition being a Ph.D. in Civil and Environmental Engineering in 2014. The Office of Graduate Education was created in the 1950-51 academic year.

The policies of the Office of Graduate Education are formulated by the Council of Graduate Education, which is advisory to the dean of graduate education. The policies are approved by the SDSM&T administration, the SDSM&T Faculty Senate, and the South Dakota Board of Regents when applicable and are administered by the dean of graduate education. This catalog provides the rules which apply to graduate students.

In the following descriptions the term "program" refers to a department, a division in a department such as the Construction Engineering and Management program within the Department of Civil and Environmental Engineering, or a non-departmental unit such as Biomedical Engineering, Materials Engineering and Science, or Nanoscience and Nanoengineering. Forms mentioned in the catalog are available at the Office of Graduate Education and on the Office of Graduate Education website.

Nature and Purpose of the Graduate Programs

The non-thesis and professional masters programs are designed to build a student's depth and breadth of knowledge and to enhance the student's preparation for a career in industry. Development of technical and managerial knowledge through course work is the primary focus of these degree programs. Programs typically include a combination of required and elective courses outlined in an individualized program of study supervised by a program coordinator. Some degrees may also encourage or require the completion of an independent project.

The MS thesis and PhD graduate programs are designed to prepare a student for a lifetime of intellectual inquiry that manifests itself in creative scholarship and research, often leading to professional careers in academia, government, business, and industrial organizations. These programs emphasize 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 and Master of Science thesis programs is the extension of knowledge, but this cannot be accomplished on all fronts simultaneously. Students must choose an area in which to specialize, a faculty member with whom to work, and a research topic of mutual interest to the student and the faculty advisor. Individualized programs of study are then developed and committee members are selected cooperatively as coursework and research are undertaken. When all coursework has been completed, the research finished, the thesis or dissertation written, and all examinations passed, the student will have acquired the knowledge and skills expected of a scholar and will have expanded the knowledge and research capability in the field.

The Council of Graduate Education

Graduate education and graduate research are among the most important functions of South Dakota School of Mines and Technology. They constitute an important element of the vitality of scholarly inquiry and intellectual achievement in the university. An important responsibility for all matters pertaining to graduate education and graduate research rests with the faculty. To provide for an important mechanism for the faculty to create, foster and maintain graduate education and graduate research programs of high quality and accomplishment, the Council of Graduate Education (CGE) is formed to:

1. Advise the dean of graduate education on all matters pertaining to graduate education
2. Establish and revise policies of graduate education
3. Review and approve/disapprove proposed graduate programs, courses and revisions
4. Review and approve/disapprove student applications of fellowships and scholarships sponsored by the Office of Graduate Education.

Graduate level curricula developments proposed by departments will be submitted to the Council of Graduate Education for review and appropriate endorsement for consideration by the Faculty Senate. Policies of graduate education will be approved by the CGE and submitted to the Faculty Senate for its approval.

The chairperson of the Council of Graduate Education is the dean of graduate education. The chair reports the results of the CGE recommendations on graduate education curricula, courses, and programs to the Curriculum Committee, and subsequent consideration by the Faculty Senate, Provost and Vice President for Academic Affairs. The chair reports CGE policy recommendations directly to the Faculty Senate for its consideration and approval, and subsequent consideration by the provost and vice president for academic affairs.

The membership of the Council of Graduate Education shall consist of voting representatives from each department with a graduate program. Members are to be elected by each academic department. Departments with one, 2, or more graduate programs will have one representative. Graduate programs that do not yet have a home department may also have a voting representative. Departments that do not have graduate programs may appoint non-voting representatives.

Graduate Programs

Master of Science degrees are offered in:

Atmospheric and Environmental Sciences
Biomedical Engineering
Chemical Engineering
Civil Engineering
Computational Sciences and Robotics
Construction Engineering and Management
Electrical Engineering
Engineering Management
Geology and Geological Engineering

Materials Engineering and Science
Mechanical Engineering
Mining Engineering and Management
Paleontology
Physics

Master of Engineering degrees are offered, with emphasis areas in Civil and Environmental Engineering, Electrical Engineering, and Materials Engineering and Science.

Doctor of Philosophy degrees are offered in:

Atmospheric and Environmental Sciences
Biomedical Engineering
Civil and Environmental Engineering
Chemical and Biological Engineering
Geology and Geological Engineering
Materials Engineering and Science
Mechanical Engineering
Nanoscience and Nanoengineering
Physics

Admission Policies

- General Requirements for Graduate Admissions
- International Student Admissions
 - English Proficiency
 - International Transcript Evaluation Requirements
 - Visa Requirements
 - Medical Insurance

General Requirements for Graduate Admissions

The Office of Graduate Education encourages applications from qualified students holding bachelor's degrees in engineering or science from accredited 4-year colleges and universities. A student desiring admission should obtain an application form from the Office of Graduate Education or via the website. The completed form and a non-refundable application fee of \$35 are required to be submitted to the Office of Graduate Education for all applicants. Required supporting documents are specified on the application and on the website. Additional information about requirements for specific graduate programs can be found in the program description section of the catalog.

All applicants wishing to be considered for admission or funding should submit their completed application package no later than February 15 for the Fall semester, August 15 for the Spring semester, and January 15 for the Summer semester. Note that some departments may have additional or different deadlines that may apply; please refer to the departmental websites for more information. Applications submitted after the above guidelines may be considered by some departments; please contact individual departments for more information. Applicant files will not be considered for acceptance until all of the required application materials are received. Applications completed by the above deadlines will, in most cases, receive a decision within one month of the deadline. If the applicant has not completed an undergraduate program, evidence of graduation must be submitted prior to enrollment.

When an application for admission to a graduate program is received, the faculty of the program in which the applicant expects to major will evaluate the applicant's academic qualifications. The department head or program coordinator, on behalf of the faculty, will recommend whether or not the applicant should be accepted into the graduate program and whether the admission

should be as an unconditional, conditional, probationary, or non-degree seeking (special) student. The dean of graduate education will review this recommendation and provide a letter of decision to the applicant.

Admission for study toward a master's degree does not imply that the student will be accepted to a doctoral program. A separate application and evaluation of the student's qualifications are necessary before acceptance into a doctoral program. Admission to a program 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 The Comprehensive Examination and Admission to Ph.D. Candidacy.

A student who is admitted to an academic program but is unable to attend in the semester in which he/she was accepted may request a deferment for up to 2 years. The request must be made in writing to the Office of Graduate Education and must specify the revised start date. Deferments must be approved by the dean of graduate education. Students must reapply if the anticipated start date is more than 2 years after the original semester of acceptance.

Students who are denied admission are not eligible to reapply to the same program for one year.

International Student Admissions

English Proficiency

All international applicants must provide evidence of English proficiency, with the exception of applicants from countries where English is the native language. Applicants who have a prior degree from a college or university in the U.S. may also be exempted, based on English courses taken and grades received in those courses.

The School of Mines has established minimum scores for admission for TOEFL, IELTS and the Pearson Test of English-Academic, listed below. We recognize a variety of valid English proficiency tests listed below which will be evaluated on an individual basis. English proficiency test results must be sent to the Office of Graduate Education. Please use school code 6652 for TOEFL results to be sent to SDSM&T.

Detailed information regarding the English proficiency requirement is available on our website at <http://www.sdsmt.edu/Admissions/International-Students/English-Proficiency/>.

Test	Minimum Score*	Upper Level Score **
TOEFL - iBT (internet based test)	68	83
TOEFL - CBT (computer based test)	190	220
TOEFL - PBT (paper based test)	520	560
IELTS	5.5	6.5
Pearson Test of English - Academic (PTE)	47	56

*Minimum scores require English proficiency testing upon arrival at the university.

**Upper level scores indicate that no additional proficiency testing is required by the university. However, additional testing and instruction may be required based on a student's performance on other placement exams, in the classroom, or by the academic department.

Applicants who are planning to attend an intensive English as a Second Language (ESL) program in the U.S. prior to attending SDSM&T may be eligible for conditional admission. Conditional admission may be granted if the applicant meets admission requirements with the exception of the minimum English score as indicated above. SDSM&T also recognizes the difficulty for

ESL students in taking standardized exams that are offered only in English, such as the Graduate Record Examination (GRE). Students in ESL programs may be required to take such tests after they have advanced to a certain level in ESL. Requirements will be specified in a conditional admission letter sent to the student. Once the student has completed the ESL program with satisfactory grades and meets any additional requirements, the student may be eligible for unconditional admission.

International Transcript Evaluation Requirements

SDSM&T requires a third party foreign transcript evaluation for all incoming international graduate students and U.S. students who have attended an institution outside the U.S. Exceptions can be granted by the dean of graduate education for exemplary students who are recommended for a waiver by the academic program to which the student is applying. The two primary evaluation companies in the U.S. are World Education Services (WES) and Educational Credential Evaluators (ECE). SDSM&T requires a course-by-course evaluation report to be sent by the evaluating institution directly to the Office of Graduate Education.

Visa Requirements

For the most recent requirements, please visit the Ivanhoe International Center website: <http://international.sdsmt.edu>.

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 SDSM&T for study toward a specific advanced degree has been granted. Form I-20 is usually necessary for admission to the U.S. for college attendance. Conditions of issuance of this form include documented evidence of financial ability to cover the projected annual costs of education at this university including living allowance. This institution will issue a DS-2019 form only when appropriate.

International students are advised that full-time status at this university is necessary in order to satisfy F-1 status requirements.

As a result of the regulations that became effective on January 1, 2003, the Family Educational Rights and Privacy Act (FERPA) is waived for F and J students with respect to reporting requirements specific to student status. The regulations will be strictly enforced by the appropriate bureau(s) within the US Department of Homeland Security (DHS), and information will be reported electronically to DHS via Student and Exchange Visitor Information System (SEVIS). The consequences to students for non-compliance with the new regulations are severe. For more information, e-mail the Ivanhoe International Center at Ivanhoe@sdsmt.edu or go to <http://international.sdsmt.edu>.

Medical Insurance

Each international student (and any dependents accompanying him/her to the United States) is required to enroll in a major medical hospitalization/surgical insurance plan. Contact the Ivanhoe International Center for details. The only exception to this rule is if the student is sponsored by his/her home country government (documentation of this policy is required). Life insurance is also strongly recommended.

Funding Policies

- Graduate Assistantships
- Assistantships with Tuition and/or Fee Support
- Graduate Fellowships and Other Resources

Graduate Assistantships

SDSM&T has funds available from various sources for graduate assistantships (GAs) and fellowships. Such awards are usually made on the basis of scholastic merit and the availability of funds. Assistantships are not available to students on probation unless an exception is granted by the dean of graduate education. Graduate special students (non-degree-seeking students) are not eligible to receive assistantships.

Graduate teaching assistantships (GTAs), graduate research assistantships (GRAs), and hybrid GRA/GTA positions are offered. A GTA assists with instruction within laboratory sections, grades papers, or performs other assigned instructional duties. A GRA is compensated to conduct supervised research, generally relating to the student's thesis or dissertation research. Hybrid positions have a combination of the duties of GRAs and GTAs, as determined by the funding department.

The dean of graduate education grants the GA award, acting upon the recommendation of the department head, program coordinator, or major professor, after evaluation of the student's academic record, overall qualifications, and programmatic progress.

GAs under state contract are subject to institutional policies set forth in the faculty/staff handbook. GRAs are required to sign an employee agreement to disclose inventions form. GTAs are required to sign a family educational rights and privacy act compliance form.

A student with a graduate assistantship should recognize that the prescribed hours of research work are minimum expectations mandated by employment practices and may not represent the effort that will be actually necessary to produce satisfactory progress and completion of a thesis or dissertation within a reasonable period of time.

Students must register before assistantships and fellowships are processed for the semester for which they are authorized. Graduate assistants who are eligible for reduced tuition at one South Dakota regental institution are also eligible for reduced tuition at other South Dakota regental institutions.

Graduate assistantships may include partial or full tuition and fees support as a benefit, as defined by South Dakota Board of Regent policy.

Assistantships with Tuition and Support

The minimum compensation, established annually by the South Dakota Board of Regents and currently set at \$3,849, must be awarded in each semester to qualify for reduced tuition.

Additionally, a student with an assistantship must meet the following minimum registration requirements to qualify for reduced tuition:

1. Spring and Fall Assistantships: The minimum registration required to receive reduced tuition with a qualifying assistantship in a fall or spring semester is 9 credits. Note, also, that FICA withholding applies to all graduate students with assistantships, or paid on an hourly basis, who are enrolled in less than 5 credits in either the Fall or Spring semester.
2. Summer Assistantships: The minimum registration required to receive reduced tuition with a qualifying assistantship in the summer is 2 credits. Note, however, that FICA withholding applies to all graduate students with assistantships, or paid on an hourly basis, who are enrolled in less than 3 credits in the summer semester.

Certain specialized courses that are outside the graduate curricula of SD Mines are not eligible for reduced tuition (<http://www.sdsmt.edu/Admissions/Tuition-and-Fees/Tuition-Rates-Descriptions/>). These include English remediation classes. Internet self support courses (course sections labeled 840T) are eligible for reduced tuition.

A student receiving an assistantship along with tuition remission is required to maintain 9 credits throughout the semester in which the support is received. If a student drops to fewer than 9 credits, the student will immediately lose the assistantship and will be required to repay the institution for the tuition remission on the dropped class unless the student adds additional credits to

maintain full time status. Students who withdraw from the institution or have their assistantship terminated in the middle of the semester will have their assistantship stipend and tuition reduction pro-rated to reflect time actually worked.

Graduate Fellowships and other Resources

A number of fellowships from industrial and governmental agency sources are currently available. Eligibility requirements and restrictions are parallel to those for graduate assistantships. A fellowship award usually does not include reduced tuition and fees as a benefit. Pre-registration by continuing students is required to prevent payment delays.

Graduate students who are U.S. citizens or eligible non-citizens may be eligible for other forms of financial aid such as federal Stafford student loans, federal Perkins student loans, or federal work study. Application and requests for additional information on these programs should be made to the Financial Aid Office at SDSM&T.

Registration Policies

- Graduate Student Registration
- Definition of Full Time & Half Time Registration
- Continuing Registration Requirements
- Minimum Academic Load
- Maximum Academic Load
- Leave of Absence

Graduate Student Registration

A graduate student will report to the advisor specified in the acceptance letter and thereafter will follow the registration procedure for all SDSM&T students. The advisor is responsible for counseling the graduate student with respect to programmatic requirements until the student has selected a major professor. In some programs, the advisor may continue to work with the student and the major professor to ensure that all degree requirements have been satisfied.

Definition of Full Time and Half Time Registration

A full time graduate student is defined as a student registered for 9 or more credit hours per semester at any of the universities in the South Dakota regental system during the academic year. All international students must be registered full-time to maintain student status with the U.S. government.

A three quarter time graduate student is defined as a student registered for at least 7 credits but less than 9 credit hours per semester during the academic year.

A half time graduate student is defined as a student registered for at least 4.5 credits and less than 7 credit hours per semester during the academic year.

2 credits are considered full-time during the summer for Office of Graduate Education purposes, including awarding assistantships and fellowships.

Audited credits do not apply toward the above definitions. Remedial English classes and deficiency courses count toward the determination of full-time status.

Continuing Registration Requirements

Degree-seeking graduate students must be registered on a continuing basis during each fall and spring semester. The number of credits required is specified in the next section, Minimum Academic Load. This applies regardless of whether the graduate student is in residence, is off-campus, or is pursuing a degree on a part time basis. Failure to maintain continuing registration will result in deactivation of the graduate student's program. Graduate students who fail to comply and subsequently wish to return to their same program of study will be required to obtain written permission from the department head or program coordinator and the dean of graduate education and may be required to reapply. Students may petition for a leave of absence if they are unable to fulfill the continuing registration requirement (See Leave of Absence section). Graduate non-degree seeking (special) students are exempt from the continuing registration rule.

Minimum Academic Load

Degree seeking graduate students must enroll for a minimum of 2 credits during the spring and fall semesters. A student must also register for a minimum of 2 credits during the summer if the student is using departmental or institutional resources or is graduating in the summer semester. Minimum registration is required during any semester in which a student schedules or takes exams, conducts research, or completes a degree. The number of credit hours taken in excess of the minimum should accurately reflect the extent of the graduate student's coursework and research activities.

Graduate students must meet this minimum registration requirement during the specific semester or summer in which they complete all requirements for their degree and become eligible for graduation. If a student fails to complete all requirements for graduation at the end of a semester there will be no grace period. Hence students who fail to complete all degree requirements prior to the official closure date for a given semester or summer will be required to register for a minimum of 2 credits during a subsequent semester or summer in order to graduate.

Please refer to the section Funding Policies for additional information on the number of credit hours required during a semester to be eligible for assistantships and financial aid.

Maximum Academic Load

13 credit hours per semester are considered to be the maximum graduate load. Higher loads must be approved by the dean of graduate education and the major professor. Students wishing to take a higher course load must complete a course overload request form. Appropriate course loads should be determined in conjunction with the advisor or major professor and should reflect the effort required for students working as GTAs or GRAs.

Leave of Absence

A student who is unable to continue his/her program of graduate study due to unanticipated circumstances may request a leave of absence from his/her program of study by completing and submitting a request for leave of absence form, available in the Office of Graduate Education and at the graduate education website. The form must be completed and signed by the student, the student's major professor, department head or program coordinator and then submitted to the Office of Graduate Education. The dean of graduate education will evaluate the request and either approve or deny it. If the request is approved, the student will not be subject to continuing registration, and the leave of absence will not count toward the time limits to complete his/her program of study. A leave of absence is determined on a semester basis and is usually limited to a maximum of one calendar year. International students are not eligible for a leave of absence if they intend to remain in the U.S.

Enrollment Policies

Dual Enrollment in Ph.D. & M.S. Programs

Dual Credit for Multiple Programs

Accelerated Master's Programs

Change of Program

Applying Credits from Outside Institutions

Applying Undergraduate Level Credits Toward an Advanced Degree

Applying Graduate Level Credits Taken as an Undergraduate Toward an Advanced Degree

Non-degree Seeking Graduate Students [Special Graduate Students]

Dual Enrollment in Ph.D. & M.S. Programs

Concurrent enrollment in a Ph.D. program and an M.S. program in the same department/program is encouraged, if allowed by the department/program. Concurrent enrollment in a Ph.D. program and an M.S. program in a different department/program is normally not allowed.

Exception Policy:

A student who seeks an exception to the above policy must follow the procedure set forth below. Students must be aware that exceptions to this policy will be granted only under extraordinary circumstances.

1. The Ph.D. student must obtain prior written approval for this dual-degree plan from his/her major professor and the head/coordinator of the relevant Ph.D. program.
2. If approval is granted in Step 1, then the Ph.D. student must obtain written approval for the M.S. degree plan from the head/coordinator of the corresponding M.S. program.
3. If approval is granted for Step 2, then the student will need to establish a second graduate student advisory committee (thesis option only) and file a separate program of study (required for all thesis and non-thesis students) for the M.S. degree with the Office of Graduate Education.
4. The dean of graduate education will have authority to either approve or disapprove this second program of study.
5. The first 2 semesters of the dual program will be considered probationary. The second program of study can be terminated based on recommendations of the Ph.D. committee and/or M.S. committee to the dean of graduate education.
6. A student who is granted dual enrollment in 2 departments/programs according to the procedure listed above may petition to use all graduate credits earned at SDSM&T toward both the MS and PhD degrees, within the constraints of the program and other graduate education policy, and subject to approval by the graduate committees for each program and the department head/program coordinator.

A student who is not dually enrolled, but who has fulfilled the requirements of an SDSM&T non-thesis M.S. degree en route to a Ph.D., may petition to receive the M.S. degree by submitting a valid Program of Study for the M.S. This petition must be made before the student is admitted to Ph.D. candidacy.

All graduate credits earned at SDSM&T are eligible for use in M.S. and Ph.D. degrees granted by SDSM&T, within the constraints of the program and other graduate education policy, and subject to approval by the graduate committees for each program and the department head/program coordinator. However, undergraduate credits used for an accelerated MS degree may not be used a third time toward a second graduate degree.

Dual Credit for Multiple Programs

Up to 12 credit hours that have been used, or are being used, to satisfy requirements for one M.S. degree at SDSM&T may be applied toward another M.S. degree from this institution, with the separate approval of the relevant advisors, programs and departments for each degree. In no cases can double-counted credits (either double-counted MS/MS, or BS/MS) be triple counted toward a third degree (BS, MS, MEng or PhD).

Accelerated Master's Programs

Accelerated M.S. degree programs enable students to complete both the B.S. and M.S. degrees in as little as 5 years. These accelerated programs are selective programs to which a student must apply. The details for a particular program can be found in the program information section of the catalog. Accelerated options are currently available in most programs, although not all programs may choose to participate in the accelerated option.

Students desiring to participate in an accelerated program are encouraged to apply at the end of their junior year. A minimum undergraduate cumulative GPA of 3.0 is required at the time the student applies to the program. Programs may impose additional GPA requirements; see program information for further details. Programs may grant exceptions to the minimum GPA requirement under situations approved by the dean of graduate education.

Up to 12 credits applied toward the B.S. program may be used to satisfy graduate credit requirements. See individual programs for the number of credits allowed by the program and other program-specific restrictions. Students applying to an accelerated BS/MS program must fill out an Accelerated BS/MS Advising Plan and find an interim advisor or major professor prior to admission to the BS/MS program. Students are not formally admitted to the graduate school until they have completed their undergraduate degree. Note that it is South Dakota Board of Regents policy that undergraduate students are not permitted to take 700 level and 800 level classes. The Accelerated BS/MS Advising Plan can be revised at any time, with the concurrence of the interim advisor or major professor and the department/program head or coordinator. The following restrictions apply:

1. The courses must be taken at the 400/500/600 level as an undergraduate. Courses taken at the 400 level are subject to the other requirements listed in this catalog pertaining to undergraduate level courses.
2. Only courses taken at SDSM&T are eligible for dual credit.
3. No transferred courses from other institutions will be allowed to count toward the accelerated master's degree.

Additional rules concerning application of other credits toward a MS degree, that are not used for the student's undergraduate degree, are listed below.

Change of Program

A student who wishes to change programs should request the change using an intent to transfer form. The current program must be notified prior to seeking the transfer. Approval from the proposed new program is required. If admittance to the new program is not granted, the possibility of a discontinuation from study in any area at SDSM&T is possible. Upon favorable recommendation from the new program, the dean of graduate education will issue a letter of transfer and notify the appropriate offices and the student of the change.

Applying Credits From Outside Institutions

A minimum of 60% of the credit hours in the graduate degree program must be completed from the institution granting the degree.

Transfer credits. Credits for graduate level coursework taken at another institution are eligible to be transferred and applied to the requirements for a degree at SDSM&T. A maximum of 12 coursework credits may be transferred to a M.S. degree and a maximum of 24 coursework credits may be transferred to a Ph.D. degree. Students wishing to request transfer credits must use the appropriate transfer of credits form found on the graduate education website.

Reduction of credits. Ph.D. candidates already holding an M.S. degree awarded by an institution other than SDSM&T may request up to a maximum of 24 semester credits of appropriate M.S. coursework credits and up to a maximum of 6 credits of acceptable M.S. research credits to apply to the Ph.D. credit requirement. Students wishing to make such a request must use the reduction of credits form found on the graduate education website.

All requests for transfer credits or reduction of credits are subject to approval by the student's graduate committee. The final list of courses that may be applied to the M.S. or the Ph.D. is established at the time that the student's program of study is approved.

Domestic graduate transfer courses and transfer grades are recorded and evaluated by SDSM&T, calculated into grade point averages according to the South Dakota regental grade scheme, and recorded on the student's academic transcript only if these transfer courses are equivalent to a specific graduate course at SDSM&T, or a course approved by the program coordinator or department head. International transfer courses will appear on the transcript along with the number of credits earned, but no grade will appear or be calculated into grade point average. See PhD Degree Requirements for additional details.

Such credit from institutions external to the South Dakota regental system must be reviewed and approved by the student's committee and by the dean of graduate education. The dean of graduate education shall notify the registrar and director of academic services in writing of the credits to be accepted and placed 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.

Applying Undergraduate Level Credits Toward an Advanced Degree

Undergraduate-level credits (300 or 400 level) taken as a graduate student are automatically placed on an undergraduate transcript and may not be used toward a graduate degree except under the following circumstances:

1. The courses must be approved by the student's graduate student advisory committee and by the department head or program coordinator.
2. The student must have earned a B grade or better in any 300 or 400 level course which is to be credited toward advanced degree requirements. (See also individual department restrictions on 300-400 level courses.)
3. The student cannot apply any credit hours or grades for 100 and 200 level courses (which are usually taken to overcome academic deficiencies) toward advanced degree requirements. If, in the opinion of the student's advisor, major professor and graduate student advisory committee, progress in these courses is unsatisfactory, additional work may be required to demonstrate proficiency.
4. The number of undergraduate credits not used to fulfill requirements for the undergraduate degree that may be applied toward a master's degree is limited to 9 hours.

Applying Graduate Level Credits Taken as an Undergraduate Toward an Advanced Degree

1. Graduate level credits taken as an undergraduate and used to fulfill requirements for the undergraduate degree may not be used toward a graduate degree unless the credits were taken as part of an approved accelerated master's program at SDSM&T.
2. Up to 12 semester hours of graduate level credits taken as an undergraduate and not used to fulfill requirements for the undergraduate degree may be used toward a graduate degree only after the courses in question are approved by the graduate student advisory committee.

Non-degree Seeking Graduate Students [Special Graduate Students]

An individual who holds a baccalaureate degree and wishes to pursue further study without a commitment to an advanced degree may apply to the Office of Graduate Education 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 subject to Office of Graduate Education policies. A maximum of 12 credit hours may be accumulated, after which a special student must either apply for admission as a degree seeking student or must petition for a variance from this policy. A course with a grade of incomplete counts toward the 12 credit maximum. Graduate students classified as special students are not eligible for assistantships. If a student is granted admission to a program as a degree-seeking student, a maximum of 12 credits taken as a special student may be applied toward the degree.

Application of Credits Taken as an Undergraduate Student or Special Graduate Student Toward an Advanced Degree

The maximum total number of SDSM&T credits, taken as an undergraduate student or special graduate student, which were not applied to an SDSM&T degree and that can be used toward a graduate degree, is 12. Note that these credits are in addition to any "doubly counted" credits associated with Accelerated Master's programs.

Grade Policies

- Graduate Grading System
- Advanced Degree Grade Requirements
- Course Retake Policy
- Pass-Fail Option for Graduate Students
- Probation and Reinstatement Policy
- Appeal Procedure

Graduate Grading System:

The grades listed in this section can be assigned to all courses with course numbers of 500 or greater. Plus and minus grades are not used.

1. Coursework Final Grades

A Exceptional

4.00 grade points per semester hour.

B Good

3.00 grade points per semester hour.

C Average

2.00 grade points per semester hour.

D Unsatisfactory

1.00 grade point per semester hour.

F Failure

0.00 grade points per semester hour.

S Satisfactory

Does not calculate into any GPA. This is the grade that will appear on a transcript for a successfully completed course taken with the pass/fail option or for research credits (see below).

U Unsatisfactory

Does not calculate into any GPA.

This is the grade that will appear on a transcript for failing to complete a pass/fail course or research credits (see below).

W Withdrawal

Does not calculate into any GPA, no credit granted.

AU Audit

Does not calculate into any GPA. An audit (AU) grade may be granted only when the student has elected the AU option on, or prior to, the census date of the term.

2. Incomplete Grades

I Incomplete

Does not calculate into any GPA. An incomplete (I) grade may be granted only when all of the following conditions apply:

- a. A student has encountered extenuating circumstances that do not permit him/her to complete the course.
- b. The student must be earning a passing grade at the time the Incomplete is requested. Anticipated course failure is not a justification for an incomplete.
- c. The student does not have to repeat the course to meet the requirements.
- d. The instructor must agree to grant an incomplete grade.
- e. The instructor and student must agree on a plan to complete the coursework.
- f. The coursework must be completed within one calendar year of the last date of the semester of the course in question. Extensions may be granted by the dean of graduate education.
- g. If the student completes the course within the specified time, the grades that may be assigned are A, B, C, D, F, S, or U.
- h. If the student does not complete the course within the specified time the incomplete grade remains on the transcript.

IP In Progress

Does not calculate into any GPA. An in progress (IP) grade may be granted only when all of the following conditions apply:

- a. The requirements for the course (for every student enrolled in the course) extend beyond the current term.
- b. The extension beyond the current term must be defined before the class begins.
- c. The instructor must request permission to award IP grades for a course from his or her department head or program coordinator and from the dean of graduate education. Then approval must be obtained from the vice president for academic affairs.
- d. A definite date for completion of the course must be established in the course syllabus.

3. Research Grades**S Satisfactory**

Does not calculate into any GPA. This is a final grade for a research course (including thesis or dissertation research).

U Unsatisfactory

Does not calculate into any GPA. This is a final grade for a research course (thesis or dissertation research).

NP Normal Progress

Does not calculate into any GPA. A normal progress (NP) grade calculates into attempted credits but does not calculate into completed credits. Research grades do count toward attempted credits once a final grade of S or U is assigned. A normal progress (NP) grade may be granted by an instructor when the instructor determines that a graduate student is making normal progress in a graduate Thesis/Dissertation course. This is intended to be an intermediate grade which should be changed to 'S' or 'U' upon completion of the course requirements.

4. Additional Grading Options**NR Grade not reported by the Instructor**

Does not calculate into any GPA.

EX Credit by Exam

Does not calculate into any GPA. An examination for credit (EX) grade may be granted only for non-course credit validation obtained through a validation process. This grade is not used for any Regental university course.

CR Credit

Does not calculate into any GPA. A credit (CR) grade may be granted only for non-course credit that is not related to an examination or to equating transfer grades to the Regental grading system. This grade is not used for any Regental university course.

TR Transcribed

Does not calculate into any GPA and no credit is granted.

LR Lab grade linked to Recitation Grade

0 credit course.

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 cumulative GPA for **all** 300 through 800 numbered courses taken in all departments which appear on the graduate transcript. In addition, the student must also have a minimum cumulative GPA of 3.00 for courses taken in his/her major department after admission to the graduate program, or taken for graduate credit at the School of Mines as an undergraduate or special student. Note that thesis and dissertation research credit hours and grades will not be counted in the determination of these grade point averages. Only courses listed on the graduate transcript are used for computing the graduate GPA.
2. The student must earn a C grade or better in any graduate course (500 through 800 level), which is indicated to be credited toward advanced degree requirements by appearing on the program of study form.
3. The student must earn a B grade or better in any 300 or 400 level course which is indicated to be credited toward advanced degree requirements by appearing on the program of study form.
4. The student's thesis or dissertation research must be of a quality to earn a final grade of S.
5. A student who fails any course within their discipline as defined by their department/program must repeat the course with a passing grade as defined above. The student may petition through his or her advisor or major professor to the dean of graduate education for an exception to this rule.
6. The student cannot apply any credit hours or grades for 100 and 200 level courses (which are usually taken to overcome academic deficiencies) toward advanced degree requirements. If, in the opinion of the student's major professor and graduate student advisory committee, progress in these courses is unsatisfactory, additional work may be required to demonstrate proficiency.
7. Of credits counted for an advanced degree, not more than 50 percent of the credit hours in any graduate program can be at the 500 level or below. Exceptions must be approved by the dean of graduate education.

If a course is repeated for a passing or improved grade, only the grade for the last attempt will be included in the computation of the cumulative grade-point average shown on the graduate student's transcript.

The final research grades for a completed program will be issued as either U for Unsatisfactory or S for Satisfactory. These S and U grades will not be used in the computation of grade-point averages. The number of credit hours allowed to be counted toward degree requirements is identified in the relevant sections under Master of Science and doctor of philosophy degree programs.

Course Retake Policy

A student will be allowed a total of 2 registrations for any particular graduate course (course numbers of 500 and above) for which credit is to be counted toward graduation. The student must petition the dean of graduate education and obtain the dean's approval to be permitted to take a graduate course more than 2 times. Only the LAST attempt of the course will count in the grade point average calculations. A student will be allowed multiple registrations for certain graduate courses for which credit toward graduation may be received more than once (e.g., Independent Study, Thesis, Research, etc.). Grades for such courses, where applicable, will be used for grade point average calculations. Please note that individual departments/programs may limit the number of credits allowed toward graduation in these types of courses.

Pass/Fail Option for Graduate Students

The following policy pertains to the pass/fail option at the graduate level:

1. 100 and 200 level courses, either within or outside of the department, which cannot be applied for credit toward a graduate degree may (with the consent of the student's major professor and graduate student advisory committee) be taken on a pass/fail basis under the same rules that apply to undergraduate students.
2. 300 through 800 level courses outside of the student's department/program may (with the consent of the student's major professor and graduate student 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 M.S. degree student may receive credit will be 6 for the thesis option and 9 for the non-thesis option.
3. No 300 through 800 level courses offered by the student's major department/program may be taken for credit under the pass/fail option. Beyond the master's level, the pass/fail option may be exercised at the discretion of the graduate student advisory committee but must still be approved by the dean of graduate education.

Probation and Reinstatement Policy

An applicant who has a large number of deficiencies, or whose undergraduate record is below admissions standards, may be admitted to the graduate program on probationary status. For a student admitted on probation, a deficiency in grade requirements during the first semester of enrollment may be considered sufficient grounds for terminating the student's enrollment in the graduate program. Such a termination decision will be made by the dean of graduate education after consulting with the student's major professor and the department head or program coordinator.

A current graduate student who does not meet the following requirements (items 1-7 below) during any semester will be placed on probation and will be informed by the dean of graduate education. A failure to remove the deficiencies during the following semester may be considered sufficient grounds for terminating the student's enrollment in the graduate program. Assistantships are not available to students on probation unless an exception is granted by the dean of graduate education.

Probation imposed because of grade deficiencies in specific courses (items 2 and 3 below) will continue each semester until the course has been retaken and an acceptable grade has been received. Probation imposed because of overall GPA deficiencies (item 1 below) will continue each semester until the GPA reaches the acceptable level.

A student will be placed on probation for a U grade received for research credit(s). Because a U is a final grade, probation will be maintained until at least one subsequent S credit is awarded. A student may graduate with "U" grades, but must also accumulate S grades for the required minimum number of research credits in a given advanced degree program. A student who has transferred from a thesis to a non-thesis program and who has received U grades as the last research grades in the thesis program will be admitted to the new program on a probationary status. Such probation may be removed by satisfactory progress (according to the usual performance criteria) during the first semester in the new program.

In addition to probation triggered by academic performance, a student may be placed on probation for failing to meet programmatic or institutional requirements. Probation for such deficiencies will be removed after the requirement has been satisfied. A student's probationary status will be reviewed at the close of each semester for appropriate action: removal from probation, continuation of probation, or termination. A student may petition the dean of graduate education for reconsideration of a termination decision. (Refer to section on Appeal Procedure.)

1. A student must maintain a B (3.00) or better grade point average in all 300 through 800 level courses that appear on the graduate transcript at SDSM&T. Thesis and dissertation research credit hours and grades will not be counted in the determination of this GPA.
2. A student must earn no less than a C (2.00) grade in any graduate course (500 through 800 level), which is to be credited toward advanced degree requirements by appearing on the program of study form.
3. A student must earn no less than a B (3.00) in any 300 or 400 level course taken for graduate credit, and which is to be credited toward advanced degree requirements by appearing on the program of study form.

4. A student's thesis or dissertation research must be of a quality to warrant the issuance of a final grade of S or an interim grade of NP. A research grade of U will result in the student being placed on probation.
5. A student must earn no less than a B (3.00) in any deficiency course required by the graduate student advisory committee even though the course cannot be applied toward a graduate degree.
6. A student must pass all courses taken on the pass-fail basis. (Refer to section on Pass/Fail Option for Graduate Students.)
7. A student must remove all other program deficiencies, such as meeting stated deadlines for applicable qualifying, comprehensive, and final examinations; selection of a graduate student advisory committee; and filing of a satisfactory program of study in the Office of Graduate Education.

Appeal Procedure

Procedures for appealing or petitioning for a variance from certain policies, when such variances are permitted in unusual or exceptional circumstances, are set forth in the relevant sections of this document. Appeals or petitions involving such matters as grade changes from F or I to W must be lodged with the Academic Appeals Committee through the vice president for academic affairs, after review by the dean of graduate education.

Appeals concerning probation, suspension, or potential variances in academic graduate policy should first be lodged with the student's major department/program. Before rendering a decision on the appeal, the department head or program coordinator will seek a recommendation from the student's graduate student advisory committee. If the student is not satisfied with the decision on the appeal, the student may petition the dean of graduate education for reconsideration of the appeal. The Council of Graduate Education may be called upon to render a decision in such cases.

For situations not covered above, or if the student is dissatisfied with a prior appeal decision, he/she should seek the advice of the dean of graduate education or the dean of students to determine what recourse is available to assist in seeking a solution.

General Degree Requirements

- Supervision of Advanced Degree Programs
- Program of Study
- Research Credits
- Certification of Degree Requirements

Supervision of Advanced Degree Programs

The supervision of the general study program of each student, including compliance with all the various South Dakota Board of Regents, institutional, and Office of Graduate Education policies, is primarily the responsibility of the advisor. For all thesis and dissertation degrees, the graduate student advisory committee assists in this role. The graduate student advisory committee consists of a minimum of:

- a major professor,
- a graduate representative, (must not be from the student's department/program),
- one additional member for master's students, for a minimum total of 3 members, or
- 3 additional members for doctoral students, for a minimum total of 5 members.

For the purposes of these roles (below), faculty may be in the professorial track (tenure-track or non tenure-track), instructor or lecturer track, or research scientist track.

The major professor is primarily responsible for supervision of the graduate student's research and thesis/dissertation preparation, as well as ensuring that academic standards and requirements are met and satisfied. The advisor and the major professor may or may not be the same person, depending on restrictions or requirements within the student's program and/or department.

The major professor serves as chairperson of the graduate student advisory committee and assists the student in selection of other members of the committee. To be eligible to serve as a major professor on a graduate student advisory committee, the person must be a full time faculty member at SDSM&T. In the case of emeritus faculty or retired faculty, departments may petition the dean of graduate education for an exception to this policy. For supervision of a master's program, the major professor must have a minimum of an M.S. degree. For supervision of a doctoral program, the major professor must have a minimum of a doctoral degree.

A co-major professor is not required, but may be beneficial to the student's committee. To be eligible to serve as a co-major professor, the person must be approved by the student's department or program. For supervision of a master's program, the co-major professor must have a minimum of an M.S. degree. For supervision of a doctoral program, the co-major professor must have a minimum of a doctoral degree.

The Graduate Representative is a faculty member of a graduate student advisory committee (must not be from the student's department/program) that represents the Office of Graduate Education and is a voting member on a doctoral or master's committee whose responsibilities are to:

- represent the broad concerns of the Office of Graduate Education and the University with respect to high standards of graduate education and scholarly performance,
- assure that all procedures are carried out fairly and according to the guidelines of the Office of Graduate Education,
- participate in conducting final examinations and provide an outcome report to the Office of Graduate Education immediately following the final exam,
- assist in the resolution of committee disputes.

To be eligible to serve as the graduate representative on a graduate student advisory committee, the person must be a full-time faculty member at SDSM&T. The person must be from a department other than the student's home department, and must be approved by the student's major program and the dean of graduate education. For supervision of a master's program, the graduate representative must have a minimum of an M.S. degree. For supervision of a doctoral program, the graduate representative must have a minimum of a doctoral degree.

To be eligible to serve as a committee member at large on a graduate student advisory committee, the person must hold a minimum of a B.S. degree, and must be approved by the student's major program. Students must have a minimum of one committee member with a doctoral degree. Departments may petition the dean of Graduate Education for exceptions.

Off-campus persons, including emeritus faculty, retired faculty, and members of industry, may serve as a co-major professor or committee member at large if they meet the requirements listed above. The committee must consist of a minimum of 3 members from the SDSM&T campus. If a committee contains more than 5 members, a majority of the committee must be members from the SDSM&T campus. In the case of emeritus faculty or retired faculty, departments may petition the dean of graduate education for an exception to this policy.

A person with graduate student status cannot serve on a graduate student advisory committee. Under extraordinary circumstances departments may petition the Council of Graduate Education for an exception to this policy.

A change in major professor may be accomplished at the student's request by submitting a request with the change of advisor form, with all appropriate approval signatures, to the dean of graduate education. Such a change of major professor also requires a new program of study.

Changes of committee members other than the major professor require:

- approval by the major professor via email,
- approval by the new committee member via email,
- documented approval of the current program of study by the new committee member.

A change of the graduate representative requires:

- approval by the major professor via email,
- approval by the new committee member via email,

- documented approval of the current program of study by the new committee member,
- approval by the dean of graduate education.

If a student completes the M.S. degree and wishes to continue for a Ph.D. the student must apply to the doctoral program. If a student is enrolled in an M.S. program and wishes to enter the doctoral program without completing the M.S. degree, the student must apply for a transfer of programs.

If a student is enrolled in a master's program, 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 transfer to the doctoral degree. Upon approval of the transfer, the department head or program coordinator, after consultation with the student and the existing advisory committee, shall expand the student's committee to a total of 5 members who will assist with the student's doctoral program.

Program of Study

For all thesis and dissertation degrees, the graduate student advisory committee will assist the student in formulating a schedule of coursework leading to the advanced degree. A copy of the appropriate form and graduate student advisory committee signatures must be filed by the student and submitted to the student's department/program and the Office of Graduate Education no later than the mid-term of the semester after which 9 credit hours have been completed or for which a grade of Incomplete has been issued. This is usually the second semester of study for full time degree seeking students. These forms can be found at the graduate education website.

Revised programs of study must be filed in a timely manner by the student and with the same offices as the original schedule. Minor course substitutions can be made with the approval of the major professor via email, along with a brief explanation of the changes.

Students in pursuit of a thesis or dissertation degree who have been granted a leave of absence before submission of a program of study will be required to submit a program of study by midterm of the semester after completion of 9 credit hours.

For all non-thesis programs, a program of study signed by the major professor or advisor (in addition to the signature of the program coordinator or department head) must be filed by the student and submitted to the student's department/program and the Office of Graduate Education no later than the middle of the semester prior to the semester of graduation. The program of study is used for degree audits to ensure that students have fulfilled all degree requirements.

Students enrolling in an accelerated MS program must fill out an Accelerated MS Advising Plan and find an interim advisor or major professor prior to admission to the MS program. The Accelerated MS Advising Plan can be revised at any time, with the concurrence of the interim advisor or major professor and the department/program head or coordinator. Accelerated MS students must submit a program of study in the first semester following the completion of the BS degree.

Research Credits

Research credit may be applied toward the fulfillment of credit-hour requirements used toward the advanced degree. Research credits are defined as either doctoral dissertation credits (898), doctoral non-dissertation research credits (888), masters thesis credits (798), or masters non-thesis research credits (788). All other credits are course credits. Elective credits are "course credits".

Certification of Degree Requirements

Before a diploma can be released, the dean of graduate education must certify that the student has fulfilled all degree requirements. For certification of the degree for a given semester, ALL requirements must be complete on or before the scheduled due dates published by the Office of Graduate Education. Note that all keys must be returned to the facilities office before the degree is granted.

Graduate students must meet the minimum registration requirement (currently 2 credits) during the specific semester or summer in which they complete all requirements for their degree and become eligible for graduation. There will be no grace period; hence, students who fail to complete all degree requirements prior to the official closure date for a given semester or summer will be required to register for a minimum of 2 credits during a subsequent semester or summer in order to graduate.

Students are strongly cautioned not to make travel plans or other arrangements that will be difficult or costly to change until they are certain that all degree requirements can and will be satisfied. It is the responsibility of the student to know and comply with these degree requirements.

M.S. Degree Requirements

- Master of Science Program Requirements
- Thesis Option Requirements
 - Thesis Submission Requirements
 - Thesis Defense Requirements
- Non-thesis Option Requirements
- Accelerated M.S. Option Requirements
- Final Examination
- M.S. Participation in Commencement
- Time Limitation for M.S. Degrees
- Master of Engineering, MEng.

Master of Science Program Requirements

Master of Science programs at SDSM&T may offer 2 options by which a student may complete the requirements for a degree. They are the thesis option and the non-thesis option. See individual program descriptions for details.

M.S. candidates already holding graduate credits from another institution may apply to transfer them to SDSM&T under terms of the policy described in "Transferring Credits from Outside Institutions". Note that additional information regarding limitations on coursework that may be applied toward the degree can be found in other sections of the catalog. Note that additional information regarding limitations on coursework that may be applied toward the degree can be found in other sections of the catalog.

Research credit may be applied toward the fulfillment of credit-hour requirements used toward the advanced degree. Research credits are defined as either doctoral dissertation credits (898), doctoral non-dissertation research credits (888), master's thesis credits (798), or master's non-thesis research credits (788). All other credits are course credits. Elective credits are "course credits".

Thesis Option Requirements

The M.S. degree minimum requirements for the thesis option are:

1. a program of at least 30 combined credit hours of coursework and research,
2. at least 15 credit hours of graduate coursework approved by the program (500 level courses and above),
3. at least 6 credit hours of thesis research and no more than 12 credit hours of thesis research, (However, the student may register for additional research credits for continuing registration purposes.)
4. a thesis that conforms to standard American English style and usage,
5. successfully defending the thesis,
6. meeting or exceeding academic standards prescribed elsewhere in this catalog, including maintaining at least a 3.0 cumulative GPA.

Thesis Submission Requirements

The thesis should represent an effort of such quality and construction that it can be displayed in the school library with similar scholarly works, as well as providing material for publication(s) in an appropriate professional journal(s). In lieu of the conventional thesis format, the thesis can consist of a compilation of published and/or submitted journal manuscripts that are derived from the student's research and are either authored or co-authored by the student. Theses submitted in this form must have an introduction and conclusion to tie the journal papers into a cohesive research paper. The final thesis must be accompanied by an abstract of 250 to 300 words and vitae of the student. Detailed instructions on the format, requirements and completion of a thesis or dissertation can be found on the website of the Office of Graduate Education.

The thesis is written under the direction of the major professor, but the student should seek guidance from all members of the graduate student advisory committee. Before starting to write the thesis, the student is urged to review the document titled "Instructions for the Preparation of Theses and Dissertations" on the graduate education website and to consult style manuals online or in the SDSM&T 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.

A final draft of the thesis, which must include all components, including title page, abstract, vita, references, etc., should be submitted by the student to each member of the graduate student advisory committee a minimum of 2 full weeks before the time and date of the student's scheduled defense. Final drafts must be complete, including all required components or the defense cannot be held. Earlier submission deadlines may be required by the graduate student advisory committee.

The graduate student's committee-approved draft of the thesis must be submitted to the Office of Graduate Education by the published deadline (approximately 2 weeks before graduation) to allow adequate time for grammatical review, corrections and revisions. This draft of the thesis, after all revisions recommended by the committee have been made, must be signed by the author and approved, signed, and dated by all committee members, the department head/program coordinator of the student's major department/program, and the dean of graduate education before any copies are made for final reproduction.

The institution requires one electronic copy and 2 paper copies (the original unbound manuscript and one bound copy) of the thesis to be kept in the Devereaux Library. Additional copies may be required by the student's program or department.

The dissemination of a thesis may be temporarily restricted due to legal or proprietary issues (ITAR, EAR, FAC, proprietary, or otherwise restricted information). A restricted thesis requires approval by the dean of graduate education and the graduate student advisory committee prior to the defense. Attendance at the defense will also be restricted. The hard copies and digital version(s) of the restricted document will not be released until the end of the specified period, which may not exceed 3 calendar years.

Thesis Defense Requirements

A student pursuing the thesis option must defend the thesis in an oral examination. The defense is open to the public except in the case of a restricted thesis (see the Thesis Submission Requirements section above). The thesis defense will be scheduled at any time after the student has completed the required coursework and after the graduate student advisory committee is satisfied that the draft thesis is an acceptable manuscript, in terms of technical quality, completeness, and proper expression and usage in American Standard English. The thesis defense may not be scheduled during the period of university final examinations. Under no circumstances should a defense go forward if the draft thesis is incomplete. The final coursework examination and thesis research defense may be combined (see the Final Examination section below).

The student shall obtain and complete the appropriate form to schedule the final examination and/or thesis defense and, in conjunction with the major professor, shall seek the approval of all committee members and file the form with the

Office of Graduate Education no less than 5 working days before the exam. The Office of Graduate Education will announce this information to the campus community.

The student's committee constitutes the examining board for the thesis defense. The major professor will head the session. The major professor is responsible for ensuring that a majority of the committee is present. The graduate representative must be physically present for the defense to go forward. The defense will not be held if these conditions cannot be met. A negative vote by any 2 or more members of the student's committee will signify failure of the defense, pending review by the graduate student advisory committee and the dean of graduate education.

Results of all written or oral examinations will be attested to by all committee members on a form furnished to the graduate representative by the Office of Graduate Education. Results must be returned to the Office of Graduation immediately following the exam by the graduate representative or other committee member to ensure chain of custody. If the student 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 graduate student advisory committee, normally 8 to 12 weeks after the date of the first examination. The student may petition his or her committee for re-examination prior to the 8 week limit.

Non-thesis Option Requirements

Students enrolled in a non-thesis program may have the option of completing a non-thesis research project or taking additional course credits in place of the research project credits. The latter option is often referred to as a coursework only option and is common in professional degree programs. Students electing a non-thesis program should check with their program or department to determine which non-thesis options are available to them.

The minimum requirements for the non-thesis M.S. degree option are:

1. a program of at least 30 credit hours of coursework (refer to specific program requirements for exact number of minimum coursework credit hours),
2. at least 20 credit hours of graduate level coursework approved by the program (500 and above),
3. a maximum of 6 credits of non-thesis research project,
4. meeting or exceeding academic standards prescribed elsewhere in this catalog, including maintaining at least a 3.0 cumulative GPA.

Accelerated M.S. Option Requirements

The accelerated master's program enables a student to complete both the B.S. and M.S. degrees in as little as 5 years. Up to 12 credits applied toward the B.S. program may be used to satisfy graduate credit requirements. See individual programs for the number of credits allowed by the program. Additional requirements apply; please see the section titled Accelerated Master's Programs for further information.

Final Examination

A master of science student may be required by his or her program to take a final examination covering course material as a requirement for the degree. The examination may be written, oral, or both. All graduate student committee members must be given the opportunity for input to, and evaluation of, a final examination.

A student pursuing the thesis option must also defend the thesis in an oral examination. The final examination and thesis defense may be combined. Oral examinations, including a thesis defense, are open to all interested faculty members, except in the case of a restricted thesis (see the Thesis Submission Requirements section above). Departmental or program policy shall determine whether non-faculty persons may attend an oral non-thesis or coursework examination.

The process for scheduling a final examination and the policies governing the examination process are described in the Thesis Defense Requirements section above.

M.S. Participation in Commencement

A student must apply to graduate by completing the application for graduation form on the graduate education website and must meet the program requirements before the degree is awarded. The application for graduation form also serves as a request to participate in the commencement ceremonies. In general, for each degree earned, a student is allowed and encouraged to participate in commencement once and have his or her name in the commencement program once. Note that participation in the commencement ceremony does not equate to the conferring of a degree. The degree is conferred when all requirements are met and the release of diploma process is completed.

The names of all students who have completed the requirements for graduation by the designated spring semester deadline will be included in the spring commencement program, and students who have completed the requirements by the designated fall semester deadline will be included in the fall commencement program. M.S. students who will complete their degree requirements in the summer term will be listed in the fall commencement program and are eligible to participate in the fall commencement ceremony. The student's name will appear in the program in the semester of completion whether the student is participating in the ceremony or not.

M.S. students who have substantially completed the degree requirements but will not meet the related spring or fall semester deadlines may petition the dean of graduate education to participate in commencement. Summer graduates who meet the below requirements may petition the dean of graduate education to participate in the spring commencement. The appropriate form is available on the website. An approved petition does not grant a waiver of registration requirements; students with an approved petition will be required to register during the semester of graduation (see section titled Minimum Academic Load).

Requests for M.S. students to participate in commencement prior to degree completion are typically only granted if:

1. For the thesis option, the student has completed all of the research for the thesis topic, and has substantially completed the writing of major portions of the thesis,
2. For the non-thesis option, the student has completed all research associated with their project, if any, and has substantially completed the writing for that project (if any).
3. For the Spring commencement, the student has an agreed upon tentative defense date that is approved by the student's major professor and committee and that is at least three weeks prior to the end of the summer semester..
4. For the Fall commencement, the student has an agreed upon tentative defense date that is approved by the student's major professor and the committee and that is within approximately 30 days of the commencement ceremony.
5. The student has completed all of the courses necessary for the degree.

A student who wishes to participate in a commencement ceremony later than the semester in which the degree is completed must notify the Office of Graduate Education of his or her intent prior to the end of the semester in which the degree requirements are met. In general, a student is allowed to participate in a commencement ceremony within one year of completing the requirements for the degree.

Time Limitation for M.S. Degree

A master of science degree program must be completed within 5 calendar years dating from the student's formal entrance into a degree seeking program. In exceptional circumstances, students may petition the dean of graduate education for an extension to the 5 year time limit. Courses taken by the student at any institution that may be credited to the degree program and that were taken more than 5 years prior to the date of anticipated graduation must be reviewed by the student's major department/program and the dean of graduate education for possible acceptance. Following this review, the student's major department/program and the dean of graduate education will determine whether a reduction in credits applicable toward the degree, a re-examination, or both, is required for the student to complete his or her degree program. The applicable forms are available at the graduate education website.

A student who is granted a leave of absence (see section titled Leave of Absence) will not be subject to continuing registration, and the leave of absence will not count toward the time limits to complete his or her program of study.

Master of Engineering, M.Eng.

The Master of Engineering program at SDSM&T is a course-based professional master's degree program. The Master of Engineering (M.Eng.) program builds upon the undergraduate engineering degree as a 'capstone' sequence composed of advanced engineering discipline courses and applied management and leadership courses. The M. Eng. degree is a coursework-only professional program with a substantive management component for engineers employed in or preparing to enter technical management roles in business and industry.

Degree requirements: The program requires 30 credits for graduation, of which 15-24 credits of engineering content must be selected from one of three available technical emphasis areas in either Civil & Environmental Engineering (CEE), Electrical Engineering (EE), and Materials Engineering & Science (MES). The remaining 6-15 credits must be management courses that complement the student's professional goals. All courses must be approved in advance by the program coordinator of the student's emphasis area. A thesis or final examination is not required. A project report is optional.

Technical Emphasis area courses	15 credits
Management courses	6 credits
<u>Technical or Management courses</u>	<u>9 credits</u>
Total course credits	30 credits

Ph.D. Degree Requirements

- The Qualifying Examination
- The Comprehensive Examination and Admission to Ph.D. Candidacy
- Dissertation Submission Requirements
- Dissertation Defense Requirements
- Ph.D. Participation in Commencement
- Residence Requirements
- Time Limitation for Ph.D. Degrees

The general requirements for the doctor of philosophy degree are:

1. satisfactory completion of a comprehensive examination and admission to candidacy,
2. a minimum total of 72 semester credits beyond the bachelor's degree, at least 36 of which should be coursework credit hours,
3. a minimum of 20 semester credit hours of appropriate research credits,
4. satisfaction of academic standards as prescribed elsewhere in this catalog, including maintaining at least a 3.0 cumulative GPA,
5. at least 2 consecutive semesters of residence as a full-time student,
6. a dissertation that conforms to standard American English style and usage, and
7. satisfaction of any departmental or program specific requirements (see department/program specific requirements in the department section of this catalog),

Between 3 and 4 academic years of full-time graduate study beyond the baccalaureate degree normally are required to earn a doctorate. Ph.D. candidates already holding graduate credits from another institution may request to apply them to the credits required for the Ph.D., under terms of the policy described in "Applying Credits from Outside Institutions".

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 (which have not been applied toward the baccalaureate) toward the 36 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 6 credits of 400-level coursework in addition to any courses credited from the M.S. degree. The head of the student's major department must petition the Council of Graduate Education through the dean of graduate education for use of 300-level credits for Ph.D. programs.

Research credit may be applied toward the fulfillment of credit hour requirements used toward the advanced degree. Research credits are defined as either doctoral dissertation credits (898), doctoral non-dissertation research credits (888), master's thesis credits (798), or masters non-thesis research credits (788). All other credits are course credits. Elective credits are "course credits".

The graduate student advisory committee approves the total number of research credits that the candidate may carry, consistent with departmental, continuing registration, and other requirements.

The graduate student advisory committee can recommend to the dean of graduate education a program requiring more credits than the minimum indicated above if it believes that this is in the best interests of the student.

The committee may approve a plan for the student to undertake work at other institutions, but may not reduce the two semester residence requirement.

The Qualifying Examination

Doctoral students admitted into all Ph.D. disciplines must pass a qualifying examination, normally to be taken within the first two years of enrollment, as per the specific guidelines of the program. The "qualifying exam" is a course-work based exam to test and demonstrate the doctoral student's proficiency in the foundational material of his or her discipline. When the student's program of foundational coursework has been substantially completed, she or he will undertake the qualifying examination. Results of this Qualifying Exam must be filed with the Office of Graduate Education by the department or program within one week of completion of the exam.

A master's student who proposes to continue into a doctoral program should so advise his or her major professor in a timely manner. The examination for the master's may be used as the qualifying examination, at the discretion of the department/program.

The Comprehensive Examination and Admission to Ph.D. Candidacy

The "comprehensive exam" is a wide-ranging exam to test and demonstrate the doctoral student's readiness to pursue doctoral research. It includes a defense of a written dissertation proposal, and may also include additional written or verbal exam components to demonstrate the student's proficiency in his or her field of study. It will be prepared by the graduate student advisory committee, with potential suggestions from any faculty member from whom the student has taken a graduate course.

The graduate student advisory committee schedules and arranges the written and oral examinations. Review of the examinations will be accomplished as soon as possible by all members of the committee. If the graduate student's advisory committee and department head/program coordinator certify that the candidate has passed the comprehensive examination, the signed admission to candidacy form must be submitted by the graduate representative or another committee member to the dean of graduate education for review and approval.

Satisfactory completion of the comprehensive examination requires that no more than one member of the graduate student advisory committee votes against passing. Upon satisfactory completion of the comprehensive exam, the student is then eligible for admission to candidacy. If the student passes with conditions, such as failure to pass a part of the examination, the committee shall inform the student promptly as to how and when the conditions may be removed. If the student has failed the comprehensive examination, another such examination should not be attempted during the same semester, though exceptions to this may be granted by the student's committee in consultation with the dean of graduate education. If the student fails a second time, work toward the doctorate can be continued only with the consent of the graduate student advisory committee, the Council of Graduate Education, and the dean of graduate education.

The comprehensive examination, and subsequent admission to candidacy, should be passed at least 12 months before the dissertation is defended. Results of the comprehensive exam and admission to candidacy must be filed with the Office of Graduate Education by the graduate representative within a week of completion of the exam.

Dissertation Submission Requirements

The dissertation is expected to advance or modify knowledge and demonstrate the candidate's technical mastery of the field of study. In lieu of the conventional dissertation format, 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. Dissertations submitted in this form must have an introduction and conclusion to tie the journal papers into a cohesive research paper. The final dissertation must be accompanied by an abstract of 250 to 350 words and vitae of the candidate. Detailed instructions on the format, requirements and completion of a thesis or dissertation can be found on the website of the Office of Graduate Education.

The dissertation is written under the direction of the major professor, but the student should seek guidance from all members of the graduate student advisory committee. Before starting to write the dissertation, the student is urged to review the document titled "Instructions for the Preparation of Theses and Dissertations" on the graduate education website and to consult style manuals online or in the SDSM&T Devereaux Library. In general, the dissertation may follow the style of captions, footnotes, and bibliographical references used by the leading technical journal in the student's field.

A final draft of the dissertation, which must include all components, including title page, abstract, vita, references, etc., should be submitted by the student to each member of the graduate student advisory committee a minimum of 2 full weeks before the time and date of the student's scheduled defense. Final drafts must be complete, including all required components or the defense cannot be held. Earlier submission deadlines may be required by the graduate student advisory committee.

The graduate student's committee-approved draft of the dissertation must be submitted to the Office of Graduate Education by the published deadline (approximately 2 weeks before graduation) to allow adequate time for grammatical review, corrections and revisions. This draft of the dissertation, after all revisions recommended by the committee have been made, must be signed by the author and approved, signed, and dated by all committee members, the department head/program coordinator of the student's major department/program. The final unbound manuscript must then be reviewed and signed by the dean of graduate education before any copies are made of any submissions for binding are done.

The institution requires one electronic copy and 2 paper copies (the original unbound manuscript and one bound copy) of the dissertation to be kept in the Devereaux Library. Additional copies may be required by the student's program or department.

The dissemination of a dissertation may be temporarily restricted due to legal or proprietary issues (ITAR, EAR, FAC, proprietary, or otherwise restricted information). A restricted dissertation requires approval by the dean of graduate education and the graduate student advisory committee prior to the defense. Attendance at the defense will also be restricted. The hard copies and digital version(s) of the restricted document will not be released until the end of the specified period, which may not exceed 3 calendar years.

Dissertation Defense Requirements

The defense of the dissertation is an oral examination open to the public except in the case of a restricted dissertation (see the Dissertation Submission Requirements section above). The dissertation defense will be scheduled at any time after the student has completed the required coursework and after the graduate student advisory committee is satisfied that the dissertation is an acceptable manuscript, in terms of technical quality, completeness and proper expression and usage in American Standard English. The dissertation defense may not be scheduled during the period of university final examinations. Under no circumstances should a defense go forward if the draft is incomplete.

The student shall obtain and complete the appropriate form to schedule the defense, and in conjunction with the major professor, shall seek the approval of all committee members. The student shall return the form to the Office of Graduate Education no less than 5 working days before the defense date. The Office of Graduate Education will announce the defense to the campus community.

The student's committee constitutes the examining board for the thesis defense. The major professor will head the session. The major professor is responsible for ensuring that a majority of the committee is present. The graduate representative must be physically present for the defense to go forward. The defense will not be held if these conditions cannot be met. A negative vote by any 2 or more members of the student's committee will signify failure of the defense, pending review by the graduate student advisory committee and the dean of graduate education.

Results of all written or oral examinations will be attested to by all committee members on a form furnished to the graduate representative by the Office of Graduate Education. Results must be returned to the Office of Graduate Education immediately following the exam by the graduate representative or other committee member to ensure chain of custody. 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 graduate student advisory committee, normally 8 to 12 weeks after the date of the first examination. The student may petition his or her committee for re-examination prior to the 8-week limit.

Ph.D. Participation in Commencement

A student must apply to graduate by completing the application for graduation form on the graduate education website and must meet the program requirements before the degree is awarded. The application for graduation form also serves as a request to participate in the commencement ceremonies. In general, for each degree earned, a student is allowed to participate in commencement once and have his or her name in the commencement program once. Note that participation in the commencement ceremony does not equate to the conferring of a degree. The degree is conferred when all requirements are met and the release of diploma process is completed.

The names of all students who have completed the requirements for graduation by the designated spring date will be included in the May program, and students who have completed the requirements by the designated fall date will be included in the December program. Summer graduates will be listed in the December program and are eligible to participate in the fall commencement ceremony. The student's name will appear in the program in the semester of completion, whether the student is participating in the ceremony or not.

A Ph.D. candidate must have successfully defended his or her dissertation, have deposited his or her final thesis or dissertation, and have completed all other degree requirements, including all fees related to the printing, binding and distribution of their dissertation by the designated date to participate in commencement and the hooding ceremony.

A student who wishes to participate in a commencement ceremony later than the semester in which the degree is completed must notify the Office of Graduate Education of his or her intent prior to the end of the semester in which the degree requirements are completed. In general, if a student wishes to participate in a commencement ceremony it is expected that the student will do so within one year of completing the requirements for the degree.

Residence Requirements

At least 2 consecutive semesters of residence as a full-time student are required at South Dakota School of Mines and Technology unless an exception is granted by the dean of graduate education and the Faculty Senate.

Time Limitation for Ph.D. Degrees

A doctoral degree program must be completed within 8 calendar years dating from the student's formal entrance into a degree-seeking program. Courses taken by the student at any institution that may be credited to the degree program and that were taken more than 8 years prior to the date of anticipated graduation must be reviewed by the student's major department/program and the dean of graduate education for possible acceptance. Following this review, the student's major department/program and the dean of graduate education will determine whether a reduction in credits applicable toward the degree, a re-examination, or both, is required for the student to complete his or her degree program. Students may petition the dean of graduate education for an extension to the 8 year time limit. The applicable forms are available at the graduate education website.

A student who is granted a leave of absence (see section titled Leave of Absence) will not be subject to continuing registration, and the leave of absence will not count toward the time limits to complete his or her program of study.

Academic Programs

Associate of Arts

General Studies, A.A.

Contact Information

Dr. Frank Van Nuys

Department of Social Sciences

Classroom Building 305

(605) 394-2481

E-mail: Frank.VanNuys@sdsmt.edu

The Associate of Arts Degree in General Studies is a two-year degree program that provides a student the opportunity to complete a curriculum in traditional fields of study. The total semester credits required is 60. The curriculum offers a broad and varied background in general education as well as opportunities to explore a number of disciplines as a basis for entrance into a four-year degree program. Completion of the A.A. degree will fulfill the general education requirements for an associate degree at the state universities of South Dakota. Approved general education courses from other state universities may be used to satisfy the School of Mines general education requirements. The program of studies is as follows:

Associate of Arts Degree General Education Requirements

The AA degree requires 24 semester credits of general education coursework. Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog.

A. Written and Oral Communication (Goals 1 and 2)

A minimum of 9 semester hours is required. This requirement can be met by taking one of two sequences of courses. Either:

- ENGL 101 Composition I **Credits: (3-0) 3**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- OR**
- ENGL 101 Composition I **Credits: (3-0) 3**
- ENGL 201 Composition II **Credits: (3-0) 3**
- SPCM 101 Fundamentals of Speech **Credits: (3-0) 3**

Note(s):

Students who intend to continue at or return to Mines for a B.S. degree should take the first sequence—ENGL 101, ENGL 279, ENGL 289.

B. Arts and Humanities (Goal 4)

Courses in western civilization, literature, philosophy, religion, non-English languages, art, music, and theatre may be used. A minimum of 3 semester hours is required. Courses offered at Mines include the following:

- ART 111/111A Drawing I **Credits: (3-0) 3**
- ART 112/112A Drawing II **Credits: (3-0) 3**

- ARTH 211 History of World Art I **Credits: (3-0) 3**
- ENGL 210 Introduction to Literature **Credits: (3-0) 3**
- ENGL 212 World Literature II **Credits: (3-0) 3**

- ENGL 221 British Literature I **Credits: (3-0) 3**
- ENGL 222 British Literature II **Credits: (3-0) 3**

- ENGL 241 American Literature I **Credits: (3-0) 3**
- ENGL 242 American Literature II **Credits: (3-0) 3**

- ENGL 250 Science Fiction **Credits: (3-0) 3**

- GER 101 Introductory German I **Credits: (4-0) 4 AND**
- GER 102 Introductory German II **Credits: (4-0) 4**

- HIST 121 Western Civilization I **Credits: (3-0) 3**
- HIST 122 Western Civilization II **Credits: (3-0) 3**

- HUM 100 Introduction to Humanities **Credits: (3-0) 3**
- HUM 200 Connections: Humanities & Technology **Credits: (3-0) 3**

- MUS 100 Music Appreciation **Credits: (3-0) 3**
- MUS 117 Music in Performance I **Credits: (1-0) 1**
- PHIL 100 Introduction to Philosophy **Credits: (3-0) 3**
- PHIL 200 Introduction to Logic **Credits: (3-0) 3**
- PHIL 220 Introduction to Ethics **Credits: (3-0) 3**
- PHIL 233 Philosophy and Literature **Credits: (3-0) 3**

- SPAN 101 Introductory Spanish I **Credits: (4-0) 4 AND**
- SPAN 102 Introductory Spanish II **Credits: (4-0) 4**

Note(s):

ART and ARTH are considered the same prefix.

Students must complete three semesters/three credits in MUS 117 to earn Humanities general education credit.

Students who intend to continue at or return to SD Mines for B.S. degree should take a minimum of 6 semester hours in two different disciplines, with two different prefixes.

C. Social Sciences (Goal 3)

Courses in anthropology, economics, geography, history, political science, psychology, and sociology may be used. A minimum of 3 semester hours is required. Courses offered at Mines include the following:

- ANTH 210 Cultural Anthropology **Credits: (3-0) 3**
- GEOG 101 Introduction to Geography **Credits: (3-0) 3**
- GEOG 200 Introduction to Human Geography **Credits: (3-0) 3**
- GEOG 210 World Regional Geography **Credits: (3-0) 3**
- GEOG 212 Geography of North America **Credits: (3-0) 3**

- HIST 151 United States History I **Credits: (3-0) 3**
- HIST 152 United States History II **Credits: (3-0) 3**

- POLS 100 American Government **Credits: (3-0) 3**
- POLS 165 Political Ideologies **Credits: (3-0) 3**
- POLS 250 Introduction to International Relations **Credits: (3-0) 3**
- PSYC 101 General Psychology **Credits: (3-0) 3**
- SOC 100 Introduction to Sociology **Credits: (3-0) 3**
- SOC 150 Social Problems **Credits: (3-0) 3**
- SOC 250 Courtship and Marriage **Credits: (3-0) 3**

Note(s):

Students who intend to continue at or return to SD Mines for B.S. degree should take a minimum of 6 semester hours in two different disciplines, with two different prefixes.

D. Mathematics (Goal 5)

A minimum of 3 semester hours of college algebra or a math course with college algebra as a prerequisite is required.

- MATH 102 College Algebra **Credits: (3-0) 3**

E. Natural Sciences (Goal 6)

A minimum of 6 semester hours in the natural sciences is required including one semester hour of laboratory. Courses in biology, chemistry, earth science, geology, and physics may be used. The following courses are offered at Mines:

- BIOL 151 General Biology I **Credits: (3-0) 3 AND**
- BIOL 151L General Biology I Lab **Credits: (0-1) 1**
- BIOL 153 General Biology II **Credits: (3-0) 3 AND**
- BIOL 153L General Biology II Lab **Credits: (0-1) 1**
- CHEM 112 General Chemistry I **Credits: (3-0) 3 AND**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- CHEM 114 General Chemistry II **Credits: (3-0) 3 AND**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- GEOL 201 Physical Geology **Credits: (3-0) 3 AND**
- GEOL 201L Physical Geology Laboratory **Credits: (0-1) 1**
- PHYS 111 Introduction to Physics I **Credits: (3-0) 3 AND**
- PHYS 111L Introduction to Physics I Laboratory **Credits: (0-1) 1**
- PHYS 113 Introduction to Physics II **Credits: (3-0) 3 AND**
- PHYS 113L Introduction to Physics II Laboratory **Credits: (0-1) 1**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3 AND**
- PHYS 213L University Physics II Laboratory **Credits: (0-1) 1**

Electives

Total semester credits required to graduate with the AA degree is 60. The number of elective credits will vary depending on the courses selected in humanities, social sciences, mathematics, and natural sciences. All elective courses must be approved by the student's academic advisor.

Other Degree Requirements

Students must have achieved a minimum cumulative grade point average of 2.00 in order to graduate with this degree.

After completion of 45 credit hours, students may register for up to nine hours of 300 level courses.

Students must meet the Institutional Credit Requirements, which include completion of a minimum of 15 credits from School of Mines. In addition, 8 of the last 15 credits counted toward the degree must be taken from School of Mines.

Students must be enrolled in at least one course during the semester of graduation.

This information and an A.A. worksheet may be found at: <http://is.sdsmt.edu>.

Bachelor of Science

Applied Biological Sciences, B.S.

Contact Information

Dr. Richard Sinden, Department Head

Department of Chemistry and Applied Biological Sciences

Chemical and Biological Engineering/Chemistry 2206

(605) 394-1678

E-mail: Richard.Sinden@sdsmt.edu

Faculty

Professors Fong and Sinden; Associate Professors Gilly, Heglund, Novak, Sani, Smirnova, and Zhu; Assistant Professors Kunza; Senior Lecturers Coble, Filipova, and Meyer; Instructors Christofferson, K. Gilcrease, and Marshall; Emeritus Professors Bang and Boyles.

Staff

Department Senior Secretary, Tara Huber; Chemical and Instrumentation Specialist, Darren Schwede.

Applied Biological Sciences

The Department of Chemistry and Applied Biological Sciences offers a Bachelor of Science in Applied Biological Sciences.

Applied Biological Sciences (ABS) graduates are rigorously trained in the biological sciences, with a strong background in the foundation areas of biology, chemistry, mathematics, and physics. The Department of Chemistry and Applied Biological Sciences offers both fundamental and advanced courses in biology and chemistry. Biology course offerings include Microbiology, Genetics, Molecular Cell Biology, Bioinformatics, Cancer Biology, Current Topics in Bioethics, Pathogenesis, and Industrial Microbiology. The Bachelor of Science in Applied Biological Sciences requires 120 semester credits.

The department prepares students for meaningful and productive careers in one of the diverse areas within the biological sciences including:

- Pre-Medicine, Pre-Professional, or Pre-Health
- Molecular Genetics
- Cancer or Biomedical Research
- Biomedical Engineering
- Biotechnology
- Environmental Sciences

Students wishing to pursue careers or graduate study in medicine, pharmaceutical science, biomedical technology, medical and patent law, or academic research can choose a premedical or molecular emphasis, rich in courses in microbiology and cell and molecular biology.

Students wishing to prepare for graduate study in biomedical engineering or pursue career fields such as bioprocessing or bioenergy can choose a biomedical engineering emphasis, which provides an opportunity to meld biology with world-class engineering courses available at SDSM&T. This emphasis involves academic preparation in various engineering disciplines, including civil, materials and metallurgical, or mechanical engineering.

ABS graduates are also well-positioned, with further certification, to fill the demand for highly-trained middle and high school science teachers.

Course Work - Classroom and Laboratory:

The department offers both fundamental and advanced courses in applied biology and chemistry. Most courses have an accompanying laboratory experience that teaches students the techniques and procedures needed to conduct applied biological research.

Independent Research:

Applied Biology is a *hands-on discipline* - not a spectator sport. Critical thinking and research skills are reinforced in professor-directed, one-on-one independent research experiences available to exceptional students. This experience is critical in preparing students for Graduate School. Nearly 50% of ABS graduates go to Graduate School, while more than 30% go to Medical or Professional.

The Department of Chemistry and Applied Biological Sciences prides itself in the 2011 opening of a new wing which houses state-of-the-art laboratory facilities and instrumentation available for cutting-edge research. In 2016-2017, a \$6.5M renovation of the old Chemistry building was completed that provided new research laboratories for CABS faculty, a new teaching laboratory, and renovated classrooms.

For students interested in graduate studies, the faculty of the Department of Chemistry and Applied Biological Sciences participate in several SDSM&T graduate programs including the M.S. and Ph.D. in Biomedical Engineering, M.S. and Ph.D. in Materials Engineering and Science, and Ph.D. in Nanoscience and Nanoengineering. Students opting for a graduate degree in these disciplines have the opportunity to perform cutting-edge research to complete a Thesis or Dissertation in their area of interest. Accelerated Masters programs, in which students can earn a M.S. in as little as one year after completion of their B.S. degree, are available for the Biomedical Engineering and Materials Engineering and Science degrees.

The program also offers a Minor in Applied Biological Sciences.

Applied Biological Sciences Curriculum/Checklist

The following curriculum shows one embodiment of a path toward the ABS degree. The sequence of courses taken will depend on the academic preparation and career objectives of incoming students. Students should consult with an Applied Biological Sciences advisor for a more personalized course of study based on career goals within the applied biological sciences. It is important to note that certain courses have prerequisite requirements. Judicious selection of electives from the approved list will allow students specialized training in an applied biological sciences area, including microbiology, molecular biology, molecular genetics, pre-professional studies, or biomedical engineering.

Freshman Year

This is freshman year.

First Semester

- BIOL 111 Introduction to Chemistry and Applied Biological Sciences **Credits: (1-0) 1**
- BIOL 151 General Biology I **Credits: (3-0) 3**
- BIOL 151L General Biology I Lab **Credits: (0-1) 1**
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- ENGL 101 Composition I **Credits: (3-0) 3**
- MATH 123 Calculus I **Credits: (4-0) 4**

Total: 16

Second Semester

- BIOL 153 General Biology II **Credits: (3-0) 3**
- BIOL 153L General Biology II Lab **Credits: (0-1) 1**
- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- MATH 125 Calculus II **Credits: (4-0) 4**
- General Education Goal 3 or 4 Elective(s) **Credits: 3**

Total: 15

Sophomore Year

First Semester

- CHEM 326 Organic Chemistry I **Credits: (3-0) 3**
- CHEM 326L Organic Chemistry I Lab **Credits: (0-2) 2**
- BIOL 331 Microbiology **Credits: (3-0) 3**
- BIOL 331L Microbiology Lab **Credits: (0-1) 1**
- General Education Goal 3 or 4 Elective(s) **Credits: 3**
- PHYS 111 Introduction to Physics I **Credits: (3-0) 3**
- PHYS 111L Introduction to Physics I Laboratory **Credits: (0-1) 1**
Or
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**

Total: 15 or 16

Second Semester

- CHEM 328 Organic Chemistry II **Credits: (3-0) 3**
- CHEM 328L Organic Chemistry II Lab **Credits: (0-2) 2**
- BIOL 371 Genetics **Credits: (3-0) 3**
- BIOL 371L Genetics Lab **Credits: (0-1) 1**
- General Education Goal 3 or 4 Elective(s) **Credits: 3**
- PHYS 113 Introduction to Physics II **Credits: (3-0) 3**
- PHYS 113L Introduction to Physics II Laboratory **Credits: (0-1) 1**
Or
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- PHYS 213L University Physics II Laboratory **Credits: (0-1) 1**

Total: 16

Junior Year

First Semester

- CHEM 464/564 Biochemistry I **Credits: (3-0) 3**
- CHEM 464L/564L Biochemistry I Lab **Credits: (0-1) 1**
- CHEM 482/582 Environmental Chemistry **Credits: (3-0) 3**
Or
- BIOL 311 Principles of Ecology **Credits: (3-0) 3**
- BIOL 446/546 Molecular Cell Biology **Credits: (3-0) 3**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**

Total: 13

Second Semester

- CHEM 465/565 Biochemistry II **Credits: (3-0) 3**
- MATH 321 Differential Equations **Credits: (3-0) 3**
OR
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**
- BIOL 480/580 Bioinformatics **Credits: (3-0) 3**
- General Education Goal 3 or 4 Elective(s) **Credits: 3**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**

Total: 15

Senior Year

First Semester

- BIOL 490 Seminar **Credits: 1 to 3**
- ABS Program Elective **Credits: 3**
- ABS Program Elective **Credits: 3**
- ABS Program Elective **Credits: 3**
- Free Elective **Credits: 3**
- Free Elective **Credits: 3**

Total: 16

Second Semester

ABS Program Elective

- ABS Program Elective **Credits: 3 or 4**
- ABS Program Elective **Credits: 3**
- Free Elective **Credits: 3**
- Free Elective **Credits: 3**

Total: 13 or 14

120 credits required for graduation

ABS Program Electives

- AES 403/503 Biogeochemistry **Credits: (3-0) 3**
- BIOL 221 Human Anatomy **Credits: (3-0) 3**
- BIOL 221L Human Anatomy Lab **Credits: (0-1) 1**
- BIOL 311 Principles of Ecology **Credits: (3-0) 3**

- BIOL 311L Principles of Ecology Laboratory **Credits: (0-1) 1**
- BIOL 326 Biomedical Physiology **Credits: (3-0) 3**
- BIOL 326L Biomedical Physiology Lab **Credits: (0-1) 1**
- BIOL 375 Current Bioethical Issues **Credits: (3-0) 3**
- BIOL 406/506 Global Environmental Change **Credits: (3-0) 3**
- BIOL 423 Pathogenesis **Credits: (3-0) 3**
- BIOL 423L Pathogenesis Lab **Credits: (0-1) 1**
- BIOL 438/538 Industrial Microbiology **Credits: (3-0) 3**
- BIOL 455/555 DNA Structure and Function **Credits: (3-0) 3**
- BIOL 470/570 Cancer Biology **Credits: (3-0) 3**
- BIOL 478/578 Microbial Genetics **Credits: (3-0) 3**
- BIOL 491 Independent Study **Credits: 1 to 4**
- BIOL 492 Topics **Credits: 1 to 5**
- BIOL 498 Undergraduate Research/Scholarship **Credits: 1 to 12**
- CBE 217 Chemical Engineering Material Balances **Credits: (3-0) 3**
- CBE 218 Chemical Engineering Fluid Mechanics **Credits: (3-0) 3**
- CBE 222 Chemical Engineering Process Thermodynamics **Credits: (3-0) 3**
- CBE 318 Chemical Engineering Mass Transfer **Credits: (3-0) 3**
- CBE 343 Chemical Kinetics and Reactor Design **Credits: (3-0) 3**
- CBE 484/584 Fundamentals of Biochemical Engineering **Credits: (3-0) 3**
- CBE 484L/584L Biochemical Engineering Laboratory **Credits: (0-1) 1**
- CHEM 352 Systematic Inorganic Chemistry **Credits: (3-0) 3**
- CHEM 332 Analytical Chemistry **Credits: 2 or 3**
- CHEM 332L Analytical Chemistry Lab **Credits: (0-1) 1**
- CHEM 342 Physical Chemistry I **Credits: 2 to 3**
- CHEM 342L Physical Chemistry I Lab **Credits: (0-1) 1**
- CHEM 344 Physical Chemistry II **Credits: 2 to 3**
- CHEM 344L Physical Chemistry II Lab **Credits: 1 to 2**
- CHEM 420/520 Organic Chemistry III **Credits: (3-0) 3**
- CHEM 421/521 Spectroscopic Analysis **Credits: (3-0) 3**
- CHEM 426/526 Polymer Chemistry **Credits: (3-0) 3**
- CHEM 434 Instrumental Analysis **Credits: (3-0) 3**
- CHEM 434L Instrumental Analysis Lab **Credits: (0-2) 2**
- CHEM 452/552 Inorganic Chemistry **Credits: (3-0) 3**
- CHEM 452L/552L Inorganic Chemistry Lab **Credits: (0-1) 1**
- CHEM 482/582 Environmental Chemistry **Credits: (3-0) 3**
- EM 215 Dynamics **Credits: (3-0) 3**
- EM 216 Statics and Dynamics **Credits: (4-0) 4**
- GEOL 361 Oceanography I **Credits: (3-0) 3**
- GEOL 416/416L/516/516L Introduction to GIS/Lab **Credits: (2-1) 3**
- IENG 321/321L Ergonomics/Human Factors Engineering/Lab **Credits: (2-1) 3**
- IENG 431/531 Industrial Hygiene **Credits: (3-0) 3**
- MATH 225 Calculus III **Credits: (4-0) 4**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**
- ME 211 Introduction to Thermodynamics **Credits: (3-0) 3**
- ME 216 Introduction to Solid Mechanics **Credits: (3-0) 3**

- ME 316 Solid Mechanics **Credits: (3-0) 3**
- ME 331 Thermo Fluid Dynamics **Credits: (3-0) 3**
- MET 232 Properties of Materials **Credits: (3-0) 3**
- MET 320 Metallurgical Thermodynamics **Credits: (4-0) 4**
- MET 422 Transport Phenomena **Credits: (4-0) 4**
- NANO 401 Introduction to Nanoscience **Credits: (3-0) 3**

Curriculum Notes

The following shows the basic course requirements for the ABS B.S. Advisors will work with individual students to tailor an individualized curriculum based on their areas of interest and academic preparedness.

General Education Requirements: 21 credits of General Education Requirements as determined by the SD Board of Regents and SDSM&T. The Globalization requirements can be met by taking BIOL 311 or CHEM 482.

Math Requirement: 11 credits (MATH 123, 125, and 321 or 381)

Physics Requirement: 7 credits (100 or 200 level PHYS courses)

Chemistry Requirement: 25 credits (CHEM 112, 112L, 114, 114L, 326, 326L, 328, 328L, 464, 464L, and 465)

Biology Requirement: 24 credits (BIOL 111, 151, 151L, 153, 153L, 331, 331L, 371, 371L, 446, 480, and 490)

ABS Program Electives: 19 credits

Free Electives: 13 credits

Total 120 credits required for the ABS B.S.

Applied and Computational Mathematics, B.S.

Applied and Computational Mathematics B.S.

Contact Information

Dr. Kyle Riley

Department of Mathematics and Computer Science

McLaury 308

(605) 394-2471

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Faculty

Professors Braman, Johnson, Kowalski, McGough, and Teets; Associate Professors Caudle, Kiche and Riley; Assistant Professors Dahl, Deschamp, Fleming and Garlick; Lecturers Bienert, Richard-Greer and Grieve; Instructors Lehmann, Leonard, and Rudy-Hinker; Emeritus Professors Carda, Corwin, Grimm, and Opp.

Applied and Computational Mathematics Major

Students majoring in mathematics will follow the accompanying applied and computational mathematics curriculum. The curriculum includes 55 credits of mathematics courses, 11 credits of computer science, 10 credits of sciences, and at least 9 credits of additional science and engineering courses that fall in a specific field (see emphasis area below). Any student majoring in mathematics who desires a minor in another field should consult his or her advisor in the Department of Mathematics and Computer Science as early in the program of study as possible. In addition, the student must contact the Office of the Registrar and Academic Services in order to declare a minor. 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 selecting courses from: MATH 353, MATH 381, MATH 382, MATH 447/547, IENG 362, and IENG 301 or IENG 302. Information concerning these examinations can be obtained from the Department of Mathematics and Computer Science.

The primary goal of the applied and computational mathematics program is to give graduates a firm understanding of mathematics and its applications to science and engineering. Graduates are expected to develop a strong foundation of knowledge and skill in the core areas of analysis, differential equations, numerical methods, and modeling. They are also expected to attain a basic understanding of probability, statistics, and algebra. Because applied mathematicians are problem solvers, graduates must develop the ability to formulate and solve problems arising from scientific and engineering applications. This entails acquiring fundamental knowledge in the basic sciences, which School of Mines students accomplish by taking courses in an emphasis area. The student will take three courses in an external discipline that will provide exposure and depth in an application area of mathematics. Information on emphasis areas and the associated courses is available from the department or advisor.

Graduates must be prepared to continue learning throughout their careers. In the two-course sequence of MATH 498 and MATH 402, students will have the opportunity to work with individual faculty members on research and develop their communication skills. This work will result in a technical paper and an oral presentation.

Upon graduation, some graduates pursue careers in fields such as computer software development, actuarial science, applied statistics, data analysis, and operations research. Others go on to pursue advanced degrees or seek certification to teach mathematics at the elementary or secondary levels.

An applied and computational mathematics major must complete a minimum of 15 credit hours in humanities and social sciences with at least 6 credit hours in humanities and at least 6 credit hours in social sciences. Refer to the humanities and social sciences section of this catalog for a list of courses satisfying these requirements. It is also important to refer to the general education core requirements under bachelor of science graduation requirements for further information. Students must complete the general education core requirements within the first 64 credits.

The accompanying sample schedule lists all required classes for the degree in their proper prerequisite sequence. Students should consult course listings for prerequisites and should consult their advisors at each registration.

Mathematics Double Major

Due to the large number of mathematics courses common with other majors and the mathematics major, many students find it attractive to pursue a double major. Students seeking the double major should consult the department for details about this option.

Accelerated Masters Option

The B.S. in Applied and Computational Mathematics program has aligned with the M.S. in Computational Sciences and Robotics (CSR) program. The accelerated option allows for students to complete both the B.S. program and the M.S. program in five years. Students interested in this program need to apply to the CSR program before or during their junior year. Students accepted into the program can apply up to ten credits of graduate courses towards their undergraduate degree and these same courses will apply to their graduate program of study. Students should inquire about this program at the department office or contact the CSR program coordinator.

Applied and Computational Mathematics Curriculum

For the bachelor of science in mathematics, a student must:

1. Take all of the courses listed in the applied and computational mathematics curriculum checklist;
2. Take 3 emphasis area courses (information about emphasis areas and supporting courses is available from the department); and
3. Have a departmental grade point average of at least 2.00 in all mathematics courses 300 level or higher. (Courses taken more than once will have only the higher grade counted for computing the departmental grade point average.)
4. Course requirements for the program also include the total number of credits per course. Any student that transfers a course that is approved for transfer will fulfill the course requirement, but if the transferred course does not meet the total credit hour requirement then the program committee will decide on the proper accommodation for meeting the credit requirement. Students should consult with their advisor to get clarification on the necessary accommodation.

Applied and Computational Mathematics Curriculum/Checklist

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog. Additional information about the program may be found at: www.sdsmt.edu/MCS.

Freshman Year

First Semester

- ENGL 101 Composition I **Credits: (3-0) 3**
- MATH 110 Survey of Computer Science and Mathematics **Credits: (1-0) 1**
- MATH 123 Calculus I **Credits: (4-0) 4**
- CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**
- ²Humanities/Social Science Elective(s) **Credits: 3**

Total: 14

Second Semester

- MATH 125 Calculus II **Credits: (4-0) 4**
- ¹Science Elective/Science Lab **Credits: 4**
- CSC 215 Programming Techniques **Credits: (4-0) 4**
- ²Humanities/Social Science Elective(s) **Credits: 3**

Total: 15

Sophomore Year

First Semester

- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- MATH 225 Calculus III **Credits: (4-0) 4**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- ²Humanities/Social Science Elective(s) **Credits: 3**

Total: 16

Second Semester

- MATH 315 Linear Algebra **Credits: (3-0) 3**
- ⁴ CSC 251 Finite Structures **Credits: 2 or 4**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- ²Humanities/Social Science Elective(s) **Credits: 3**

Total: 16

Junior Year

First Semester

- MATH 423 Advanced Calculus I **Credits: (4-0) 4**
- MATH 432 Partial Differential Equations **Credits: (3-0) 3**
- MATH 452/552 Advanced Studies in Mathematics **Credits: (3-0) 3**
- MATH 373 Introduction to Numerical Analysis **Credits: (3-0) 3**
- ³Elective/Emphasis **Credits: 2**

Total: 15

Second Semester

- MATH 382 Probability Theory and Statistics II **Credits: (3-0) 3**
- MATH 424 Advanced Calculus II **Credits: (4-0) 4**
- MATH 451/551 Math Modeling **Credits: (3-0) 3**
- ³Elective/Emphasis **Credits: 5**

Total: 15

Senior Year

First Semester

- MATH 413 Abstract Algebra I **Credits: (3-0) 3**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**
- MATH 498 Undergraduate Research/Scholarship **Credits: (1-0) 1**
- ³Elective/Emphasis **Credits: 8**

Total: 15

Second Semester

- MATH 443/543 Data Analysis **Credits: (3-0) 3**
- MATH 421 Complex Analysis **Credits: (3-0) 3**
- MATH 402 Communicating Mathematics **Credits: (1-0) 1**
- ³Elective/Emphasis **Credits: 7**

Total: 14

120 credits required for graduation

Curriculum Notes

¹ The science requirement for this major consists of PHYS 211/211-A, PHYS 213/213-A, one course from among BIOL 151, CHEM 112, GEOL 201, plus a lab associated with one of the science courses taken - either BIOL 151L, CHEM 112L, GEOL 201L, or PHYS 213L.

² Students should consult the "General Education Requirements" section of this catalog for a complete listing of all general education requirements. It is important to note that all general education requirements must be completed within the first 64 credits taken. Math majors are additionally required to take a total of at least 15 semester hours of electives in humanities and social sciences. At least three credits of humanities/social sciences must be at the 300 level or above.

³ Math majors must complete 3 courses in a science or engineering emphasis area. Any double major automatically satisfies this emphasis area requirement with their other major. Further information about possible emphasis areas is available from the department. Math majors are also required to complete at least three credits in a nontechnical elective. Nontechnical elective

courses include: PE, Music, MSL, Humanities, or Social Sciences. Please note the nontechnical elective is in addition to the 15 credits of Humanities and Social Sciences that are required for the major.

⁴CSC 251 must be taken for four credits to apply towards the Applied and Computational Mathematics major.

⁵CHEM 106, CSC 105, MATH 021, MATH 101, MATH 102, MATH 120, PHYS 111, and PHYS 113 may not be counted towards the degree in Applied and Computational Mathematics.

Chemical Engineering, B.S.

Contact Information

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Faculty

Professors Dixon, Gilcrease, Menkhaus, Puszynski, Salem and Winter; Associate Professors Benjamin, Sani, and Shende; Assistant Professors Brenza, Groven, and Hadley. Lecturer Pinkelman.

Director and Emeritus Faculty

Professor and Composites and Polymer Engineering Laboratory Director Salem and Emeritus Professors Bang, Bauer, and Munro.

Staff

Chemical and Biological Engineering Administrative Assistant, Lila Baskerville. Chemical and Biological Engineering Program Assistant, Lori Litzen. Chemical and Instrumentation Specialist, Ivan Filipov.

Chemical and Biological Engineering (CBE)

The Department of Chemical and Biological Engineering (CBE) offers a B.S. degree in Chemical Engineering which is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>, 415 North Charles Street, Baltimore, MD 21201, Phone: +1.410.347.7700 . CBE also offers a M.S. degree in Chemical Engineering and a Ph.D. in Chemical and Biological Engineering. Our department name, Chemical and Biological Engineering, reflects the forward-looking integration of chemical engineering, chemical sciences and biological sciences. With a specialization in biochemical engineering and emphases in advanced materials, biomedical engineering, energy technology, environmental engineering, and petroleum engineering you can personalize your education. An accelerated Master of Science (B.S. + M.S.) degree program is also available for qualified undergraduate students.

What is Chemical Engineering?

Chemical Engineering (ChE) is an optimal combination of the molecular sciences (chemistry and biology), the physical sciences (physical chemistry and physics), the analytical sciences (math and computer programming) and engineering. Chemical Engineering focuses on the description and design of processes that combine engineering principles of heat and fluid flow with chemical reactions and molecular separations to produce high-value products useful to humankind from multiple raw material sources. Chemical Engineers do this while always insuring that the processes they design, build and manage are safe, environmentally responsible and economical.

Examples of such processes include:

Alternative and renewable energy	Microprocessor manufacturing
Artificial organs and biomedicine	Mineral and ore refining
Bioenergy production	Oil and natural gas refining
Biological fermentation	Paper manufacturing
Biopharmaceuticals	Pharmaceutical design and mfg.
Ceramic manufacturing	Polymer production
Energetic materials production	Polymer composites production
Food processing	Nanomaterials manufacturing

Designing and modeling such processes requires a strong fundamental understanding of the chemical and biological phenomena at work. ChE students develop a wide range of problem solving skills grounded in mathematics and computer analysis techniques. ChE graduates are recruited for their technical engineering knowledge as well as their problem solving, systems analysis, leadership skills, and communication skills.

What do chemical engineers do?

ChE graduates work in a wide variety of manufacturing, process design, and research fields. The unique combination of molecular sciences and engineering analysis make ChE professionals highly qualified for many career options in chemical, petroleum, mineral processing, pharmaceutical, food processing, biomedicine, biotechnology, semiconductor, defense, and alternative energy industries, state and federal government and academia. Recent graduates from SDSM&T have gone to work in ChE positions at 3M, ADM, Baker Hughes, Burns & McDonnell, Dakota Gasification, Dow Chemical, Dow Corning, Cargill, Caterpillar, Emerson, Exxon-Mobile, Freeport-McMoRan Copper and Gold, Halliburton, Kimberly Clark, Lafarge, Lyondell-Basel, Michelin, POET, Quadra Mining, R.S. Stover, SD DENR, Solvay Chemicals and many others. CBE alumni also regularly pursue graduate education at many of the country's top chemical engineering research institutions such as Stanford, University of Minnesota, University of Washington, and the University of Wisconsin.

To delve deeper into the broad range of exciting careers available to you in chemical engineering go to the American Institute of Chemical Engineers website (www.aiche.org) and pull down Events & Resources/Career/Career FAQ's then click on "What exactly does a chemical engineer do?" and click on "Chemical Engineers in Action: Innovation at Work" (<http://www.chemicalengineering.org/>). You will find that if you wish to be engaged in discovering answers to the World's pressing engineering challenges, Chemical Engineering is the field for you.

Another attribute that sets Chemical Engineering apart from many other engineering career paths is that chemical engineering opens doors to other professions. The problem solving skills and process analysis tools developed in the Chemical Engineering curriculum make ChE graduates uniquely suited to pursue careers as doctors, patent lawyers, business managers, financial analysts, marketing directors, environmental stewards, policy makers, and philanthropy directors.

What will I learn as a ChE student?

ChE students take multiple courses in chemistry and biology to develop a fundamental understanding of the molecular sciences. The program includes physics, math, and computer courses to provide the analytical tools required for modeling and to design processes. Finally the core Chemical Engineering curriculum includes engineering courses in thermodynamics, heat and mass transport, fluid dynamics, chemical reaction kinetics and reactor design, molecular separations and unit operations, and process design and control. Elective courses are also available to provide emphasis specialization in areas such as advanced materials (e.g. composites, nanomaterials and polymers), bioprocessing/biochemical engineering, energy technology, environmental engineering, and petroleum engineering.

Chemical Engineering at the School of Mines

The vision of the CBE Department is: **To provide nationally and internationally recognized chemical and biological engineering education and research.**

Through the baccalaureate degree, students are prepared to become practicing chemical engineers, ready to enter the workforce and make immediate contributions. As a graduate of the SDSM&T chemical engineering program you will be able to perform at a level that meets or exceeds industry, government lab, and graduate school expectations. Within a few years of your graduation, you will have the characteristics described by the following **Chemical Engineering Program Educational Objectives:**

1. Graduates apply fundamental and practical knowledge of unit operations, thermodynamics, reaction engineering, process control and design of safe, economical and sustainable chemical/biological processes.
2. Graduates are successfully employed and advancing in governmental and industrial positions requiring chemical engineering expertise.
3. Graduates are prepared to succeed in graduate and professional programs.

At the time of your graduation, you will have the characteristics described by the following **Chemical Engineering Student Outcomes.**

- a. Ability to apply mathematics, science and engineering principles.
- b. Ability to design and conduct experiments, analyze and interpret data.
- c. Ability to design a system, component, or process to meet desired needs.
- d. Ability to function on multidisciplinary teams.
- e. Ability to identify, formulate and solve engineering problems.
- f. Understanding of professional and ethical responsibility.
- g. Ability to communicate effectively.
- h. The broad education necessary to understand the impact of engineering solutions in a global and societal context.
- i. Recognition of the need for and an ability to engage in life-long learning.
- j. Knowledge of contemporary issues.
- k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

Where do I find more information on Chemical Engineering at SDSM&T?

Visit our webpage <http://www.sdsmt.edu/CBE/> to learn more about chemical engineering at the SDSM&T. You will learn more about industries in which you can be employed, the AIChE Safety and Chemical Education Certificate Program, profession development opportunities, scholarship opportunities, CBE laboratories, and co-op, intern, and research employment opportunities while you pursue your degree as well as new initiatives within CBE.

Chemical Engineering Curriculum/Checklist

The courses listed in the curriculum have been chosen to develop a well-rounded education, beginning with the foundations of mathematics, biology, 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, thermodynamics, computer solutions to complex engineering problems, process control, kinetics, and reactor design, all the while developing their critical thinking, general problem solving, leadership and communication skills.

Although a minor in chemical engineering is not available, you can obtain a specialization in biochemical engineering or an emphasis in emerging areas such as advanced materials, biomedical engineering, energy technology, environmental engineering, or petroleum engineering by tailoring your elective courses.

The chemical engineering faculty at SDSM&T keep the curriculum current and dynamic. As a part of this evolutionary process, the faculty continues to develop innovative approaches to teaching chemical engineering lectures and laboratories. An example of this is the integration of process design and simulation throughout the chemical engineering laboratory experiences. Sophisticated process design simulators (such as the commercial software, AspenPlus and COMSOL), are being co-integrated with process design projects. Major funding for these developments have and continue to come from the National Science Foundation and from industrial sponsors. The chemical engineering faculty is also involved in the university's Tablet PC Program. Tablet PCs have been used to explore new ways to deliver courses and integrate into the curriculum sophisticated process software. In addition, SDSM&T offers the opportunity for students and professors to interact in small groups and individual learning sessions.

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

- MATH 123 Calculus I **Credits: (4-0) 4**
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- CBE 111/111L Introduction to Chemical Process Modeling/Lab **Credits: (1-1) 2**
- ENGL 101 Composition I **Credits: (3-0) 3**
- Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 16

Second Semester

- MATH 125 Calculus II **Credits: (4-0) 4**
- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- CBE 117L Programming for Chemical and Biological Engineering **Credits: (0-1) 1**
- Humanities or Social Sciences Elective(s) **Credits: 6**

Total: 18

Sophomore Year

First Semester

- CBE 217 Chemical Engineering Material Balances **Credits: (3-0) 3**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- Biology Elective **Credits: 3**
- CHEM 326 Organic Chemistry I **Credits: (3-0) 3**
- CHEM 220L Experimental Organic Chemistry IA **Credits: (0-1) 1**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**

Total: 16

Second Semester

- CBE 218 Chemical Engineering Fluid Mechanics **Credits: (3-0) 3**
- CBE 222 Chemical Engineering Process Thermodynamics **Credits: (3-0) 3**
- CBE 250 Computer Applications in Chemical Engineering **Credits: (2-0) 2**
- CHEM 328 Organic Chemistry II **Credits: (3-0) 3**
- MATH 225 Calculus III **Credits: (4-0) 4**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**

Total: 18

Junior Year

First Semester

- CBE 317 Chemical Engineering Heat Transfer **Credits: (3-0) 3**
- CBE 321 Chemical Engineering Equilibrium Thermodynamics **Credits: (3-0) 3**
- CBE 333 Process Measurements and Control **Credits: (1-0) 1**
- CBE 333L Chemical Engineering Process Control Lab **Credits: (0-1) 1**
- CBE 361L Chemical Engineering Fluid Laboratory **Credits: (0-1) 1**
- CHEM 332 Analytical Chemistry **Credits: 2 or 3 (ChE's take 2 credit hours)**
- CHEM 332L Analytical Chemistry Lab **Credits: (0-1) 1**
- CHEM 342 Physical Chemistry I **Credits: 2 to 3 (ChE's take 2 credit hours)**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**

Total: 17

Second Semester

- CBE 318 Chemical Engineering Mass Transfer **Credits: (3-0) 3**
- CBE 343 Chemical Kinetics and Reactor Design **Credits: (3-0) 3**
- CBE 362L Chemical Engineering Heat Transfer Laboratory **Credits: (0-1) 1**
- CBE 364 Chemical Process Design, Economics, and Safety **Credits: (2-0) 2**
- CHEM 344 Physical Chemistry II **Credits: 2 to 3 (ChE's take 2 credit hours)**
- CHEM 342L Physical Chemistry I Lab **Credits: (0-1) 1**
or
- CHEM 344L Physical Chemistry II Lab **Credits: 1 to 2**
- Engineering Elective **Credits: 3**
- Humanities or Social Sciences Elective **Credits: 3**

Total: 18

Senior Year

First Semester

- CBE 417 Chemical Engineering Equilibrium Separations **Credits: (2-0) 2**
- CBE 463 Process Design for Chemical Engineering **Credits: (1-1) 2**
- CBE 465 Advanced Process and Equipment Design **Credits: (2-0) 2**
- Chemical Engineering Elective **Credits: 3**
- Department Approved Elective **Credits: 3**

Total: 12

Second Semester

- CBE 433 Process Control **Credits: (3-0) 3**
- CBE 461L Chemical Engineering Mass Transfer and Reaction Engineering Laboratory **Credits: (0-1) 1**
- CBE 466 Capstone Design for Chemical Engineering **Credits: (0-2) 2**
- CBE 487 Global and Contemporary Issues in Chemical Engineering **Credits: 1-0) 1**
- Chemical Engineering Elective **Credits: 3**
- Chemical Engineering Lab Elective **Credits: 1**
- Department Approved Elective **Credits: 4**

Total: 15

130 credits required for graduation

Curriculum Notes

Board of Regents General Education Requirements:

Students working in conjunction with their advisor need to ensure General Education Requirements are completed in the required timeframe. Hum/SS electives require 6 credit (cr) hr each from Humanities and Social Sciences.

Optional emphases and specialization in ChE:

The academic advisor recommends and approves courses to take if students are interested in an emphasis in one of these areas: advanced materials (nano materials, polymers, ceramics, materials processing, corrosion, or solid state/semi-conductors), biomedical engineering, energy technology, environmental engineering, or petroleum engineering. A specialization in biochemical engineering is also offered.

Biochemical Engineering Specialization

BIOL Elective (3 cr hr):

Select from

- BIOL 341 Microbial Processes in Engineering and Natural Sciences **Credits: (3-0) 3** (preferred)
- BIOL 371 Genetics **Credits: (3-0) 3 OR**
- Other approved by advisor.

CHE Elective (6 cr hr):

Select 6 credits from

- CBE 424/524 Molecular Modeling and Simulation **Credits: (3-0) 3**
- CBE 434/534 Design of Separation Processes **Credits: (1-0) 1**
- CBE 434L/534L Design of Separation Processes Laboratory **Credits: (0-1) 1**
- CBE 444/544 Reactor Design **Credits: (3-0) 3**
- CBE 445/545 Oxidation and Corrosion of Metals **Credits: (3-0) 3**
- CBE 450/550 Systems Analysis Applied to Chemical Engineering **Credits: 2 to 3**
- CBE 455/555 Pollution Phenomena and Process Design **Credits: (3-0) 3**
- CBE 474/574 Polymer Technology **Credits: 2 to 3**
- CBE 474L/574L Experimental Polymer Technology **Credits: (0-1) 1**
- CBE 475/575 Advances in Processing and Nanoengineering of Polymers **Credits: (2-0) 2**
- CBE 476/576 Organosilicon Polymer Chemistry and Technology **Credits: (1-0) 1**
- CBE 482/582 Upstream Oil and Gas Processing **Credits: 1 or 3**
- CBE 483/583 Petroleum Refining **Credits: 2 or 3**
- CBE 484/584 Fundamentals of Biochemical Engineering **Credits: (3-0) 3**
- CBE 484L/584L Biochemical Engineering Laboratory **Credits: (0-1) 1**
- CBE 485/585 Renewable and Sustainable Energy **Credits: (3-0) 3**
- CBE 485L/585L Renewable and Sustainable Energy Lab **Credits: (0-1) 1**
- CBE 486/586 Immuno-Engineering **Credits: 2 or 3**
- CBE 488/588 Applied Design of Experiments for the Chemical Industry **Credits: (2-0) 2**
- CBE 489/589 Composites Manufacturing **Credits: (1-0) 1**
- CBE 491 Independent Study **Credits: 1 to 3**
- CBE 492 Topics **Credits: 1 to 3**
- CBE 498 Undergraduate Research/Scholarship **Credits: Credit to be arranged. OR**
- Others approved by advisor.

CHE Lab Elective (1 cr hr):

Select 1 credit from

- CBE 434L/534L Design of Separation Processes Laboratory **Credits: (0-1) 1**
- CBE 474L/574L Experimental Polymer Technology **Credits: (0-1) 1**
- CBE 484L/584L Biochemical Engineering Laboratory **Credits: (0-1) 1**
- CBE 485L/585L Renewable and Sustainable Energy Lab **Credits: (0-1) 1**
- CBE 498 Undergraduate Research/Scholarship **Credits: Credit to be arranged.** OR
- Other approved by advisor.

Engineering Elective (3 cr hr):

Select 3 credits from engineering courses other than CBE prefix; requires advisor approval. These courses are typically at a 200 level or higher.

Department Approved Elective (7 cr hr):

Select from the following: CBE, Chem, or other approved courses to fulfill emphasis electives. These courses are typically at a 120 level or higher. May include:

- CP 297/397/497 Cooperative Education **Credits: 1 to 3 ***
- Up to three (3) credits of advanced military science **Credits: 1 to 3**
- Up to three (3) credits 300 level or above Humanities, Social Science or Business **Credits: 1 to 3**
- One (1) credit of Physical Education (PE) or Music Ensemble (MUEN)
- EXPL 285/385/485/585/685 Study Abroad Experiences **Credits: 1 to 3**

*Can take up to six (6) credits maximum

Chemistry B.S.

Contact Information

Dr. Richard Sinden (Department Head)

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Chemistry and Biological Engineering/Chemistry 2206

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Faculty

Professors, Fong and Sinden; Associate Professors Gilley, Heglund, Novak, Sani, Smirnova, and Zhu; Assistant Professor Kunza; Senior Lecturers Coble, Filipova, and Meyer; Instructors Christofferson, K. Gilcrease, and Marshall; Emeritus Professors Bang and Boyles.

Staff

Department Senior Secretary, Tara Huber; Chemical and Instrumentation Specialist, Darren Schwede.

Chemistry

The Department of Chemistry and Applied Biological Sciences offers a Bachelor of Science in Chemistry.

The Bachelor of Science in Chemistry degree fulfills the recommendations of the Committee on Professional Training of the American Chemical Society (ACS), the world's largest scientific society. Graduates with the Bachelor of Science in Chemistry are certified by ACS as having completed coursework recommended by ACS. The coursework within the department offers a broad-based and rigorous education which emphasizes a molecular approach to chemical phenomena, an approach central to the heart of any chemical field. The department offers foundation and in-depth coursework in the five major sub-disciplines of Chemistry: Analytical, Biochemistry, Inorganic, Organic, and Physical Chemistry. The Bachelor of Science in Chemistry degree requires 120 semester credits.

The department prepares students for careers in the chemical sciences by affording the intellectual, technical, and communications opportunities conducive to the development of future generations of scientists. The Department of Chemistry and Applied Biological Sciences prides itself in the 2011 opening of a new wing which houses state-of-the-art laboratory facilities and instrumentation available for cutting edge research. In 2016-2017, a \$6.5M renovation of the old Chemistry building provided new research laboratories for CABS faculty, a new teaching laboratory, and renovated classrooms. Students find opportunities to work with faculty who hold high caliber, peer-reviewed, externally-funded research grants awarded by federal agencies including the Air Force Research Laboratory, Office of Naval Research, Army Research Office, United States Department of Agriculture, the National Science Foundation, and many other agencies. This affords students opportunities to present their research at local or national biannual meetings of the American Chemical Society.

For students interested in graduate studies, the faculty of the Department of Chemistry and Applied Biological Sciences participate in several SDSM&T graduate programs including the M.S. and Ph.D. in Biomedical Engineering, M.S. and Ph.D. in Chemical and Biological Engineering, M.S. and Ph.D. Materials Engineering and Science, and Ph.D. in Nanoscience and Nanoengineering. Students opting for a graduate degree in these disciplines have the opportunity to perform cutting-edge research with a dissertation in fundamental and in-depth areas of chemistry while augmenting their chemistry background with

coursework specific to their respective graduate program of enrollment. Accelerated Masters programs, in which students can earn a M.S. in as little as one year after completion of their B.S. degree, are available for the Biomedical Engineering, Chemical and Biological Engineering, and Materials Engineering and Science degrees.

As chemistry is pervasive in the economy of the United States, graduates of the department find diverse employment opportunities in government, private, and academic sectors, and are highly sought after by employers. Additionally, the Bachelor of Science in Chemistry degree is an excellent choice as a pre-professional degree option for those students seeking further study in medicine, dentistry, pharmacy, veterinary medicine, materials science, environmental science, patent or environmental law, and education.

Advisors work closely with their assigned students in order to ensure each student completes all degree requirements in a timely manner, meets prerequisites for further education (such as medical or other professional schools), and is knowledgeable about post-graduation options and employment opportunities.

The department also offers a minor in chemistry to SDSM&T students.

Chemistry Curriculum/Checklist

The following shows the preferred curriculum for the Chemistry B.S. degree. The sequence of courses taken will depend on the academic preparation of incoming students. Students should consult with a Chemistry advisor for their individualized course of study. It is important to note that certain courses have prerequisite requirements. Moreover, as certain courses are taught every two years, curricula are shown for the junior and senior years for both even and odd year cycles.

Freshman Year

First Semester

- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- ENGL 101 Composition I **Credits: (3-0) 3**
- MATH 123 Calculus I **Credits: (4-0) 4**
- General Education Goal 3 or 4 Elective(s) **Credits: 3**
- CHEM 111 Introduction to Chemistry and Applied Biological Sciences **Credits: (1-0) 1**

Total: 15

Second Semester

- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- MATH 125 Calculus II **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- General Education Goal 3 or 4 Elective(s) **Credits: 3**

Total: 14

Sophomore Year

First Semester

- CHEM 332 Analytical Chemistry **Credits: 2 or 3³**
- CHEM 332L Analytical Chemistry Lab **Credits: (0-1) 1**
- CHEM 326 Organic Chemistry I **Credits: (3-0) 3**
- CHEM 326L Organic Chemistry I Lab **Credits: (0-2) 2**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- General Education Goal 3 or 4 Elective(s) **Credits: 3**

Total: 15

Second Semester

- CHEM 328 Organic Chemistry II **Credits: (3-0) 3**
- CHEM 328L Organic Chemistry II Lab **Credits: (0-2) 2**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- PHYS 213L University Physics II Laboratory **Credits: (0-1) 1**
- General Education Goal 3 or 4 Elective(s) **Credits: 3**

Total: 15

Junior Year

First Semester - Odd Years

- CHEM 352 Systematic Inorganic Chemistry **Credits: (3-0) 3**
- CHEM 342 Physical Chemistry I **Credits: 2 to 3** ³
- CHEM 342L Physical Chemistry I Lab **Credits: (0-1) 1**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- ¹ Elective(s) **Credits: 3**
- ² CHEM 420/520 Organic Chemistry III **Credits: (3-0) 3**
OR
- ¹ Elective(s) **Credits: 3**

Total: 16

Second Semester - Odd Years

- CHEM 344 Physical Chemistry II **Credits: 2 to 3** ³
- CHEM 344L Physical Chemistry II Lab **Credits: 1 to 2** ⁴
- CHEM 452/552 Inorganic Chemistry **Credits: (3-0) 3**
- CHEM 452L/552L Inorganic Chemistry Lab **Credits: (0-1) 1**
- ¹ Elective(s) **Credits: 6**
- ² CHEM 421/521 Spectroscopic Analysis **Credits: (3-0) 3**
OR
- ¹Elective(s) **Credits: 3**

Total: 17

First Semester - Even Years

- CHEM 352 Systematic Inorganic Chemistry **Credits: (3-0) 3**
- CHEM 342 Physical Chemistry I **Credits: 2 to 3**³
- CHEM 342L Physical Chemistry I Lab **Credits: (0-1) 1**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- CHEM 482/582 Environmental Chemistry **Credits: (3-0) 3**
- ¹Elective(s) **Credits: 3**

Total: 16

Second Semester - Even Years

- CHEM 344 Physical Chemistry II **Credits: 2 to 3**³
- CHEM 344L Physical Chemistry II Lab **Credits: 1 to 2**⁴
- CHEM 370 Chemical Literature **Credits: (1-0) 1**
- CHEM 434 Instrumental Analysis **Credits: (3-0) 3**
- CHEM 434L Instrumental Analysis Lab **Credits: (0-2) 2**
- ¹Elective(s) **Credits: 7**

Total: 17

Senior Year

First Semester - Odd Years

- CHEM 464/564 Biochemistry I **Credits: (3-0) 3**
- ¹Elective(s) **Credits: 9**
- ² CHEM 420/520 Organic Chemistry III **Credits: (3-0) 3**
OR
- ¹Elective **Credits: 3**

Total: 15

Second Semester - Odd Years

- CHEM 452/552 Inorganic Chemistry **Credits: (3-0) 3**
- CHEM 452L/552L Inorganic Chemistry Lab **Credits: (0-1) 1**
- ¹Elective(s) **Credits: 2**
- ² CHEM 421/521 Spectroscopic Analysis **Credits: (3-0) 3**
OR
- ¹Elective(s) **Credits: 3**
- ² CHEM 465/565 Biochemistry II **Credits: (3-0) 3**
OR
- ¹Elective(s) **Credits: 3**

Total: 12

First Semester - Even Years

- CHEM 482/582 Environmental Chemistry **Credits: (3-0) 3**
- CHEM 464/564 Biochemistry I **Credits: (3-0) 3**
- ¹Elective(s) **Credits: 9**

Total: 15

Second Semester - Even Years

- CHEM 370 Chemical Literature **Credits: (1-0) 1**
- CHEM 434 Instrumental Analysis **Credits: (3-0) 3**
- CHEM 434L Instrumental Analysis Lab **Credits: (0-2) 2**
- ¹ Elective(s) **Credits: 4**
- ² CHEM 465/565 Biochemistry II **Credits: (3-0) 3**

Total: 13

120 credits required for graduation

Curriculum Notes

¹Twenty-seven (27) elective credits are required. These electives can be used to tailor a degree to meet requirements for pursuit of an advanced degree.

²Three credits of advanced chemistry electives are required. Take any one of the following courses: CHEM 420/520 Organic Chemistry III , CHEM 421/521 Spectroscopic Analysis , CHEM 426/526 Polymer Chemistry or CHEM 465/565 Biochemistry II

³ Three credit option is needed for the Chemistry major or minor.

⁴ The two credit option is encouraged as CHEM 342L is being phased out of the Chemistry major.

Civil Engineering, B.S.

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Faculty

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Civil and Environmental Engineering at the School of Mines

Civil and environmental engineers are problem solvers, meeting the needs for environmental stewardship, renewable energy, sustainable design solutions, and community planning for a better tomorrow. Civil and environmental engineers serve the public by designing a wide variety of infrastructure systems such as dams and waterways, harbors, bridges, buildings, water supply and wastewater systems, highways and airports, tunnels and pipelines, and renewable energy facilities.

Students interested in a career in civil or environmental engineering follow a curriculum that culminates in a bachelor of science degree in civil engineering that is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>, 415 North Charles Street, Baltimore, MD 21201; Phone +1.410.347.7700.

The mission of the CEE Department is to provide our students with the fundamental knowledge and skills required to address the needs of society through design, research and construction, and to instill in them the desire for professionalism, leadership, and lifelong learning.

The goal of the BSCE program with regard to undergraduate education is to produce graduates, who, within a few years of graduation, will demonstrate the following **Civil Engineering Program Objectives**:

1. Engage in the professional practice of civil and environmental engineering,
2. Actively participate in professional and/or civic organizations,
3. Pursue opportunities to assume leadership roles in their professional and/or service activities, and
4. Seek to continue their educations through advanced studies in civil or environmental engineering or a related professional discipline, continuing education and/or professional development activities.

The undergraduate curriculum provides a comprehensive education for students who wish to pursue a professional career directly after graduation. The B.S. program in civil engineering also serves as a preparation for graduate studies in any of the specialized

branches of civil and environmental engineering, construction management or other professional degrees such as business, medicine, or law.

Curriculum

The civil and environmental engineering curriculum begins with students gaining fundamental understanding of humanities, social sciences, mathematics, and basic sciences. Students interested in environmental engineering may follow a curriculum specifically tailored to this important subdisciplinary area. Under civil engineering three minors are available for students to pursue; environmental engineering, sustainable engineering, and global engineering. In the senior year, a capstone design course allows students to work in multi-disciplinary teams to develop alternative solutions, incorporate sustainable design principles, perform feasibility and economic analyses, and create detailed designs. The capstone design experience culminates with a formal final written report and a presentation to the faculty and student peers.

At the time of graduation, students completing the BSCE program will be able to demonstrate the following **Civil Engineering Program Outcomes**:

- a. An ability to apply knowledge of mathematics, science, and engineering;
- b. An ability to design and conduct experiments, as well as to analyze and interpret data;
- c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
- d. An ability to function on multi-disciplinary teams;
- e. An ability to identify, formulate, and solve engineering problems;
- f. An understanding of professional and ethical responsibility;
- g. An ability to communicate effectively;
- h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
- i. A recognition of the need for, and an ability to engage in life-long learning;
- j. A knowledge of contemporary issues; and
- k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Graduate programs in civil engineering or construction management afford opportunities for motivated students to pursue advanced studies. An accelerated Master of Science (BS/MS) degree program is available for qualified seniors enrolled in engineering B.S. programs at the South Dakota School of Mines and Technology. The accelerated master's degree program allows B.S. engineering students to take up to nine (9) graduate-level credits to simultaneously meet undergraduate and graduate degree program requirements. For more information about the accelerated master's degree program, see the Civil and Environmental Engineering M.S. section of the catalog or contact CENE Graduate Coordinator Dr. Marc Robinson (Marc.Robinson@sdsmt.edu).

Department Approved Electives

The civil engineering undergraduate curriculum includes 12 credit hours of Department Approved Electives that students may use to gain knowledge and skills in a specialized area to meet their individual career goals. Students may participate in undergraduate research or scholarship, which may include international design projects or cooperative education. Students must apply for the cooperative education program prior to starting work. For more information about the cooperative education program, contact Dr. Scott Kenner (Scott.Kenner@sdsmt.edu).

Department Approved Electives include the following which are described in more detail on the department web page: <http://www.sdsmt.edu/Academics/Departments/Civil-and-Environmental-Engineering/Curriculum-and-Checklists/>

- At least 9 credits of CEE 400-level or above coursework not applied to another CEE graduation requirement.
- Up to 6 credit hours of CEE 498 (Undergraduate Research/Scholarship), CEE 491 (Independent Study) or CP 497 (Cooperative Education); not more than 3 credits may be CEE 491 or CP 497.

- Up to 3 credit hours of 300, 400, 500, or 600 level courses in engineering, science, math or computer science not applied to another CEE graduation requirement.

Professionalism

Students are encouraged to participate in the student chapter of the American Society of Civil Engineers (ASCE), Engineers and Scientists Abroad (ESA), the Center of Excellence for Advanced Manufacturing and Production (CAMP) that involves designing, building, testing, and competing in a variety of engineering challenges), or any other of the many student organizations on campus. During the senior year, students are strongly encouraged to take the Fundamentals of Engineering (F.E.) examination. Passing the F.E. examination is the first step toward registration as a Professional Engineer (P.E.). The second and final step in the registration process is the successful completion of the Professional Engineering examination, which is normally taken after working under the supervision of a P.E. for at least four years.

Mines Advantage Program

Mines Advantage is an optional professional development program designed for all SD Mines students. Participating students will go through 30 total experiences in 6 core competency areas. Experiences include everything from attending a cultural event to participating in a mock interview with the career center. Additional information can be found at: <http://www.sdsmt.edu/MinesAdvantage/>

SD Mines Honors Program

Students can apply to be accepted into the Honors program when they enter as a Freshman through the end of their sophomore year. Challenging academics is a given at Mines, where most of our entering students would qualify for the academically-oriented honors programs at most universities. That's why our Honors program is different. It's designed to challenge and develop exceptional students beyond academics: developing leadership by solving problems that benefit others. Additional information can be found at: <http://www.sdsmt.edu/honors/>

EPICS

EPICS is an academic program where undergraduate students earn course credits for participation in teams that tackle real-world projects and benefit real communities. Students can participate in EPICS at any time during their degree program. Additional information can be found at: <http://www.sdsmt.edu/EPICS/>

Civil Engineering Curriculum/Checklist

Students pursuing a traditional civil engineering education will follow the curriculum below. The BSCE curriculum for the environmental engineering emphasis is shown separately. Civil Engineering, B.S. - Environmental Engineering Emphasis.

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog. Other advising information is available through the department.

Freshman Year

First Semester

- ENGL 101 Composition I **Credits: (3-0) 3**
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- ² MATH 123 Calculus I **Credits: (4-0) 4**
- CEE 130/130L Introduction to Civil and Environmental Engineering/Lab **Credits: (1-1) 2**
- ¹ Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 16

Second Semester

- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- MATH 125 Calculus II **Credits: (4-0) 4**
- CEE 117/117L Introduction to CADD/Lab **Credits: (1-1) 2**
- ² EM 214 Statics **Credits: (3-0) 3**
- ¹ Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 18

Sophomore Year

First Semester

- MATH 225 Calculus III **Credits: (4-0) 4**
- CEE 206/206L Engineering Surveys I/Lab **Credits: (2-1) 3**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- ² EM 331 Fluid Mechanics **Credits: (3-0) 3**
- ¹ Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 16

Second Semester

- ² CEE 326 Environmental Engineering I **Credits: (3-0) 3**
- CEE 284 Applied Numerical Methods **Credits: (3-0) 3**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- ME 221 Dynamics of Mechanisms **Credits: (3-0) 3**
- ² EM 321 Mechanics of Materials **Credits: (3-0) 3**
- ¹ Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 18

Junior Year

First Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- CEE 316/316L Engineering and Construction Materials/Lab **Credits: (2-1) 3**
- ² CEE 336/336L Hydraulic Systems Design/Lab **Credits: (2-1) 3**
- ² CEE 346/346L Geotechnical Engineering/Lab **Credits: (2-1) 3**
- ² CEE 353 Structural Theory **Credits: (3-0) 3**

Total: 15

Second Semester

- CEE 325 Introduction to Sustainable Design **Credits: (3-0) 3**
- GEOE 221/221L Geology for Engineers/Lab **Credits: (2-1) 3**
OR
- GEOL 201 Physical Geology **Credits: (3-0) 3**

Three of the following four courses

- CEE 327/327L Environmental Engineering II/Lab **Credits: (2-1) 3**
- CEE 337 Engineering Hydrology **Credits: (3-0) 3**
- CEE 347 Geotechnical Engineering II **Credits: (3-0) 3**
- CEE 456 Concrete Theory & Design **Credits: (3-0) 3**

Total: 15

Senior Year

First Semester

- ³ CEE Department Approved Elective(s) **Credits: 6**
- IENG 302 Engineering Economics **Credits: (3-0) 3**
- CEE 463 Concepts of Professional Practice **Credits: (2-0) 2**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**
- ¹Advanced Humanities or Social Sciences Elective **Credit: 3**

Total: 17

Second Semester

- CEE 474/574 Construction Engineering and Management **Credits: (3-0) 3**
- ³ CEE Department Approved Elective(s) **Credits: 6**
- ⁴ CEE 489 Capstone Design Project **Credits: (0-3) 3**
- ⁵ Science/Math Elective **Credits: 3**

Total: 15

130 credits required for graduation

Curriculum Notes

¹ Consult the section of the catalog addressing graduation requirements for a description of the combinations of lower level (1xx/2xx) social sciences and humanities courses meeting the SDBOR General Education Goals #3 and #4. Students must complete at least 3 credits at an advanced level (300 or above).

² Students must earn a "C" or better in the following courses to advance in the program: MATH 123, EM 214, EM 321, EM 331, CEE 326, CEE 336/336L, CEE 346/346L, CEE 353.

³ At least 9 credits of CEE 400-level or above coursework not applied to another CEE graduation requirement.

⁴ Prerequisites for CEE 489 are: CEE 326, CEE 336/336L, and CEE 346/346L all with a "C" or better.

⁵ Basic science electives

Civil Engineering, B.S. - Environmental Engineering Emphasis

Contact Information

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E-mail: Venkata.Gadhamshetty@sdsmt.edu

Faculty

Professors Kenner and Stone; Associate Professors Robinson, Capehart, Benning, and Gadhamshetty; Assistant Professors Arneson-Meyer, Shearer, Whitaker, Geza, and Waterman; Instructor Bienert.

Environmental Engineering Emphasis, BS Civil Engineering at School of Mines

Environmental engineering is an important emphasis area in the broad field of civil engineering. Environmental engineers design systems and solve pressing global problems in all areas related to the environment and public health: sustainable design of drinking water treatment and distribution, wastewater treatment, and solid and hazardous waste disposal systems; development of air quality monitoring and pollution prevention programs; design of site remediation and mining reclamation programs; and development of ecosystem protection and restoration efforts, among others.

Students interested in a career in environmental engineering at the School of Mines follow a curriculum with an emphasis in environmental engineering that culminates in a bachelor of science degree in civil engineering that is accredited by the Engineering Accreditation Commission of ABET, www.abet.org, 415 North Charles Street, Baltimore, MD 21201; Phone +1.410.347.7700.

The mission of the CEE Department is to provide our students with the fundamental knowledge and skills required to address the needs of society through design, research and construction, and to instill in them the desire for professionalism, leadership, and lifelong learning.

The goal of the BSCE program with regard to undergraduate education is to produce graduates, who, within a few years of graduation, will demonstrate the following **Civil Engineering Program Objectives**:

1. Engage in the professional practice of civil and environmental engineering,
2. Actively participate in professional and/or civic organizations,
3. Pursue opportunities to assume leadership roles in their professional and/or service activities, and
4. Seek to continue their educations through advanced studies in civil or environmental engineering or a related professional discipline, continuing education and/or professional development activities.

The undergraduate curriculum provides a comprehensive education for students who wish to pursue a professional career directly after graduation. The B.S. program in civil engineering also serves as preparation for graduate studies in any of the specialized branches of environmental or civil engineering, construction management or other professional degrees such as medicine or law.

Curriculum

The curriculum for the BSCE with environmental engineering emphasis includes courses in the liberal arts, higher mathematics, basic sciences, engineering sciences, and engineering design. Civil and environmental engineers often work on interdisciplinary teams to solve complex system design problems, so a broad background in engineering fundamentals and the natural sciences is essential. Students will take courses in environmental, geotechnical, water resources, construction, and sustainable engineering, as well as related chemical engineering courses, to prepare them for a career and/or additional studies.

In the senior year, a capstone design course allows students to work in multi-disciplinary teams to develop alternative solutions, incorporate sustainable design principles, perform feasibility and economic analyses, and create detailed designs. The capstone design experience culminates with a formal final written report and a presentation to the faculty and the students' peers. Minors in environmental engineering, sustainable engineering, and global engineering are also available.

At the time of graduation, students completing the BSCE program will be able to demonstrate the following **Civil Engineering Program Outcomes**:

- a. An ability to apply knowledge of mathematics, science, and engineering;
- b. An ability to design and conduct experiments, as well as to analyze and interpret data;
- c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
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- i. A recognition of the need for, and an ability to engage in life-long learning;
- j. A knowledge of contemporary issues; and
- k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Graduate programs in civil and environmental engineering or construction engineering and management afford opportunities for motivated students to pursue advanced studies. An accelerated Master of Science (BS/MS) degree program is available for qualified seniors enrolled in engineering B.S. programs at the South Dakota School of Mines. The accelerated master's degree program allows B.S. engineering students to take up to nine (9) graduate-level credits to simultaneously meet undergraduate and graduate degree program requirements. For more information about the accelerated master's degree program, see the Civil and Environmental Engineering, M.S. section of the catalog or contact the CENE Graduate Coordinator Dr. Marc Robinson, (Marc.Robinson@sdsmt.edu).

Department Approved Electives

The curriculum for the BSCE with environmental engineering emphasis includes 15 credit hours of Department Approved Electives that students may use to gain knowledge and skills to meet their individual career goals. Students may participate in undergraduate research or scholarship, which may include international design projects, or cooperative education. Students must apply for the cooperative education program prior to starting work. For more information about the cooperative education program, contact Dr. Scott Kenner, (scott.kenner@sdsmt.edu).

Department Approved Electives include the following, and a list can also be found on the departmental web page: www.sdsmt.edu/Academics/Departments/Civil-and-Environmental-Engineering/Curriculum-and-Checklists/

- At least 9 credits of CEE 400-level or above coursework not applied to another CEE graduation requirement.
- Up to 6 credit hours of CEE 498 (Undergraduate Research/Scholarship), CEE 491 (Independent Study) or CP 297/397/497 (Cooperative Education); not more than 3 credits may be CEE 491 or CP 297/397/497.

- Up to 3 credit hours of 300, 400, 500, or 600 level courses in engineering, science, math or computer science not applied to another CEE graduation requirement.

Professionalism

Students are encouraged to participate in the student chapter of the American Society of Civil Engineers (ASCE), Engineers and Scientists Abroad (ESA), the Center of Excellence for Advanced Manufacturing and Production (CAMP) that involves designing, building, testing, and competing in a variety of engineering challenges), or any other of the many student organizations on campus. During the senior year, students are strongly encouraged to take the Fundamentals of Engineering (F.E.) examination. Passing the F.E. examination is the first step toward registration as a Professional Engineer (P.E.). The second and final step in the registration process is the successful completion of the Professional Engineering examination, which is normally taken after working under the supervision of a P.E. for at least four years.

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SD Mines Honors Program

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EPICS

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Environmental Engineering Emphasis Curriculum/Checklist

Freshman Year

First Semester

- ENGL 101 Composition I **Credits: (3-0) 3**
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- ² MATH 123 Calculus I **Credits: (4-0) 4**
- CEE 130/130L Introduction to Civil and Environmental Engineering/Lab **Credits: (1-1) 2**
- ¹Humanities or Social Science Elective **Credits: 3**

Total: 16

Second Semester

- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- MATH 125 Calculus II **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- ² EM 214 Statics **Credits: (3-0) 3**
- ¹Humanities or Social Science Elective(s) **Credits: 3**

Total: 17

Sophomore Year

First Semester

- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- MATH 225 Calculus III **Credits: (4-0) 4**
- CHEM 332 Analytical Chemistry **Credits: 2 or 3**
- ² EM 331 Fluid Mechanics **Credits: (3-0) 3**
- CBE 217 Chemical Engineering Material Balances **Credits: (3-0) 3**
- ¹Humanities or Social Science Elective **Credits: 3**

Total: 18

Second Semester

- ^{2,5} CEE 326 Environmental Engineering I **Credits: (3-0) 3**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- CBE 222 Chemical Engineering Process Thermodynamics **Credits: (3-0) 3**
- CEE 284 Applied Numerical Methods **Credits: (3-0) 3**
- ² EM 321 Mechanics of Materials **Credits: (3-0) 3**
- ¹ Humanities or Social Science Elective(s) **Credits: 3**

Total: 18

Junior Year

First Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- CEE 426/526 Environmental Engineering Unit Operations and Processes **Credits: (3-0) 3**
- CEE 316/316L Engineering and Construction Materials/Lab **Credits: (2-1) 3**
- ^{2, 5} CEE 336/336L Hydraulic Systems Design/Lab **Credits: (2-1) 3**
- ^{2, 5} CEE 346/346L Geotechnical Engineering/Lab **Credits: (2-1) 3**

Total: 15

Second Semester

- CEE 325 Introduction to Sustainable Design **Credits: (3-0) 3**
- CEE 327/327L Environmental Engineering II/Lab **Credits: (2-1) 3**
- CEE 337 Engineering Hydrology **Credits: (3-0) 3**
- CEE 427/527 Environmental Engineering Biological Process Design **Credits: (3-0) 3**
- CEE 426/526 Environmental Engineering Unit Operations and Processes **Credits: (3-0) 3**
- GEOE 221/221L Geology for Engineers/Lab **Credits: (2-1) 3**
- **OR**
- GEOL 201 Physical Geology **Credits: (3-0) 3**
- IENG 301 Basic Engineering Economics **Credits: (2-0) 2**

Total: 17

Senior Year

First Semester

- CEE 463 Concepts of Professional Practice **Credits: (2-0) 2**
- ³ CEE Department Approved Elective(s) **Credits: 9**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**

Total: 14

Second Semester

- CEE 474/574 Construction Engineering and Management **Credits: (3-0) 3**
- ⁴ CEE Department Approved Elective(s) **Credits: 6**
- ¹ Humanities or Social Science Elective **Credits: 3**
- ⁵ CEE 489 Capstone Design Project **Credits: (0-3) 3**

Total: 15

130 credits required for graduation

Curriculum Notes

¹ Consult the section of the catalog addressing graduation requirements for a description of the combinations of lower level (1xx/2xx) social sciences and humanities courses meeting the SDBOR General Education Goals #3 and #4. Students must complete at least 3 credits at an advanced level (300 or above).

² Students must earn a "C" or better in the following courses to advance in the program: MATH 123, EM 214, EM 321, EM 331, CEE 326, CEE 336/336L, and CEE 346/346L.

³ At least 9 credits of CEE 400-level or above course work not applied to another CEE graduation requirement.

⁴ (6 credits) Choose from BIOL 341, CBE 455/555, CEE 421/521, CHEM 326, CHEM 482/582, GEOE 475/475L/575/575L, and MEM 405.

⁵ Prerequisites for CEE 489 are: CEE 326, CEE 336/336L, and CEE 346/346L, all with a "C" or better.

Computer Engineering, B.S.

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Faculty

Professors Corwin, Sohraby and Weiss; Associate Professors Pyeatt, McGough, Hoover, Tolle, and Montoya; Assistant Professor Zhao; Instructor Linde; Professor Emeritus and Senior Lecturer Batchelder; Professors Emeritus Cox, McNeil, Meiners, Opp, and Oliver.

Computer Engineering

The computer engineering curriculum prepares students for life-long careers 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 a number of 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 vision, robotics, and computer architecture.

The bachelor of science program in computer engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org, 415 North Charles Street, Baltimore, MD 21201; Phone (410) 347-7700.

Mission

The mission of the computer engineering program, in support of the mission of School of Mines, is to provide computer engineering students with education that is broadly based in the fundamentals of the profession so that graduates will be able to maintain a high degree of adaptability throughout their professional careers. It is also intended that the students will develop a dedication to the profession, assume leadership roles, and an ability to maintain professional competency through a program of life-long learning.

Objectives

1. Graduates will be able to successfully practice computer engineering and related fields regionally, nationally, and globally.
2. Graduates will be well-educated in the fundamental and applied concepts of computer engineering and be able to continue their professional development throughout their careers.
3. Graduates will be skilled in clear communications and teamwork and capable of functioning responsibly and ethically in diverse environments.

4. Graduates will be prepared to demonstrate leadership in outreach, innovation and invention.

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, which are often multidisciplinary. This foundation provides students with a broad base of understanding that allows them to apply their knowledge of scientific and engineering principles to the practical and innovative solutions of existing and future problems.

Students are required to develop a high level of written and oral communication skills and to work well as a member of a team. They must develop a social and ethical awareness so they understand their responsibility to protect both the occupational and public health and safety and to implement these factors in their professional activities. Students are encouraged to participate in the activities of professional societies, such as the Institute of Electrical and Electronics Engineers (IEEE), 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;
- Senior elective courses;
- Senior capstone experience; and
- Participation in competitive team projects such as the Robotics team, the Alternative Fuel Vehicle Team, the Unmanned Aerial Vehicle Team, Lunar Regolith Mining, and the Formula SAE Mini-Indy Team.

Graduate School Opportunities

The undergraduate curriculum is broad based to give graduates flexibility in their career paths. Qualified students may study areas of interest in more depth and specialize further by pursuing a graduate program at the School of Mines.

Computer Engineering Curriculum/Checklist

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog.

The computer engineering program utilizes the Fundamentals of engineering (FE) exam taken by students prior to graduation for program assessment.

Freshman Year

First Semester

- MATH 123 Calculus I **Credits: (4-0) 4**
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- CENG 244/244L Introduction to Digital Systems/Lab **Credits: (3-1) 4**
- Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 15

Second Semester

- ENGL 101 Composition I **Credits: (3-0) 3**
- MATH 125 Calculus II **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- Humanities or Social Sciences Elective(s) **Credits: 3**
- CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**

Total: 16

Sophomore Year

First Semester

- EE 220/220L Circuits I/Lab **Credits: (3-1) 4**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- PHYS 213L University Physics II Laboratory **Credits: (0-1) 1**
- CENG 264L Electromechanical Systems Product Development and Design Lab **Credits: (0-2) 2**
- CSC 215 Programming Techniques **Credits: (4-0) 4**

Total: 17

Second Semester

- ² CSC 251 Finite Structures **Credits: 2 or 4**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- EE 221/221L Circuits II/Lab **Credits: (3-1) 4**
- Humanities or Social Sciences Elective(s) **Credits: 3**
- MATH 225 Calculus III **Credits: (4-0) 4**

Total: 18

Junior Year

First Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- EE 320/320L Electronics I/Lab **Credits: (3-1) 4**
- EE 313 Signals and Systems **Credits: (3-0) 3**
- CENG 351/351L Mechatronics and Measurement Systems **Credits: (3-1) 4**
- CSC 315 Data Structures & Algorithms **Credits: (4-0) 4**

Total: 18

Second Semester

- EM 216 Statics and Dynamics **Credits: (4-0) 4**
- EE 314/314L Control Systems/Lab **Credits: (3-1) 4**
- CENG 447/447L/547/547L Embedded Systems **Credits: (3-1) 4**
- CENG 342/342L Digital Systems/Lab **Credits: (3-1) 4**

Total: 16

Senior Year

First Semester

- IENG 301 Basic Engineering Economics **Credits: (2-0) 2**
- CENG 464 Senior Design Project I **Credits: (0-2) 2**
- CENG Senior Elective(s) **Credits: 4**
- CENG 448/448L/548/548L Real-Time Operating Systems **Credits: (3-1) 4**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**

Total: 15

Second Semester

- CENG 465 Senior Design Project II **Credits: (0-2) 2**
- CENG Senior Elective(s) **Credits: 7**
- Humanities or Social Sciences Elective **Credits: 3**
- ¹Approved Math/Sciences Electives: **Credits: 3**

Total: 15

130 credits required for graduation

Curriculum Notes

¹ Approved basic math/science courses must be at 300-level or higher with prefixes MATH, PHYS, CHEM.

² Four (4) credit version is required for CENG majors.

CENG Senior Electives

Any regular CENG, CSC, or EE 4xx, dual-listed 5xx, or 6xx course may be used toward the CENG senior electives requirement with the exceptions of CENG 464/CSC 464/EE 464, CENG 465/CSC 465/EE 465, CENG 447/447L/547/547L, CENG 448/448L/548/548L, and EE 505/505L. A maximum of four (4) co-op credits, CENG/CSC/EE 491/591/691, CENG/CSC/EE 492/592/692, and/or CENG/CSC/EE 498 may be used toward the CENG senior electives requirement if a written request presented by the student is approved by the ECE faculty. The student request must justify that the CENG design requirement is met. Additional courses approved toward the CENG senior electives requirement are listed below.

- CSC 314/314L Assembly Language/Lab **Credits: (2-1) 3**
- CSC 340 Software Engineering and Design **Credits: (3-0) 3**
- EE 322/322L Electronics II/Lab **Credits: (3-1) 4**
- EE 330/330L Energy Systems/Lab **Credits: (3-1) 4**
- EE 362 Electric and Magnetic Properties of Materials **Credits: (3-0) 3**
- EE 381 Electric and Magnetic Fields **Credits: (3-0) 3**
- EE 382 Applied Electromagnetics **Credits: (3-0) 3**

Computer Science, B.S.

Computer Science B.S.

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Faculty

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Computer Science Major

The primary goal of the computer science program is to prepare graduates to enter a dynamic and rapidly changing field as competent computer scientists. Graduates are expected to be capable in all phases of software development including design, development, and testing. Graduates should also 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. Graduates must be able to read and comprehend the literature of the discipline and be sufficiently well-versed in general theory to allow growth within the discipline as it advances. Most of the graduates will 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.

The bachelor of science program in computer science is accredited by the Computing Accreditation Commission of ABET, www.abet.org, 415 North Charles Street, Baltimore, MD 21201; Phone +1.410.347.7700

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.

A computer science major must complete a minimum of 15 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. It is also important to refer to the general education core requirements under bachelor of science graduation requirements for further information. Students must complete the general education core requirements within the first 64 credits.

Any computer science major desiring a minor in another field should consult his or her advisor in the Department of Mathematics and Computer Science as early in his or her program of study as possible. The Office of the Registrar and Academic Services has a form that must be signed by the student and the department heads of both departments involved.

Mathematics Double Major

Due to the large number of courses common to the computer science major and the mathematics major, many students find it attractive to pursue a double major in these two areas. Students seeking the double major should consult their advisors for details about this option.

Accelerated Masters Option

The B.S. in Computer Science program has aligned with the M.S. in Computational Sciences and Robotics (CSR) program. The accelerated option allows for students to complete both the B.S. program and the M.S. program in five years. Students interested in this program need to apply to the CSR program before or during their junior year. Students accepted into the program can apply up to ten credits of graduate courses towards their undergraduate degree and these same courses will apply to their graduate program of study. Students should inquire about this program at the department office or contact the CSR program coordinator.

Computer Science Curriculum

For the bachelor of science in Computer Science, a student must:

1. Take all of the courses listed in the Computer Science curriculum checklist;
2. Successfully complete a minimum of 4 computer science elective courses from the following list: CSC 410/510, CSC 412/512, CSC 414/514, CSC 415/415L/515/515L, CSC 416/516, CSC 426/526, CSC 433/533, CSC 441/541, CSC 442/542, CSC 445/545, CSC 447/547, CSC 449/549, CSC 454/554, CSC 476/476L/576/576L, and CENG 444/444L/544/544L. A 3-credit Co-op (CP 497) may be substituted for, at most, one computer science elective. Special topics and independent study courses may not be used to satisfy the computer science elective requirement.; and
3. Have a departmental grade point average of at least 2.00 in all CSC courses 300 level or higher. (Courses taken more than once will have only the higher grade counted for computing the departmental grade point average.)
4. Course requirements for the program also include the total number of credits per course. Any student that has an approved course for transfer will fulfill the course requirement, but if the transferred course does not meet the total credit hour requirement then the program committee will decide on the proper accommodation for meeting the total credit hour requirement. Students should consult with their advisor to get clarification on the necessary accommodation.

Computer Science Curriculum/Checklist

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

- ENGL 101 Composition I **Credits: (3-0) 3**
- MATH 123 Calculus I **Credits: (4-0) 4**
- CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**
- ¹Humanities or Social Sciences Elective(s) **Credits: 3**
- CSC 110 Survey of Computer Science and Mathematics **Credits: (1-0) 1**

Total: 14

Second Semester

- MATH 125 Calculus II **Credits: (4-0) 4**
- ¹Humanities or Social Sciences Elective(s) **Credits: 3**
- CSC 250 Computer Science II **Credits: (4-0) 4**
- ² CSC 251 Finite Structures **Credits: 2 or 4**

Total: 15

Sophomore Year

First Semester

- CSC 300 Data Structures **Credits: (4-0) 4**
- MATH 225 Calculus III **Credits: (4-0) 4**
- CSC 314/314L Assembly Language/Lab **Credits: (2-1) 3**
- ¹Humanities or Social Science Elective(s) **Credits: 3**

Total: 14

Second Semester

- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- CSC 484 Database Management Systems **Credits: (3-0) 3**
- MATH 315 Linear Algebra **Credits: (3-0) 3**
- ¹Humanities or Social Sciences Elective(s) **Credits: 3**
- ¹Science Elective **Credits: 3**
- ¹Science Elective Lab **Credits: 1**

Total: 16

Junior Year

First Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- CSC 317 Computer Organization and Architecture **Credits: (3-0) 3**
- CSC 372 Analysis of Algorithms **Credits: (3-0) 3**
- ¹Science Elective **Credits: 3**
- ¹Science Elective Lab **Credits: 1**

Total: 15

Second Semester

- CSC 456/456L Operating Systems/Lab **Credits: (3-1) 4**
- CSC 470 Software Engineering **Credits: (3-0) 3**
- ¹Elective or CSC Elective **Credits: 9**

Total: 16

Senior Year

First Semester

- CSC 461 Programming Languages **Credits: (4-0) 4**
- CSC 464 Senior Design I **Credits: (2-0) 2**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**
- ¹Humanities or Social Sciences Elective(s) **Credits: 3**
- ¹Elective or CSC Elective **Credits: 3**

Total: 15

Second Semester

- CSC 468/568 Graphical User Interface Programming **Credits: (3-0) 3**
- CSC 465 Senior Design II **Credits: (2-0) 2**
- ¹Elective or CSC Elective **Credits: 6**
- ¹Elective or MATH Elective **Credits: 3**

Total: 14

120 credits required for graduation

Curriculum Notes

- CSC 464/CSC 465 is a two-course sequence in senior design. It is expected that the course sequence will be taken in successive semesters.
- An exit exam, such as the Major Field Achievement Test in Computer Science, will be given as part of CSC 465. The overall results of this exam will be used to assess the computer science program.
- CHEM 106, CSC 105, MATH 021, MATH 101, MATH 102, MATH 120, PHYS 111, and PHYS 113 may not be counted towards the Computer Science degree.

¹ Elective courses must be chosen to satisfy all of the following requirements.

- Fifteen semester hours in humanities or social science. At least 6 hours must be in humanities and at least 6 hours must be in social sciences.
- Six credit hours of humanities and 6 credit hours of social science must be completed within the first 64 hours. It is important to refer to the general education requirements under bachelor of science graduation requirements for further information.
- A minimum of 4 computer science elective courses from the following list: CSC 410/510, CSC 412/512, CSC 414/514, CSC 415/415L/515/515L, CSC 416/516, CSC 426/526, CSC 433/533, CSC 441/541, CSC 442/542, CSC 445/545, CSC 447/547, CSC 449/549, CSC 454/554, CSC 476/476L/576/576L, and CENG 444/444L/544/544L. A 3-credit Co-op (CP 497) may be substituted for, at most, one computer science elective. Special topics and independent study courses may not be used to satisfy the computer science elective requirement;
- The eleven credit science requirement for this major consists of PHYS 211/211-A and two more lecture courses from among BIOL 151, BIOL 153, CHEM 112, CHEM 114, GEOL 201, or PHYS 213/213-A; plus two labs that accompany the science courses taken, i.e., either BIOL 151L, BIOL 153L, CHEM 112L, CHEM 114L, GEOL 201L, or PHYS 213L. Students must complete science classes from at least two different disciplines.
- The math elective includes any course from the following list: MATH 321, MATH 381, MATH 382, MATH 413, MATH 421, MATH 423, or MATH 443/543 .

²CSC 251 must be taken for four credits to apply towards the Computer Science major.

Electrical Engineering, B.S.

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Faculty

Professors Sohraby and Whites; Associate Professors Hoover, Montoya, Tolle, and Anagnostou; Assistant Professor Zhao; Instructors Linde and Rausch; Professor Emeritus and Senior Lecturer Batchelder; Professors Emeritus Cox, McNeil, Meiners, Opp, Simonson and Oliver.

Electrical Engineering

The electrical engineering curriculum prepares students for life-long careers 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 and control systems, and properties of materials. Electrical engineering students are required to select a number of 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, microwave engineering, antenna engineering, and computer systems.

The bachelor of science program in electrical engineering is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>, 415 North Charles Street, Baltimore, MD 21201; Phone +1.410.347.7700.

Mission

The mission of the electrical engineering program, in support of the mission of School of Mines, is to provide electrical engineering students with education that is broadly based in the fundamentals of the profession so that graduates will be able to maintain a high degree of adaptability throughout their professional careers. It is also intended that the students will develop a dedication to the profession, assume leadership roles, and an ability to maintain professional competency through a program of lifelong learning.

Objectives

1. Graduates will be able to successfully practice electrical engineering and related fields regionally, nationally, and globally.
2. Graduates will be well-educated in the fundamental and applied concepts of electrical engineering and be able to continue their professional development throughout their careers.
3. Graduates will be skilled in clear communications and teamwork and capable of functioning responsibly and ethically in diverse environments.

4. Graduates will be prepared to demonstrate leadership in outreach, innovation and invention.

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 members of a team. They must develop a social and ethical awareness so they understand their responsibility to protect both occupational and public health and safety and to implement these factors in their professional activities. Students are encouraged to participate in the activities of professional societies, such as the Institute of Electrical and Electronics Engineers (IEEE), 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;
- Senior elective courses;
- Senior capstone experience; and
- Participation in competitive team projects such as the Robotics Team, the Alternative Fuel Vehicle Team, the Unmanned Aerial Vehicle Team, Lunar Regolith Mining, and the Formula SAE Mini-Indy Team.

Graduate School Opportunities

The undergraduate curriculum is broadly based to give graduates flexibility in their career paths. Qualified students may study areas of interest in more depth and specialize further by pursuing a graduate program at the School of Mines.

Undergraduate students with strong interest and background in Electrical Engineering may choose to apply for the accelerated BS/MS in Electrical Engineering at the beginning of their junior year.

Electrical Engineering Curriculum/Checklist

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog.

The Electrical Engineering program utilizes the Fundamentals of Engineering (FE) exam taken by students prior to graduation for program assessment.

Freshman Year

First Semester

- MATH 123 Calculus I **Credits: (4-0) 4**
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- CENG 244/244L Introduction to Digital Systems/Lab **Credits: (3-1) 4**
- Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 15

Second Semester

- ENGL 101 Composition I **Credits: (3-0) 3**
- MATH 125 Calculus II **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- Humanities or Social Sciences Elective(s) **Credits: 3**
- CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**

Total: 16

Sophomore Year

First Semester

- EE 220/220L Circuits I/Lab **Credits: (3-1) 4**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- PHYS 213L University Physics II Laboratory **Credits: (0-1) 1**
- Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 17

Second Semester

- EM 216 Statics and Dynamics **Credits: (4-0) 4**
- EE 221/221L Circuits II/Lab **Credits: (3-1) 4**
- MATH 225 Calculus III **Credits: (4-0) 4**
- EE 351/351L Mechatronics and Measurement Sys/Lab **Credits: (3-1) 4**
- EE 264L Electromechanical Systems Product Development and Design Lab **Credits: (0-2) 2**

Total: 18

Junior Year

First Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- EE 313 Signals and Systems **Credits: (3-0) 3**
- EE 320/320L Electronics I/Lab **Credits: (3-1) 4**
- EE 362 Electric and Magnetic Properties of Materials **Credits: (3-0) 3**
OR
- * PHYS 439/539 Solid State Physics **Credits: 4**
- EE 381 Electric and Magnetic Fields **Credits: (3-0) 3**

Total: 16

Second Semester

- EE 314/314L Control Systems/Lab **Credits: (3-1) 4**
- EE 322/322L Electronics II/Lab **Credits: (3-1) 4**
- EE 330/330L Energy Systems/Lab **Credits: (3-1) 4**
- EE 382 Applied Electromagnetics **Credits: (3-0) 3**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**

Total: 18

Senior Year

First Semester

- IENG 301 Basic Engineering Economics **Credits: (2-0) 2**
- EE 464 Senior Design Project I **Credits: (0-2) 2**
- ²EE Electrical Engineering Senior Elective(s) **Credits: 8**
- ³Free Elective **Credits: 3**

Total: 15

Second Semester

- EE 465 Senior Design Project II **Credits: (0-2) 2**
- ²EE Electrical Engineering Senior Elective **Credits: 3**
- ⁴Technical Elective **Credits: 3**
- Humanities or Social Sciences Elective(s) **Credits: 3**

Choose 4 Credits From Either:

- ¹ CENG 447/447L/547/547L Embedded Systems **Credits: (3-1) 4**
OR
- ¹ ME 211 Introduction to Thermodynamics **Credits: (3-0) 3**
with Free Elective **Credits: 1**

Total: 15

130 credits required for graduation

Curriculum Notes

¹ Students must choose to take 4 credits from either CENG 447/447L/547/547L Credits: **(3-1) 4 or ME 211 Credits: (3-0) 3** plus one credit free elective.

² Eleven electrical engineering senior elective credits required.

³ A free elective is any college level course 100 level or above that is acceptable toward an engineering or science degree. Military science courses, 100 level and above, apply as free electives only; substitution for departmental, technical, humanities, or social science electives is not permitted.

⁴ A technical elective is any science or engineering course 200 level or above that does not duplicate the content of any other course required for graduation. Co-op credits may be used for technical elective credit. A maximum of 6 co-op credits may be used for the EE degree.

* EE students are required to take the three credit version. They may take the four credit version at their own discretion.

EE Senior Electives

Any regular CENG, CSC, or EE 4xx, dual-listed 5xx, or 6xx course may be used toward the EE senior electives requirement with the exceptions of CENG 464/CSC 464/EE 464, CENG 465/CSC 465/EE 465, CENG 447/447L/547/547L (if used in place of ME 211), and EE 505/505L. A maximum of four (4) co-op credits, CENG/CSC/EE 491/591/691, CENG/CSC/EE 492/592/692, and/or CENG/CSC/EE 498 may be used toward the EE senior electives requirement if a written request presented by the student is approved by the ECE faculty. The student request must justify that the EE design requirement is met. Additional courses approved toward the EE senior electives requirement are listed below.

- CSC 314/314L Assembly Language/Lab **Credits: (2-1) 3**
- CENG 342/342L Digital Systems/Lab **Credits: (3-1) 4**
- CSC 340 Software Engineering and Design **Credits: (3-0) 3**

Geological Engineering, B.S.

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Supporting Faculty

Professors Duke, Masterlark, Price and Uzunlar; Assistant Professors Baran and Ustunisik; Adjunct Faculty M. Anderson, Iles, Roggenthen, and Valder.

Geological Engineering

Geological engineering is the development and conservation of natural resources in ways useful to humankind. It encompasses diverse fields such as groundwater resources, subsurface contamination, slope stability, environmental site design, and mineral and petroleum exploration and production. Instruction in geological engineering provides training at both the undergraduate and graduate levels through the Ph.D.

Geological Engineering (GEOE) as a relatively rare degree program that only 13 schools in the U.S. offer. The degree bridges the gap between the science of geology and multiple engineering disciplines including mining, civil, petroleum and environmental engineering. As such, the curriculum that students complete as part of the degree is very diverse, with courses covering topics in geology, the engineering disciplines stated above, and engineering topics unique to geological engineering.

The GEOE program at SD Mines prides itself in providing a hands-on field based education. Students spend a large amount of instruction time in the field through lab and design courses, as well as a GEOE specific, six-credit field course taken between the junior and senior year. It is this significant field experience and wide breadth of expertise that sets geological engineering graduates apart from other engineering fields, and is a large contributor to why our program has such a high placement rate (89-100% over the past 20 years).

Geological Engineering Program Educational Objectives

The program educational objectives describe what graduates of the geological engineering program are expected to attain within a few years after graduation. These objectives are based on the needs of the programs constituencies.

1. Graduates of the geological engineering program will perform competently in professional practice in the areas of:
 - groundwater
 - environmental site planning and natural hazards

- geomechanics and geotechnics
 - fuels or minerals
2. Graduates will demonstrate the ability to design and implement appropriate solutions to geological engineering problems, within economic constraints, while exercising ethical responsibilities and continued professional development and/or licensure.

In support of these objectives, the program in geological engineering provides students with:

- a. an understanding of the fundamental principles of geological engineering, basic engineering, engineering economics, and geology,
- b. academic training and design experiences to prepare them for engineering practice and career advancement in the geological engineering profession during their first several years of work, and
- c. an education that prepares them to pursue advanced studies if they so desire.

Geological Engineering Education

An integral part of the educational experience is development of the ability to design solutions for meeting desired needs in geological engineering work. The design component of the curriculum is developed within geological engineering courses that integrate basic science (including geology, chemistry, and physics) and engineering science (including statics, mechanics of materials, fluid mechanics, soil mechanics, and thermodynamics). This engineering design experience includes a two-semester capstone design sequence. The capstone engineering design courses build upon and integrate previous coursework 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 life-long learning in order to embrace new technologies and to stay current within the engineering profession. Graduates with a broad range of skills, flexibility in learning new technologies, and sound training in fundamental principles can expect a competitive advantage in the job market and workplace.

The bachelor of science program in geological engineering is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>, 415 North Charles Street, Baltimore, MD 21201, Phone +1.410.347.7700.

A minor in geological engineering is not available.

Professional Development

Students in geological engineering are encouraged to participate in the Tech Geological Association as well as to become student members of the Association of Engineering Geologists (AEG), National Ground Water Association, the Society for Mining, Metallurgy, and Exploration (SME), and/or the Society of Petroleum Engineers (SPE). Students are strongly encouraged to take the Fundamentals of Engineering examination, as the first step in becoming a registered professional engineer.

Geological Engineering Curriculum/Checklist

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- MATH 123 Calculus I **Credits: (4-0) 4**
- ENGL 101 Composition I **Credits: (3-0) 3**
- GEOE 110L Introduction to Geological and Mining Engineering/Lab **Credits: (0-1) 1**
- General Education Goal 3 and Goal 4 Elective(s) **Credits: 6**

Total: 17

Second Semester

- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- MATH 125 Calculus II **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- GEOE 221/221L Geology for Engineers/Lab **Credits: (2-1) 3**
- CEE 117/117L Introduction to CADD/Lab **Credits: (1-1) 2**

Total: 16

Sophomore Year

First Semester

- EM 214 Statics **Credits: (3-0) 3**
- MATH 225 Calculus III **Credits: (4-0) 4**
- MEM 201L Surveying for Mineral Engineers **Credits: (0-2) 2**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- General Education Goal 3 Elective(s) **Credits: 3**

Total: 15

Second Semester

- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- EM 321 Mechanics of Materials **Credits: (3-0) 3**
- GEOL 212/212L Mineralogy and Crystallography/Lab **Credits: (2-1) 3**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- Gen. Ed. Goal 4 Electives **Credits: 3**

Total: 15

Junior Year

First Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- GEOL 331/331L Stratigraphy and Sedimentation/Lab **Credits: (2-1) 3**
- GEOL 341/341L Igneous and Metamorphic Petrology/Lab **Credits: (2-1) 3**
- CEE 346/346L Geotechnical Engineering/Lab **Credits: (2-1) 3**
- MET 320 Metallurgical Thermodynamics **Credits: (4-0) 4**

Total: 16

Second Semester

- GEOL 322/322L Structural Geology/Lab **Credits: (2-1) 3**
- ¹ GEOE 324/324L Engineering Geophysics I/Lab **Credits: (2-1) 3**
- EM 331 Fluid Mechanics **Credits: (3-0) 3**
- GEOL 416/416L/516/516L Introduction to GIS/Lab **Credits: (2-1) 3**
- MEM 302 Mineral Economics and Finance **Credits: (3-0) 3**

Total: 15

Summer

- ¹ GEOE 410 Engineering Field Geology **Credits: (6-0) 6**
(SD Mines students must take GEOE 410 for 6 credits.)

Total: 6

Senior Year

First Semester

- ¹ GEOE 466/466L/566/566L Engineering and Environmental Geology/Lab **Credits: (2-1) 3**
- ¹ GEOE 475/475L/575/575L Groundwater/Lab **Credits: (2-1) 3**
- ¹ GEOE 464 Geological Engineering Design Project I **Credits: (3-0) 3**
- ² Approved Elective(s) **Credits: 3**
- ³ Professional Elective(s) **Credits: 3**

Total: 15

Second Semester

- MEM 304/304L Theoretical and Applied Rock Mechanics/Lab **Credits: (2-1) 3**
- ³ Professional Elective(s) **Credits: 3**
- ¹ GEOE 465 Geological Engineering Design Project II **Credits: (3-0) 3**
- ¹ GEOE 461/561 Petroleum Drilling and Production Engineering **Credits: (3-0) 3**
- Upper Level Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 15

130 credits required for graduation

Curriculum Notes

Additional coursework in mathematics and statistics is encouraged. MATH 381 and MATH 382 are recommended statistics courses. MATH 432 is recommended for students interested in numerical modeling of partial differential equations.

¹ A grade of "C" or better is required in these courses for graduation with a Geological Engineering BS Degree.

Approved Electives (3 credits required):

² The purpose of the approved elective is to allow students to gain knowledge that will support their chosen area of expertise through a course that may or may not have significant engineering content. Commonly, students will enroll in a GEOE or GEOL course, co-op credits, or other advisor-approved courses to satisfy these three credits. All of the courses listed in the "Professional Elective" list below will also satisfy the approved elective requirement, but courses cannot be double-counted.

Professional Electives (6 credits required):

³ Professional elective courses must contain significant engineering content. The list below includes courses that satisfy the GEOE professional elective requirement. Students may take a course that is not on the list if it is approved by their advisor (including 600-level graduate courses).

*denotes courses whose prerequisite is also on this list and would be taken as a pair.

‡denotes courses that have MEM 304/304L Theoretical and Applied Rock Mechanics/Lab as a prerequisite (typically taken during the spring semester of senior year).

- GEOE 412/512 Science and Engineering Field Applications **Credits: 3 to 6**
- GEOE 421/521 Aqueous Geochemistry **Credits: (3-0) 3**
- GEOE 425/425L/525/525L Engineering Geophysics II/Lab **Credits: (2-1) 3**
- GEOL 451/451L Economic Geology/Lab **Credits: (2-1) 3**
- GEOE 482/482L/582/582L Applied Geomorphology/Lab **Credits: (3-0) 3**

- CEE 325 Introduction to Sustainable Design **Credits: (3-0) 3**
- CEE 326 Environmental Engineering I **Credits: (3-0) 3**
- CEE 327/327L Environmental Engineering II/Lab **Credits: (2-1) 3 ***
- CEE 337 Engineering Hydrology **Credits: (3-0) 3**
- CEE 347 Geotechnical Engineering II **Credits: (3-0) 3**
- CEE 425/525 Sustainable Engineering **Credits: (3-0) 3**
- CEE 426/526 Environmental Engineering Unit Operations and Processes **Credits: (3-0) 3**
- CEE 427/527 Environmental Engineering Biological Process Design **Credits: (3-0) 3**
- CEE 428/528 Oil and Gas Development and the Environment **Credits: (3-0) 3**
- CEE 437/437L/537/537L Watershed and Floodplain Modeling/Lab **Credits: (2-1) 3 ***
- CEE 447/547 Foundation Engineering **Credits: (3-0) 3**
- CEE 448/548 Applied Geotechnical Engineering **Credits: (3-0) 3**
- MEM 305 Introduction to Explosives Engineering **Credits: (3-0) 3**
- MEM 307 Mineral Exploration and Geostatistics **Credits: (3-0) 3**
- MEM 405 Mine Permitting and Reclamation **Credits: (3-0) 3**
- MEM 420/520 Advanced Tunneling and Underground Excavation **Credits: (3-0) 3 ♡**
- MEM 425/525 Advanced Rock Mechanics **Credits: (3-0) 3 ♡**
- MEM 430/530 Resource Industry Mergers and Acquisitions **Credits: (3-0) 3**
- MEM 433/433L/533/533L Advanced Mine Planning & Design **Credits: (2-1) 3**
- MEM 435/535 Resource Industry Finance and Accounting **Credits: (3-0) 3**
- MEM 445/545 Advanced Geostatistics and Grade Estimations **Credits: (2-1) 3 ***
- MEM 450/550 Rock Slope Engineering **Credits: (3-0) 3 ♡**
- MEM 480/580 Advanced Explosives and Blasting **Credits: (3-0) 3 ***

Geology, B.S.

Contact Information

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Faculty

Professors Anderson, Duke, Masterlark, Price and Uzunlar; Associate Professor Pagnac; Assistant Professors Baran and Ustunisik; Professors Emeritus Fox, Lisenbee, Martin, Paterson, and Redden.

Supporting Faculty

Professor Stetler; Associate Professors Katzenstein and Sawyer; Assistant Professor Li; Professors Emeritus Davis and Rahn; Adjunct Faculty M. Anderson, Benton, Iles, McCormick, Roggenthen, and Valder.

Geology Program (includes Paleontology)

Geologists study processes shaping Earth today and through its history to learn how it formed, how it has developed over time, and how life has evolved through time in response to tectonic and climatic changes. In their careers, geologists may seek to understand the formation of natural resources like minerals or petroleum, protect water and soil resources, or mitigate against geologic hazards like earthquakes and volcanoes. The GEOL program at SD Mines takes advantage of the proximity of the Black Hills through a rigorous field-based education that provides students a unique blend of hands-on experiences with strong theoretical foundations. Students have the opportunity to take electives in five focus areas including Energy and Mineral Resources, Environmental Geology, Geomathematics, Geospatial Technology, and Paleontology.

Geology Program Outcomes

A graduate with a BS in Geology is expected to:

- Apply scientific and mathematical knowledge to problems in the geosciences
- Analyze and interpret geological and other scientific data
- Work professionally with a team
- Collect geological data (from the literature, field, or laboratory) to answer a scientific question
- Follow the ethical standards of the geoscience profession
- Communicate effectively in oral and written form

- Apply geological knowledge to global systems and human societies
- Investigate geological problems using appropriate technology

Choosing a career focus

Many different career opportunities are open to students in the geosciences. Students complete a core of geology courses to solidly prepare them for careers in the geosciences. Additional electives are chosen to focus on a particular career path and best prepare the student for employment or graduate school. Students may focus in one of five career paths or select electives from two or more career paths, depending on their interests.

GEOL focus areas include:

- **Energy and Mineral Resources:** exploration and development of energy and mineral resources. Graduate may explore for and assist with extracting these resources.
- **Environmental Geology:** protection and management of natural resources. Graduates may work for environmental firms, or could do environmental work for petroleum and mineral companies. Many government agencies also hire graduates with these skills.
- **Geomathematics:** applications of mathematics, statistics, and numerical methods to quantify geologic phenomena. Prepares students for graduate studies. These skills are in high demand for employment in academic, industrial, and government research sectors.
- **Geospatial Technology:** managing spatial data using GIS, GPS, and remote sensing. Graduates may work in traditional petroleum, mining, or environmental companies, for government agencies, or within the geospatial industry that provides and manages maps and imagery to the world.
- **Paleontology:** study of ancient organisms and environments. Graduates in this focus area will often attend graduate school to develop research and teaching careers, but career opportunities also are available in museums, governmental agencies, or with consulting firms that survey and preserve fossil resources.

Students are strongly encouraged to consult with their advisor in selecting a career path and electives.

Recommended Electives

Energy and Mineral Resources

Recommended electives for energy and mineral resource geology include:

Free Electives

- MEM 120 Introduction to Mining, Sustainable Development, and Safety **Credits: (3-0) 3**
- MEM 201L Surveying for Mineral Engineers **Credits: (0-2) 2**
- MEM 204 Surface Mining Methods and Unit Operations **Credits: (3-0) 3**
- MEM 301/301L Computer Applications in Mining/Lab **Credits: (1-1) 2**
- MEM 307 Mineral Exploration and Geostatistics **Credits: (3-0) 3**
- MET 220 Mineral Processing and Resource Recovery **Credits: (3-0) 3**
- POLS 407 Environmental Law & Policy **Credits: (3-0) 3**

Program electives

- GEOE 324/324L Engineering Geophysics I/Lab **Credits: (2-1) 3**
- GEOE 461/561 Petroleum Drilling and Production Engineering **Credits: (3-0) 3**
- GEOE 466/466L/566/566L Engineering and Environmental Geology/Lab **Credits: (2-1) 3**
- * GEOL 351 Earth Resources and the Environment **Credits: (3-0) 3**

- GEOL 403/503 Regional Field Geology **Credits: (0-1) 1**
- GEOL 420/520 Introduction to Remote Sensing **Credits: (3-0) 3**
- * GEOL 422/422L/522/522L Tectonics and Sedimentary Basin Analysis/Lab **Credits: (2-1) 3**
- GEOL 442/442L/542/542L Optical Petrology/Lab **Credits: (2-1) 3 ***
- * GEOL 450 Fluid and Thermal Diffusion **Credits: (3-0) 3**
- * GEOL 451/451L Economic Geology/Lab **Credits: (2-1) 3**
- GEOL 476/576 Petroleum Geology **Credits: (3-0) 3 ***

A minor in Petroleum Systems is also offered; consult the requirements in the catalog.

Environmental Geology

Recommended electives for environmental geology include:

Free electives

- AES 201 Introduction to Atmospheric Sciences **Credits: (3-0) 3**
- AES 403/503 Biogeochemistry **Credits: (3-0) 3**
- AES 406/506 Global Environmental Change **Credits: (3-0) 3**
- BIOL 311 Principles of Ecology **Credits: (3-0) 3**
- BIOL 331 Microbiology **Credits: (3-0) 3**
- POLS 407 Environmental Law & Policy **Credits: (3-0) 3**

Program electives

- GEOE 324/324L Engineering Geophysics I/Lab **Credits: (2-1) 3**
- GEOE 466/466L/566/566L Engineering and Environmental Geology/Lab **Credits: (2-1) 3**
- GEOE 475/475L/575/575L Groundwater/Lab **Credits: (2-1) 3**
- GEOE 482/482L/582/582L Applied Geomorphology/Lab **Credits: (3-0) 3**
- GEOL 351 Earth Resources and the Environment **Credits: (3-0) 3**
- GEOL 361 Oceanography I **Credits: (3-0) 3**
- GEOL 403/503 Regional Field Geology **Credits: (0-1) 1**
- GEOL 420/520 Introduction to Remote Sensing **Credits: (3-0) 3**

Geospatial Technology

Recommended electives for geospatial technology include:

Free electives

- CSC 250 Computer Science II **Credits: (4-0) 4**
- CEE 437/437L/537/537L Watershed and Floodplain Modeling/Lab **Credits: (2-1) 3**
- MEM 201L Surveying for Mineral Engineers **Credits: (0-2) 2**
- MEM 301/301L Computer Applications in Mining/Lab **Credits: (1-1) 2**

Program electives

- GEOE 482/482L/582/582L Applied Geomorphology/Lab **Credits: (3-0) 3**
- GEOL 417/517 Geospatial Databases **Credits: (3-0) 3**
- GEOL 419/519 Advanced Geospatial Analysis **Credits: (3-0) 3**
- GEOL 420/520 Introduction to Remote Sensing **Credits: (3-0) 3**
- GEOL 450 Fluid and Thermal Diffusion **Credits: (3-0) 3**

A minor and undergraduate certificate in Geospatial Technology are also offered; consult the requirements in the catalog for further information. Students considering the geospatial minor should take GEOL 416/416L/516/516L Intro to GIS by their junior year.

Geomathematics

Recommended electives for geomathematics include:

Free Electives

- MATH 321 Differential Equations **Credits: (3-0) 3**
- MATH 315 Linear Algebra **Credits: (3-0) 3**
- MATH 353 Linear Optimization **Credits: (3-0) 3**
- MATH 382 Probability Theory and Statistics II **Credits: (3-0) 3**
- MATH 451/551 Math Modeling **Credits: (3-0) 3**

Program Electives

- GEOE 324/324L Engineering Geophysics I/Lab **Credits: (2-1) 3**
- GEOE 475/475L/575/575L Groundwater/Lab **Credits: (2-1) 3**
- GEOL 419/519 Advanced Geospatial Analysis **Credits: (3-0) 3**
- GEOL 450 Fluid and Thermal Diffusion **Credits: (3-0) 3**

Paleontology

Recommended electives for paleontology include:

Free electives

- AES 403/503 Biogeochemistry **Credits: (3-0) 3**
- AES 406/506 Global Environmental Change **Credits: (3-0) 3**
- BIOL 121 Basic Anatomy **Credits: (3-0) 3**
- BIOL 121L Basic Anatomy Lab **Credits: (0-1) 1**
- BIOL 151 General Biology I **Credits: (3-0) 3**
- BIOL 123 Basic Physiology **Credits: (3-0) 3**
- BIOL 153 General Biology II **Credits: (3-0) 3**
- BIOL 311 Principles of Ecology **Credits: (3-0) 3**

Program electives

- GEOE 482/482L/582/582L Applied Geomorphology/Lab **Credits: (3-0) 3**
- GEOL 361 Oceanography I **Credits: (3-0) 3**
- GEOL 372 Dinosaurs **Credits: (3-0) 3**
- GEOL 403/503 Regional Field Geology **Credits: (0-1) 1**
- GEOL 471/571 Field Paleontology **Credits: (0-2) 2**
- GEOL 472/472L/572/572L Museum Collections Management/Lab **Credits: (2-1) 3**
- GEOL 473/473L/573/573L Museum Exhibit Design/Lab **Credits: (2-1) 3**
- GEOL 474/574 Paleontological Resource Management **Credits: (3-0) 3**
- GEOL 475/475L/575/575L Vertebrate Fossil Preparation and Conservation **Credits: (2-1) 3**

Professional Development

The senior year culminates in an individual research project (GEOL 464, GEOL 465) in which the student practices the professional accomplishments of project planning, organization, scientific research, time management, and oral/written communication.

Students are strongly encouraged to participate in professional societies active on campus, including the AAPG Student Chapter, Tech Geological Association, the Society of Economic Geologists and the Paleontology Club. Students interested in paleontology and mineralogy may have opportunities to volunteer or work on collections, archives, educational outreach and/or research projects through the Museum of Geology. Internships in industry and government are commonly available and highly recommended.

Advanced Degrees

The B.S. in Geology can provide a pathway to professional careers in teaching, law, or medicine. For careers in science education, students should consult teaching programs at other colleges for auxiliary education courses that would be needed for teacher certification. With some adaptation, this degree can provide a foundation for professional graduate degrees such as in medicine or law.

Graduate programs, both master's and doctoral, are available and involve additional specialization in geology or paleontology and incorporate original research leading to the completion and defense of a thesis or dissertation. Completion of graduate degrees leads to higher-level professional employment including college-level instruction.

Geology/Paleontology Curriculum/Checklist

It is the student's responsibility to check with his or her advisor for any program modifications that may occur after the publication of this catalog. When planning coursework, students are advised that the courses GEOL 212/212L, GEOL 341/341L, GEOL 322/322L and GEOL 410 form a critical sequence that must be taken in the order listed.

Freshman Year

First Semester

- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- ENGL 101 Composition I **Credits: (3-0) 3**
- GEOL 201 Physical Geology **Credits: (3-0) 3**
- GEOL 201L Physical Geology Laboratory **Credits: (0-1) 1**
- GEOL 110 Explorations in Geology **Credits: (2-0) 2**

Total: 13

Note: Some students may need preparatory math in the first semester, such as MATH 102 or MATH 120.

Second Semester

- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- MATH 123 Calculus I **Credits: (4-0) 4**
- ¹ Gen. Ed. Goal 3 and Goal 4 Electives **Credits: 6**

Total: 14

Sophomore Year

First Semester

- MATH 125 Calculus II **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- ² GEOL 323 Search for Our Past **Credits: (3-0) 3**
- ¹ Gen Ed Goal 3 and Goal 4 Elective(s) **Credits: 3**

One of: 2-3 Credits

- CSC 111/111L Introduction to Computer Programming/Lab **Credits: (2-0) 2**
- CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**
- CSC 170/170L Programming for Engineers and Scientists **Credits: (3-0) 3**

Total: 15-16

Second Semester

- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- GEOL 212/212L Mineralogy and Crystallography/Lab **Credits: (2-1) 3**
- ¹ Gen Ed Goal 3 and Goal 4 Elective(s) **Credits: 3**

One of: 3-4 Credits

- ³ MATH 225 Calculus III **Credits: (4-0) 4**
- ³ MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**

Total: 16

Junior Year

First Semester

- ¹ ENGL 289 Technical Communications II **Credits: (3-0) 3**
- ² GEOL 331/331L Stratigraphy and Sedimentation/Lab **Credits: (2-1) 3**
- ² GEOL 341/341L Igneous and Metamorphic Petrology/Lab **Credits: (2-1) 3**
- ² GEOL 416/416L/516/516L Introduction to GIS/Lab **Credits: (2-1) 3**
- ⁴Program Elective(s) **Credits: 3**

Total: 15

Second Semester

- ^{*2} GEOL 322/322L Structural Geology/Lab **Credits: (2-1) 3**
- ^{*2} GEOL 461/461L Invertebrate Paleontology/Lab **Credits: (2-1) 3**
- ⁴Program Elective(s) **Credits: 3**
- Free Elective(s) **Credits: 3**

One of: 3 Credits

- [#] GEOE 324/324L Engineering Geophysics I/Lab **Credits: (2-1) 3**
- ^{*#} GEOE 482/482L/582/582L Applied Geomorphology/Lab **Credits: (3-0) 3**

Total: 15

Summer

- ² GEOL 410 Field Geology **Credits: (6-0) 6**

Total: 6

Senior Year

First Semester

- ² GEOL 464 Senior Research I **Credits: (0-1) 1**
- ⁴ Program Elective(s) **Credits: 6**
- Free Elective(s) **Credits: 3**
- Humanities/Social Science elective(s) **Credits: 3**

Total: 13

Second Semester

- ^{2, 5} GEOL 465 Senior Research II **Credits: (0-3) 3**
- Program Elective(s) **Credits: 6**
- Free elective(s) **Credits: 3-5**

Total: 12-14

120 credits required for graduation

Curriculum Notes

* Course offered in alternate years.

Students must take at least one of these two courses (GEOE 324/324L, GEOE 482/482L/582/582L). If both are taken, the second may serve as a program elective.

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

² A grade of "C" or better is required in these courses for graduation with a Geology B.S.

³ Students should consult an advisor when choosing math courses.

⁴ Program electives must have a GEOL or GEOE prefix. At least 9 credits must be taken from 400-level courses. Substitutions must be approved by the department head.

⁵ Under exceptional circumstances, a student may petition the department head to substitute program electives for GEOL 465.

Industrial Engineering and Engineering Management, B.S.

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Faculty

Professors Kellogg and Kerk; Associate Professors Matejcik, Jensen, and Piper; Assistant Professor Dubey; and Instructor Jensen.

Industrial Engineering and Engineering Management

Industrial engineering and engineering management is concerned with the design, improvement, installation, and management of integrated systems of people, material, and equipment. Graduates of the program employ a set of skills that includes mathematical modeling, probability and statistics, computer science, human factors, interpersonal skills, project management, and an ability to manage and administer large technical engineering and research projects. Thus, industrial engineering and engineering management may be thought of as applied problem solving, from inception to implementation and management.

Program Objectives

The objectives of the industrial engineering and engineering management program are to produce graduates who:

- Contribute to the success of companies through effective problem solving.
- Design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and environments.
- Effectively manage business operations and project management teams.
- Continue to develop the personal and professional skills necessary to adapt to our changing societal, technological, and global environments.

Graduates of the industrial engineering and engineering management program are expected to meet the challenges for contemporary professional practice, be able to adapt and solve the increasingly complex problems faced by industry, embrace innovation through intellectual diversity and creative problem solving, and continue to develop holistically as a learner to become leaders of tomorrow.

Program Outcomes

At the time of graduation students completing the BS IEEM degree will be able to demonstrate the following outcomes.

- An ability to apply knowledge of mathematics, science, and engineering;
- An ability to design and conduct experiments, as well as to analyze and interpret data;

- An ability design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
- An ability to function on a multidisciplinary team;
- An ability to identify, formulate, and solve engineering problems;
- An understanding of professional and ethical responsibility;
- An ability to communicate effectively;
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context

Curriculum

The curriculum is designed to give students a thorough knowledge in the fundamental principles within the four primary stems of industrial engineering: operations research and optimization, manufacturing, statistical processes, and human engineering. In addition, through a variety of coursework and experiential learning activities, students develop an understanding of the engineering relationships with the management tasks of planning, leading, organizing, and controlling as well as the integrative nature of management systems.

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. Service learning components, laboratories, case work, simulations, and the capstone design sequence reinforce the managerial aspects of systems integration, systems design, and the global, societal, and business context for product and process improvement.

Students may participate in the Cooperative Education Internship Program. The co-op credits may count as approved engineering elective courses.

Accreditation

The bachelor of science program in industrial engineering and engineering management is accredited for industrial engineering by the Engineering Accreditation Commission of ABET, <http://www.abet.org>, 415 North Charles Street, Baltimore, MD 21201; Phone +1.410.347.7700.

Industrial Engineering Curriculum/Checklist

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

- MATH 123 Calculus I **Credits: (4-0) 4**
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- Humanities or Social Sciences Elective(s) Credits: 3
- ENGL 101 Composition I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**

- IENG 248/248L Engineering Graphics and Computer Modeling **Credits: (1-1) 2**

Total: 16

Second Semester

- MATH 125 Calculus II **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- PSYC 101 General Psychology **Credits: (3-0) 3**
- IENG 241L Introduction to Quality Methods and Teaming **Credits: (0-2) 2**
- Humanities or Social Sciences Elective(s) Credits: 3

Total: 15

Sophomore Year

First Semester

- Engineering Fundamentals Elective Credits: 3
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- MATH 225 Calculus III **Credits: (4-0) 4**
- IENG 381 Introduction to Probability and Statistics **Credits: (3-0) 3**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- PHYS 213L University Physics II Laboratory **Credits: (0-1) 1**

Total: 17

Second Semester

- IENG 384 Process Control Tools **Credits: (3-0) 3**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- IENG 215 Cost Estimating for Engineers I **Credits: (1-0) 1 AND**
- IENG 216 Cost Estimating for Engineers II **Credits: (1-0) 1 AND**
- IENG 217 Cost Estimating for Engineers III **Credits: (1-0) 1**
- Engineering Fundamentals Elective Credits: 3
- IENG 302 Engineering Economics **Credits: (3-0) 3**
- Humanities or Social Sciences Elective(s) Credits: 3

Total: 18

Junior Year

First Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- IENG 311/311L Work Methods and Measurements/Lab **Credits: (2-1) 3**
- IENG 486 Statistical Quality and Process Control **Credits: (3-0) 3**
- IENG 352 Creativity and Innovation **Credits: (1-0) 1**
- IENG 354 Marketing Technology Innovations **Credits: (1-0) 1**
- IENG 362 Stochastic Models **Credits: (3-0) 3**
- Professional Breadth Elective Credits: 3

Total: 17

Second Semester

- IENG 355 Financing Technology Innovations **Credits: (1-0) 1**
- IENG 441 Simulation **Credits: (3-0) 3**
- ENGM 435/535 Optimization Techniques **Credits: (3-0) 3**
- IENG 321/321L Ergonomics/Human Factors Engineering/Lab **Credits: (2-1) 3**
- Engineering Fundamentals Elective Credits: 3
- Professional Breadth Elective Credits: 4

Total: 17

Senior Year

First Semester

- IENG 425 Production and Operation Management **Credits: (3-0) 3**
- IENG 331 Safety Engineering **Credits: (3-0) 3** ¹
- IENG 471 Facilities Planning **Credits: (3-0) 3**
- IENG 464 Senior Design Project I **Credits: (0-2) 2**
- IENG 462 Industrial and Engineering Management Profession **Credits: (1-0) 1**
- Professional Breadth Elective Credits: 3

Total: 15

Second Semester

- IENG 366 Engineering Management **Credits: (3-0) 3**
- IENG 465 Senior Design Project II **Credits: (0-3) 3**
- IENG 475/475L Computer-Controlled Manufacturing Systems and Robotics **Credits: (2-1) 3**
- Humanities or Social Sciences Elective(s) Credits: 3
- Department Elective Credits: 3

Total: 15

130 credits required for graduation

Curriculum Notes

¹IENG 341 (Industrial Hygiene) may be substituted during a second semester.

Students planning to apply for the accelerated master degree should consult their advisor.

Elective courses must be chosen to satisfy all of the following requirements.

1. Fifteen semester hours in humanities or social science. At least 6 hours must be in humanities and at least 6 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. At least 3 hours of humanities or social science must be at the 300 or 400 level.

Department Electives (6 credits)

Human Engineering (3 credits)

- IENG 331 Safety Engineering **Credits: (3-0) 3**
- IENG 431/531 Industrial Hygiene **Credits: (3-0) 3**

Department Breadth (3 credits)

- IENG 353 Commercialization of New Technology **Credits: (1-0) 1**
- IENG 356 Technology Start Ups **Credits: (1-0) 1**
- IENG 451/451L Operational Strategies/Lab **Credits: (2-1) 3**
- IENG 452 Introduction to Six Sigma **Credits: (1-0) 1**
- IENG 466/566 Project Planning and Control **Credits: (3-0) 3**
- IENG 492 Topics **Credits: 1 to 3**

Engineering Fundamentals (9 credits)

Fundamentals (9 credits from at least two different areas)

Materials

- MET 231 Structures and Properties of Materials Lab **Credits: (0-1) 1**
- MET 232 Properties of Materials **Credits: (3-0) 3**

Circuits

- EE 301/301L Introduction to Circuits, Machines, and Systems/Lab **Credits: (3-1) 4 OR**
- EE 220/220L Circuits I/Lab **Credits: (3-1) 4**

Statics/Dynamics

- EM 214 Statics **Credits: (3-0) 3 OR**
- EM 216 Statics and Dynamics **Credits: (4-0) 4**
OR
- EM 214 Statics Credits: 3 **AND**
- EM 215 Dynamics **Credits: (3-0) 3**
OR
- EM 214 Statics Credits: 3 **AND**
- ME 221 Dynamics of Mechanisms **Credits: (3-0) 3**

Thermodynamics

- CBE 222 Chemical Engineering Process Thermodynamics **Credits: (3-0) 3**
- ENVE 320 **OR**
- MET 320 Metallurgical Thermodynamics **Credits: (4-0) 4**
- ME 211 Introduction to Thermodynamics **Credits: (3-0) 3**

Fluid Mechanics

- EM 327
- EM 328 Applied Fluid Mechanics **Credits: (3-0) 3 OR**
- EM 331 Fluid Mechanics **Credits: (3-0) 3 OR**
- ME 331 Thermo Fluid Dynamics **Credits: (3-0) 3**

Mechanics

- ME 216 Introduction to Solid Mechanics **Credits: (3-0) 3 OR**
- EM 321 Mechanics of Materials **Credits: (3-0) 3**

Professional Breadth (10 credits)

- Courses in Department Electives beyond 6-credit requirement
- Courses in Engineering Fundamentals beyond 9 credit requirement

Engineering Breadth

- CENG 244/244L Introduction to Digital Systems/Lab **Credits: (3-1) 4**
- GEOE 221/221L Geology for Engineers/Lab **Credits: (2-1) 3**
- CP 297/397/497 Cooperative Education **Credits: 1 to 3**
- CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**
- CSC 250 Computer Science II **Credits: (4-0) 4**
- CBE 217 Chemical Engineering Material Balances **Credits: (3-0) 3 OR**
- CBE 317 Chemical Engineering Heat Transfer **Credits: (3-0) 3**
- CBE 318 Chemical Engineering Mass Transfer **Credits: (3-0) 3 OR**
- ENVE 318

Mathematics and Science Breadth

- MATH 315 Linear Algebra **Credits: (3-0) 3**
- MATH 373 Introduction to Numerical Analysis **Credits: (3-0) 3**
- MATH 423 Advanced Calculus I **Credits: (4-0) 4**
- MATH 451/551 Math Modeling **Credits: (3-0) 3**

- MATH 447/547 Design of Experiments **Credits: (3-0) 3**
- GEOL 201 Physical Geology **Credits: (3-0) 3**
- BIOL 121 Basic Anatomy **Credits: (3-0) 3**
- BIOL 121L Basic Anatomy Lab **Credits: (0-1) 1**
- BIOL 123 Basic Physiology **Credits: (3-0) 3**
- BIOL 123L Basic Physiology Lab **Credits: (0-1) 1**
- BIOL 151 General Biology I **Credits: (3-0) 3**
- BIOL 151L General Biology I Lab **Credits: (0-1) 1**
- BIOL 153 General Biology II **Credits: (3-0) 3**
- BIOL 153L General Biology II Lab **Credits: (0-1) 1**
- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- CHEM 326 Organic Chemistry I **Credits: (3-0) 3**
- CHEM 326L Organic Chemistry I Lab **Credits: (0-2) 2**
- CHEM 328 Organic Chemistry II **Credits: (3-0) 3**
- CHEM 328L Organic Chemistry II Lab **Credits: (0-2) 2**

Organizational Management Breadth

- PSYC 331 Industrial and Organizational Psychology **Credits: (3-0) 3**
- ENGM xxx
- ACCT 210
- ACCT 211
- BADM 350
- BADM 370
- BADM 407
- ECON 201
- ECON 202

Petitioned Courses

Students may petition the department to consider specific courses that are not on the approved list. Students must submit a formal petition in writing requesting that a specific course be considered for inclusion on the student's program of study. The petition must include the course prefix and number and specific, but concise, rationale as to how the course complements the student's professional development for a given career goal.

Interdisciplinary Sciences: Atmospheric Sciences Specialization, B.S.

Interdisciplinary Sciences B.S.

Contact Information for IS-ATM

Dr. Adam J. French

Atmospheric and Environmental Sciences Program
Mineral Industries Building 208
(605) 394-1649
E-mail: Adam.French@sdsmt.edu

Contact Information for IS-HLTH/IS-STS

Dr. Allison B. Gilmore

Departments of Humanities and Social Sciences
Classroom Building 317
(605) 394-2481
E-mail: Allison.Gilmore@sdsmt.edu

The bachelor of science degree in interdisciplinary sciences (IS) is a science degree program that seeks to serve the needs of students whose goals cannot be met within the other science departments. IS students choose from three areas of specialization: atmospheric sciences; pre-professional health sciences; and science, technology, and society. The IS degree program allows students to enroll in a wide variety of math and science courses, as well as carefully chosen electives in the humanities, fine arts, and social sciences.

The Interdisciplinary Sciences degree is especially appropriate for the following individuals.

- Students pursuing professional and health services careers, including but not limited to law and law enforcement, the military, medicine, physical therapy, and radiography.
- Students whose educational and career goals require courses in several departments and the integration of knowledge from diverse fields.

The benefits of the interdisciplinary sciences degree include

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

Areas of Specialization

Interdisciplinary sciences majors choose from three areas of specialization that will prepare them for graduate and professional programs.

- Atmospheric Sciences

- Pre-Professional Health Sciences
- Science, Technology, and Society

Interdisciplinary Sciences Program Admission Policy

After successful completion of at least 60 credit hours and at least one year prior to the intended graduation date, the student must apply for admission to the degree program by filing a plan of study with the IS steering committee. The plan of study must be approved by the steering committee before a student will be formally admitted to the program. This plan of study consists of (1) a Letter of Intent stating the career goals to which the IS degree coursework is to be applied and (2) an IS worksheet showing the courses already taken and the courses to be completed prior to graduation. The Letter of Intent and worksheet must be reviewed and approved by the student's IS advisor before submission to the steering committee. The Letter of Intent form and worksheet may be accessed on the IS website. Worksheets are available for each specialization.

Deadline for submitting the Letter of Intent and worksheet to the IS office: For May graduates - April 30 of the preceding year; for August graduates - July 30 of preceding year; for December graduates - November 30 of preceding year. Students must have an approved Letter of Intent and IS worksheet on file in the IS office before registering for IS 498, the senior capstone project.

Science Minors available to IS Students

Students pursuing the IS specializations are strongly encouraged to complete a minor in another science field at School of Mines as part of their 120 total credits. Minors are available in applied biological sciences, chemistry, computer science, geology, geospatial technology, mathematics, physics, or occupational safety. Students should consult the policy on minors and the specific courses required for each minor, provided elsewhere in the catalog. The IS degree is not available as a minor.

Transfer Studies

Students who reside in local communities can achieve considerable savings in their education costs by completing a portion of their studies close to home before transferring to another institution to complete their desired major. Students who do not intend to pursue a degree offered at the School of Mines are encouraged to take courses appropriate for the two-year associate of arts (A.A.) degree in general studies. Through this program of access and transfer, students still experience the excellent educational environment found on the School of Mines campus. Students should consult the programs of study for the school from which they plan to graduate and then work closely with their A.A. advisor to select courses with the highest likelihood of transferability. Completion of the A.A. degree will fulfill the general education requirements for a baccalaureate degree at the other state universities of South Dakota (BHSU, DSU, NSU, SDSU, and USD).

Pre-law/Pre-medicine Study at Mines

While the IS specializations in pre-professional health sciences (HLTH) and science, technology, and society (STS) are especially designed to help students meet the entrance requirements for medical or law school, a particular baccalaureate degree is not required for admission into most law and medical programs. Graduates from the School of Mines with degrees in several of the science and engineering programs have successfully completed these professional programs. Students are encouraged to consult the admissions requirements and policies for those professional and medical schools to which they intend to apply.

Pre-Nursing Study at Mines

The IS degree program does not include a pre-nursing track. Students interested in earning a nursing degree from SDSU or USD should apply to those degree-granting universities. Upon acceptance to SDSU or USD, students can take courses offered by School of Mines that meet pre-nursing requirements. For more information visit the SDSU web site or the USD web site.

Teaching Opportunities and Certification

Students who are interested in teaching science or math at the secondary education level should contact education programs at the other state universities for information on the auxiliary courses required for certification. The Master of Science in secondary education degree, an accelerated certification program offered through Black Hills State University, may be of interest to students completing the IS and other science degrees at the School of Mines. Information on this program can be obtained from the BHSU website at www.bhsu.edu/

General Requirements for Graduation

For all interdisciplinary sciences specializations, students are responsible to check with their advisors for any program modifications that may occur after the publication of this catalog.

I. IS Core Courses (IS 201, IS 401, IS 498)	9 credits
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II. English sequence (ENGL 101, ENGL 279, ENGL 289)	9 credits
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III. Math, Computer Science, Sciences

Math and Computer Sciences ¹	min. 12
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Biology ²	min. 3
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Chemistry ²	min. 3
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Additional Natural Sciences ²	min. 24
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Other Math, CSC, Sciences	min. 18
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SUBTOTAL	60
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IV. Humanities and Social Sciences

Humanities general education	6
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Humanities upper division	6
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Social Sciences general education	6
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Social Science upper division	6
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SUBTOTAL	24
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V. Program Approved Electives ³	18
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120 credits required for graduation

Curriculum Notes

¹ All IS specializations require MATH 123 Calculus I or a math course requiring MATH 123 as its prerequisite. Some specializations require additional math courses beyond Math 123.

² All IS specializations require a minimum of 30 credit hours in the natural sciences, including 6 hours in sequence (e.g., BIOL 151/BIOL 153) and 12 hours at the upper division. Chemistry must be at the CHEM 112 level or higher. Biology must be at the BIOL 121 level or higher. Students are expected to identify a science concentration and are encouraged to pursue a science minor as appropriate to their specialization. Students should work with their advisors to determine the most appropriate science electives for their career goals.

³ Engineering courses may be counted toward graduation as electives only.

Thirty-six of the required 120 credits must be at the junior or senior level (courses numbered 300 and above.)

Students must meet the Institutional Credit Requirements, which include completion of a minimum of 30 credits from the School of Mines. In addition, 15 of the last 30 credits counted towards the degree must be taken from School of Mines.

Interdisciplinary Sciences Core Courses

All IS students take a sequence of three core courses, spread out over the course of three years. These courses are sequential and cannot be taken concurrently. IS courses cannot be counted for humanities/social science credit.

- IS 201 Introduction to Science, Technology, and Society **Credits: (3-0) 3** in the sophomore year;
- IS 401 Writing and Research in the Interdisciplinary Sciences **Credits: (3-0) 3** in the first semester of the senior year; and
- IS 498 Undergraduate Research/Scholarship **Credits: (0-3) 3** (senior project) in the second semester of the senior year.

Specialization in Atmospheric Sciences: Curriculum/Course Checklist

Course sequences may vary by student entry year, math/science placements, availability of AES courses, and career objectives. Students should consult with an atmospheric and environmental sciences/interdisciplinary sciences advisor for a more personalized course of study based on career goals within the atmospheric and environmental sciences.

[Click here for printable/expanded version of the flowchart](#)

Required Courses for the Atmospheric Sciences Specialization Are:

- All courses and other curriculum requirements for the general IS degree requirement.
- The atmospheric sciences undergraduate series: AES 201, AES 401, AES 404, AES 406, AES 430, AES 450, AES 455, AES 460.
- The following mathematics and science courses (including required prerequisites): BIOL 311, CHEM 112, CHEM 112L, CHEM 114, CHEM 114L, CSC 150 or CSC 170, PHYS 211, PHYS 213, PHYS 213L, MATH 123, MATH 125, MATH 225, MATH 321.
- Sufficient professional development electives for a total of 120 academic credit hours.

Freshman Year

First Semester

- ¹ CHEM 112 General Chemistry I **Credits: (3-0) 3**
- ¹ CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- ENGL 101 Composition I **Credits: (3-0) 3**
- ² MATH 123 Calculus I **Credits: (4-0) 4**
- Gen Ed Humanities/Social Science Elective **Credits: 3**

Total: 14

Second Semester

- ¹ CHEM 114 General Chemistry II **Credits: (3-0) 3**
- ¹ CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- ² CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**
- **OR**
- CSC 170/170L Programming for Engineers and Scientists **Credits: (3-0) 3**
- ² MATH 125 Calculus II **Credits: (4-0) 4**
- Gen Ed Humanities/Social Science Elective **Credits: 6**

Total: 17

Sophomore Year

First Semester

- AES 201 Introduction to Atmospheric Sciences **Credits: (3-0) 3**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- ² MATH 225 Calculus III **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- Gen Ed Humanities/Social Science Elective **Credits: 3**

Total: 16

Second Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- IS 201 Introduction to Science, Technology, and Society **Credits: (3-0) 3**
- ² MATH 321 Differential Equations **Credits: (3-0) 3**
- ¹ PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- ¹ PHYS 213L University Physics II Laboratory **Credits: (0-1) 1**
- ⁴ AES 404/504 Atmospheric Thermodynamics **Credits: 2 or 3**

Total: 16

Junior Year

First Semester

- AES 450 Synoptic Meteorology I **Credits: (3-0) 3**
- AES 460/560 Atmospheric Dynamics **Credits: (3-0) 3**
- ¹ BIOL 311 Principles of Ecology **Credits: (3-0) 3**
- Upper Division HUM/SS Elective **Credits: 3**

Total: 12

Second Semester

- AES 406/506 Global Environmental Change **Credits: (3-0) 3**
- AES 430/530 Radar Meteorology **Credits: (3-0) 3**
- AES 455/555 Synoptic Meteorology II **Credits: (3-0) 3**
- ³ AES/SCI/MATH/ENG Electives **Credits: 3**
- Upper Division HUM/SS Elective **Credits: 3**

Total: 15

Senior Year

First Semester

- AES 401/501 Atmospheric Physics **Credits: (3-0) 3**
- IS 401 Writing and Research in the Interdisciplinary Sciences **Credits: (3-0) 3**
- ³ AES/SCI/MATH/ENG Electives **Credits: 6**
- Upper Division HUM/SS Elective **Credits: 3**

Total: 15

Second Semester

- ³ AES/SCI/MATH/ENG Electives **Credits: 9**
- IS 498 Undergraduate Research/Scholarship **Credits: (0-3) 3**
- Upper Division HUM/SS Elective **Credits: 3**

Total: 15

120 credits required for graduation

Curriculum Notes

¹ All IS specializations require a minimum of 30 semester hours of natural sciences, including a minimum of 3 semester hours in chemistry, 3 semester hours in biology, 6 semester hours in a science sequence, and 12 semester hours at the upper division. The atmospheric sciences/meteorology specialization requires one year of general chemistry with labs, one year of university physics with lab, and one semester of BIOL 311 Principles of Ecology. Students should consult with their advisors to determine additional science courses appropriate for their career paths.

² All IS specializations require MATH 123 or a math course requiring MATH 123 as its prerequisite. Atmospheric sciences/meteorology requires CSC 150/150L or CSC 170/170L and additional math coursework beyond MATH 123. MATH 102 and MATH 120 may not be used toward graduation requirements for IS-ATM specialization. Students in the IS-ATM specialization who begin their program with MATH 102 may require an additional 1-2 semester to complete their degree.

³ Students should consult with their atmospheric and environmental sciences/interdisciplinary sciences advisors on the most appropriate AES/science/math/ engineering electives for their career paths. Engineering courses are counted as electives. See Atmospheric Sciences Minor.

⁴Students in the IS-ATM specialization should take AES 404/504 for 3 credits.

Interdisciplinary Sciences: Pre-Professional Health Sciences Specialization, B.S.

A strong background in science will prepare students in the pre-professional health sciences specialization for entry into a variety of graduate and professional programs, including medical and dental schools, physical and occupational therapy programs, physician assistant and chiropractic programs, optometry and radiography programs. Volunteer work in the community and complementary coursework in the humanities and social sciences are included to help students meet the admissions requirements of these professional schools.

Students planning to enter these professions should consult the programs of study for the schools of interest to them. Working closely with their advisor, they will select the courses needed to fulfill the graduation requirements for the IS degree and to meet the entrance requirements for the professional schools in health science.

For more information, students should review the resources available on the BSIS website at is.sdsmt.edu

Interdisciplinary Sciences B.S.

Contact Information for IS-ATM

Dr. Adam J. French

Atmospheric and Environmental Sciences Program
Mineral Industries Building 208
(605) 394-1649
E-mail: Adam.French@sdsmt.edu

Contact Information for IS-HLTH/IS-STS

Dr. Allison B. Gilmore

Departments of Humanities and Social Sciences
Classroom Building 317
(605) 394-2481
E-mail: Allison.Gilmore@sdsmt.edu

The bachelor of science degree in interdisciplinary sciences (IS) is a science degree program that seeks to serve the needs of students whose goals cannot be met within the other science departments. IS students choose from three areas of specialization: atmospheric sciences; pre-professional health sciences; and science, technology, and society. The IS degree program allows students to enroll in a wide variety of math and science courses, as well as carefully chosen electives in the humanities, fine arts, and social sciences.

The Interdisciplinary Sciences degree is especially appropriate for the following individuals.

- Students pursuing professional and health services careers, including but not limited to law and law enforcement, the military, medicine, physical therapy, and radiography.
- Students whose educational and career goals require courses in several departments and the integration of knowledge from diverse fields.

The benefits of the interdisciplinary sciences degree include

- Flexibility in a wide range of study;

- Individual design allowing the student to help select the content of the degree; and
- The opportunity to study natural sciences, social sciences, and humanities from a broad perspective, thus providing a well-rounded program.

Areas of Specialization

Interdisciplinary sciences majors choose from three areas of specialization that will prepare them for graduate and professional programs.

- Atmospheric Sciences
- Pre-Professional Health Sciences
- Science, Technology, and Society

Interdisciplinary Sciences Program Admission Policy

After successful completion of at least 60 credit hours and at least one year prior to the intended graduation date, the student must apply for admission to the degree program by filing a plan of study with the IS steering committee. The plan of study must be approved by the steering committee before a student will be formally admitted to the program. This plan of study consists of (1) a Letter of Intent stating the career goals to which the IS degree coursework is to be applied and (2) an IS worksheet showing the courses already taken and the courses to be completed prior to graduation. The Letter of Intent and worksheet must be reviewed and approved by the student's IS advisor before submission to the steering committee. The Letter of Intent form and worksheet may be accessed on the IS website. Worksheets are available for each specialization.

Deadline for submitting the Letter of Intent and worksheet to the IS office: For May graduates - April 30 of the preceding year; for August graduates - July 30 of preceding year; for December graduates - November 30 of preceding year. Students must have an approved Letter of Intent and IS worksheet on file in the IS office before registering for IS 498, the senior capstone project.

Science Minors available to IS Students

Students pursuing the IS specializations are strongly encouraged to complete a minor in another science field at School of Mines as part of their 120 total credits. Minors are available in applied biological sciences, chemistry, computer science, geology, geospatial technology, mathematics, physics, or occupational safety. Students should consult the policy on minors and the specific courses required for each minor, provided elsewhere in the catalog. The IS degree is not available as a minor.

Transfer Studies

Students who reside in local communities can achieve considerable savings in their education costs by completing a portion of their studies close to home before transferring to another institution to complete their desired major. Students who do not intend to pursue a degree offered at the School of Mines are encouraged to take courses appropriate for the two-year associate of arts (A.A.) degree in general studies. Through this program of access and transfer, students still experience the excellent educational environment found on the School of Mines campus. Students should consult the programs of study for the school from which they plan to graduate and then work closely with their A.A. advisor to select courses with the highest likelihood of transferability. Completion of the A.A. degree will fulfill the general education requirements for a baccalaureate degree at the other state universities of South Dakota (BHSU, DSU, NSU, SDSU, and USD).

Pre-law/Pre-medicine Study at Mines

While the IS specializations in pre-professional health sciences (HLTH) and science, technology, and society (STS) are especially designed to help students meet the entrance requirements for medical or law school, a particular baccalaureate degree is not required for admission into most law and medical programs. Graduates from the School of Mines with degrees in several of the science and engineering programs have successfully completed these professional programs. Students are encouraged to consult the admissions requirements and policies for those professional and medical schools to which they intend to apply.

Pre-Nursing Study at Mines

The IS degree program does not include a pre-nursing track. Students interested in earning a nursing degree from SDSU or USD should apply to those degree-granting universities. Upon acceptance to SDSU or USD, students can take courses offered by School of Mines that meet pre-nursing requirements. For more information visit the SDSU web site or the USD web site.

Teaching Opportunities and Certification

Students who are interested in teaching science or math at the secondary education level should contact education programs at the other state universities for information on the auxiliary courses required for certification. The Master of Science in secondary education degree, an accelerated certification program offered through Black Hills State University, may be of interest to students completing the IS and other science degrees at the School of Mines. Information on this program can be obtained from the BHSU website at www.bhsu.edu/

General Requirements for Graduation

For all interdisciplinary sciences specializations, students are responsible to check with their advisors for any program modifications that may occur after the publication of this catalog.

I. IS Core Courses (IS 201, IS 401, IS 498)	9 credits
II. English sequence (ENGL 101, ENGL 279, ENGL 289)	9 credits
III. Math, Computer Science, Sciences	
Math and Computer Sciences ¹	min. 12
Biology ²	min. 3
Chemistry ²	min. 3
Additional Natural Sciences ²	min. 24
Other Math, CSC, Sciences	min. 18
SUBTOTAL	60

IV. Humanities and Social Sciences

Humanities general education	6
Humanities upper division	6
Social Sciences general education	6
Social Science upper division	6
SUBTOTAL	24

V. Program Approved Electives ³ 18

120 credits required for graduation

Curriculum Notes

¹ All IS specializations require MATH 123 Calculus I or a math course requiring MATH 123 as its prerequisite. Some specializations require additional math courses beyond Math 123.

² All IS specializations require a minimum of 30 credit hours in the natural sciences, including 6 hours in sequence (e.g., BIOL 151/BIOL 153) and 12 hours at the upper division. Chemistry must be at the CHEM 112 level or higher. Biology must be at the BIOL 121 level or higher. Students are expected to identify a science concentration and are encouraged to pursue a science minor as appropriate to their specialization. Students should work with their advisors to determine the most appropriate science electives for their career goals.

³ Engineering courses may be counted toward graduation as electives only.

Thirty-six of the required 120 credits must be at the junior or senior level (courses numbered 300 and above.)

Students must meet the Institutional Credit Requirements, which include completion of a minimum of 30 credits from the School of Mines. In addition, 15 of the last 30 credits counted towards the degree must be taken from School of Mines.

Interdisciplinary Sciences Core Courses

All IS students take a sequence of three core courses, spread out over the course of three years. These courses are sequential and cannot be taken concurrently. IS courses cannot be counted for humanities/social science credit.

- IS 201 Introduction to Science, Technology, and Society **Credits: (3-0) 3** in the sophomore year;
- IS 401 Writing and Research in the Interdisciplinary Sciences **Credits: (3-0) 3** in the first semester of the senior year; and
- IS 498 Undergraduate Research/Scholarship **Credits: (0-3) 3** (senior project) in the second semester of the senior year.

Pre-Professional Health Sciences (IS-HLTH): General Curriculum/Course Checklist

Students should consult with their advisors for a more personalized course of study based on career goals within the health sciences. Course requirements may vary according to professional program, e.g., medical school, radiographic technology, physical therapy. Course sequence may also vary by student entry year, math/science placements, course availability, and career objectives.

[Click here for printable/expanded version of the flowchart](#)

[Click here for printable/expanded version of the flowchart](#)

Freshman Year

First Semester

- ENGL 101 Composition I **Credits: (3-0) 3**
- BIOL 151 General Biology I **Credits: (3-0) 3**
- BIOL 151L General Biology I Lab **Credits: (0-1) 1**
- ¹ Math/CSC Elective **Credits: 4**
- ² Gen Ed Humanities/Social Science Elective **Credits: 3**

Total: 14

Second Semester

- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- BIOL 153 General Biology II **Credits: (3-0) 3**
- BIOL 153L General Biology II Lab **Credits: (0-1) 1**
- Math/CSC Elective **Credits: 3**
- Gen Ed Humanities/Social Science Elective **Credits: 3**
- ³ Program Approved Elective **Credits: 3**

Total: 17

Sophomore Year

First Semester

- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- IS 201 Introduction to Science, Technology, and Society **Credits: (3-0) 3**
- BIOL 221 Human Anatomy **Credits: (3-0) 3**
- BIOL 221L Human Anatomy Lab **Credits: (0-1) 1**
- Gen Ed Humanities/Social Science Elective **Credits: 3**

Total: 17

Second Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- Math/CSC Elective **Credits: 4**
- Gen Ed Humanities/Social Science Elective **Credits: 3**
- BIOL 326 Biomedical Physiology **Credits: (3-0) 3**
- BIOL 326L Biomedical Physiology Lab **Credits: (0-1) 1**

Total: 14

Junior Year

First Semester

- ² Science Electives **Credits: 9**
- 300/400 HUM/SS Elective **Credits: 3**
- Math/CSC Elective **Credits: 3**

Total: 15

Second Semester

- Science Electives **Credits: 9**
- 300/400 HUM/SS elective **Credits: 3**
- Program Approved Electives **Credits: 3**

Total: 15

Senior Year

First Semester

- IS 401 Writing and Research in the Interdisciplinary Sciences **Credits: (3-0) 3**
- Science Electives **Credits: 4**
- Upper Division HUM/SS Elective **Credits: 3**
- Program Approved Elective **Credits: 4**

Total: 14

Second Semester

- IS 498 Undergraduate Research/Scholarship **Credits: (0-3) 3**
- 300/400 HUM/SS Elective **Credits: 3**
- Program Approved Electives **Credits: 8**

Total: 14

120 credits required for graduation

Curriculum Notes

Thirty-six (36) credits of the 120 credits required for graduation must be at a junior or senior level (courses numbered 300 or above).

¹ A minimum of twelve (12) semester hours of approved mathematics and computer sciences is required, including Math 123 or a math course requiring Math 123 as its prerequisite. Math 102 and Math 120 may be used towards graduation requirements for the IS-HLTH degree.. Students should consult with their advisors on the most appropriate math/computer science electives for their career paths.

² A minimum of twenty-four (24) semester hours of university-approved humanities and social sciences is required. This minimum includes six (6) hours of general education coursework in Humanities, six (6) hours of general education coursework in Social Sciences, six (6) hours of upper division Humanities, and six (6) hours of upper division Social Sciences. Pre-health students are advised to take PSYC 101, SOC 100, and upper division psychology courses in preparation for professional school admission exams.

³ All IS specializations require a minimum of thirty (30) semester hours of natural sciences, including a minimum of three (3) semester hours in chemistry (Chem 112 or higher), three (3) semester hours in biology (Biol 121 or higher), and twelve (12) semester hours at the upper division. Of the thirty hours required in natural sciences, a minimum of six (6) credits must be sequential. The Professional Health Sciences specialization requires one year of general biology with labs, one year of general chemistry with labs, and one year of anatomy/physiology with labs. Students should consult with their advisors to determine the sequence of additional science courses appropriate for and required by their career paths, for example, pre-med and pre-dental students will also need organic chemistry, biochemistry, and physics. Pre-physical therapy students will also need physics. For information on specific requirements, IS majors are advised to consult their advisors and the worksheet for their career areas (e.g., pre-med, pre-PT, pre-PA) available from the IS website: www.sdsmt.edu/is.

⁴ Program-approved electives may include additional coursework in math, computer science, and the natural sciences. Students should consult with their advisors on the most appropriate science electives for their career paths. Students are expected to identify a science concentration and are encouraged to pursue a science minor (e.g., applied biological sciences or chemistry) as appropriate to their specialization. A total of 60 hours in math, computer science, and natural sciences is required. Elective credits may include additional college coursework at the 100 level or above in math, computer science, sciences, humanities, social sciences, business, military science, or engineering as needed to meet the required minimums or to qualify for a science minor.

Interdisciplinary Sciences: Science, Technology, and Society Specialization, B.S.

The science, technology, and society specialization combines a strong science background with a firm grounding in environmental, social, and science policy issues. Students pursue a science concentration, such as environmental science, or a minor in a science field, which is complemented by studies in areas such as political science, history, humanities, English, and philosophy. Coursework will prepare students for additional study in law school, in science policy or public policy programs, or in graduate programs in science. Careers can include positions in community and government agencies, in science and technology companies, in the military and law enforcement, as science teachers, or as science lobbyists.

For more information, students should review the resources available on the BSIS website at is.sdsmt.edu

Interdisciplinary Sciences B.S.

Contact Information for IS-ATM

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Contact Information for IS-HLTH/IS-STTS

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The bachelor of science degree in interdisciplinary sciences (IS) is a science degree program that seeks to serve the needs of students whose goals cannot be met within the other science departments. IS students choose from three areas of specialization: atmospheric sciences; pre-professional health sciences; and science, technology, and society. The IS degree program allows students to enroll in a wide variety of math and science courses, as well as carefully chosen electives in the humanities, fine arts, and social sciences.

The Interdisciplinary Sciences degree is especially appropriate for the following individuals.

- Students pursuing professional and health services careers, including but not limited to law and law enforcement, the military, medicine, physical therapy, and radiography.
- Students whose educational and career goals require courses in several departments and the integration of knowledge from diverse fields.

The benefits of the interdisciplinary sciences degree include

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

Areas of Specialization

Interdisciplinary sciences majors choose from three areas of specialization that will prepare them for graduate and professional programs.

- Atmospheric Sciences
- Pre-Professional Health Sciences
- Science, Technology, and Society

Interdisciplinary Sciences Program Admission Policy

After successful completion of at least 60 credit hours and at least one year prior to the intended graduation date, the student must apply for admission to the degree program by filing a plan of study with the IS steering committee. The plan of study must be

approved by the steering committee before a student will be formally admitted to the program. This plan of study consists of (1) a Letter of Intent stating the career goals to which the IS degree coursework is to be applied and (2) an IS worksheet showing the courses already taken and the courses to be completed prior to graduation. The Letter of Intent and worksheet must be reviewed and approved by the student's IS advisor before submission to the steering committee. The Letter of Intent form and worksheet may be accessed on the IS website. Worksheets are available for each specialization.

Deadline for submitting the Letter of Intent and worksheet to the IS office: For May graduates - April 30 of the preceding year; for August graduates - July 30 of preceding year; for December graduates - November 30 of preceding year. Students must have an approved Letter of Intent and IS worksheet on file in the IS office before registering for IS 498, the senior capstone project.

Science Minors available to IS Students

Students pursuing the IS specializations are strongly encouraged to complete a minor in another science field at School of Mines as part of their 120 total credits. Minors are available in applied biological sciences, chemistry, computer science, geology, geospatial technology, mathematics, physics, or occupational safety. Students should consult the policy on minors and the specific courses required for each minor, provided elsewhere in the catalog. The IS degree is not available as a minor.

Transfer Studies

Students who reside in local communities can achieve considerable savings in their education costs by completing a portion of their studies close to home before transferring to another institution to complete their desired major. Students who do not intend to pursue a degree offered at the School of Mines are encouraged to take courses appropriate for the two-year associate of arts (A.A.) degree in general studies. Through this program of access and transfer, students still experience the excellent educational environment found on the School of Mines campus. Students should consult the programs of study for the school from which they plan to graduate and then work closely with their A.A. advisor to select courses with the highest likelihood of transferability. Completion of the A.A. degree will fulfill the general education requirements for a baccalaureate degree at the other state universities of South Dakota (BHSU, DSU, NSU, SDSU, and USD).

Pre-law/Pre-medicine Study at Mines

While the IS specializations in pre-professional health sciences (HLTH) and science, technology, and society (STS) are especially designed to help students meet the entrance requirements for medical or law school, a particular baccalaureate degree is not required for admission into most law and medical programs. Graduates from the School of Mines with degrees in several of the science and engineering programs have successfully completed these professional programs. Students are encouraged to consult the admissions requirements and policies for those professional and medical schools to which they intend to apply.

Pre-Nursing Study at Mines

The IS degree program does not include a pre-nursing track. Students interested in earning a nursing degree from SDSU or USD should apply to those degree-granting universities. Upon acceptance to SDSU or USD, students can take courses offered by School of Mines that meet pre-nursing requirements. For more information visit the SDSU web site or the USD web site.

Teaching Opportunities and Certification

Students who are interested in teaching science or math at the secondary education level should contact education programs at the other state universities for information on the auxiliary courses required for certification. The Master of Science in secondary education degree, an accelerated certification program offered through Black Hills State University, may be of interest to students completing the IS and other science degrees at the School of Mines. Information on this program can be obtained from the BHSU website at www.bhsu.edu/

General Requirements for Graduation

For all interdisciplinary sciences specializations, students are responsible to check with their advisors for any program modifications that may occur after the publication of this catalog.

I. IS Core Courses (IS 201, IS 401, IS 498) 9 credits

II. English sequence (ENGL 101, ENGL 279, ENGL 289) 9 credits

III. Math, Computer Science, Sciences

Math and Computer Sciences ¹ min. 12

Biology ² min. 3

Chemistry ² min. 3

Additional Natural Sciences ² min. 24

Other Math, CSC, Sciences min. 18

SUBTOTAL 60

IV. Humanities and Social Sciences

Humanities general education 6

Humanities upper division 6

Social Sciences general education 6

Social Science upper division 6

SUBTOTAL 24

V. Program Approved Electives ³ 18

120 credits required for graduation

Curriculum Notes

¹ All IS specializations require MATH 123 Calculus I or a math course requiring MATH 123 as its prerequisite. Some specializations require additional math courses beyond Math 123.

² All IS specializations require a minimum of 30 credit hours in the natural sciences, including 6 hours in sequence (e.g., BIOL 151/BIOL 153) and 12 hours at the upper division. Chemistry must be at the CHEM 112 level or higher. Biology must be at the

BIOL 121 level or higher. Students are expected to identify a science concentration and are encouraged to pursue a science minor as appropriate to their specialization. Students should work with their advisors to determine the most appropriate science electives for their career goals.

³ Engineering courses may be counted toward graduation as electives only.

Thirty-six of the required 120 credits must be at the junior or senior level (courses numbered 300 and above.)

Students must meet the Institutional Credit Requirements, which include completion of a minimum of 30 credits from the School of Mines. In addition, 15 of the last 30 credits counted towards the degree must be taken from School of Mines.

Interdisciplinary Sciences Core Courses

All IS students take a sequence of three core courses, spread out over the course of three years. These courses are sequential and cannot be taken concurrently. IS courses cannot be counted for humanities/social science credit.

- IS 201 Introduction to Science, Technology, and Society **Credits: (3-0) 3** in the sophomore year;
- IS 401 Writing and Research in the Interdisciplinary Sciences **Credits: (3-0) 3** in the first semester of the senior year; and
- IS 498 Undergraduate Research/Scholarship **Credits: (0-3) 3** (senior project) in the second semester of the senior year.

Science, Technology, and Society (IS-STS): General Curriculum/Course Checklist

Course sequence may vary by student entry year, math/science placements, course availability, and career objectives. Students should consult with their advisors for a more personalized course of study based on career goals.

[Click here for printable/expanded version of the flowchart](#)

Freshman Year

First Semester

- ENGL 101 Composition I **Credits: (3-0) 3**
- ¹ Math/CSC Elective **Credits: 4**
- ² Gen Ed Humanities/Social Science Elective **Credits: 3**
- BIOL 151 General Biology I **Credits: (3-0) 3**
- BIOL 151L General Biology I Lab **Credits: (0-1) 1**

Total: 14

Second Semester

- Math/CSC Elective **Credits: 3**
- ³ Science Electives **Credits: 4**
- Gen Ed Humanities/Social Science Elective **Credits: 3**
- ⁴Program Approved Elective **Credits: 3**
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**

Total: 17

Sophomore Year

First Semester

- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- IS 201 Introduction to Science, Technology, and Society **Credits: (3-0) 3**
- Science Elective **Credits: 8**
- Gen Ed Humanities/Social Science Elective **Credits: 3**

Total: 17

Second Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- Math/CSC Elective **Credits 4**
- Science Elective **Credits: 4**
- Gen Ed Humanities/Social Science Elective **Credits: 3**

Total: 14

Junior Year

First Semester

- Math/CSC Elective **Credits: 3**
- 300/400 Science Electives **Credits: 4**
- 300/400 HUM/SS Elective **Credits: 3**
- Program Approved Elective **Credits: 4**

Total: 14

Second Semester

- 300/400 Science Elective **Credits: 4**
- Science Electives **Credits: 3**
- 300/400 HUM/SS elective **Credits: 3**
- Program Approved Elective **Credits: 4**

Total: 14

Senior Year

First Semester

- IS 401 Writing and Research in the Interdisciplinary Sciences **Credits: (3-0) 3**
- Science Electives **Credits: 3**
- 300/400 HUM/SS Elective **Credits: 3**
- 300/400 Program Approved Elective **Credits: 3**
- 300/400 Science Elective **Credits: 4**

Total: 16

Second Semester

- IS 498 Undergraduate Research/Scholarship **Credits: (0-3) 3**
- Science Electives **Credits: 4**
- 300/400 HUM/SS Elective **Credits: 3**
- Program Approved Elective **Credits: 4**

Total: 14

120 credits required for graduation

Curriculum Notes

Thirty-six (36) credits of the 120 credits required for graduation must be at a junior or senior level (courses numbered 300 or above).

¹A minimum of twelve (12) semester hours of university-approved mathematics and computer sciences is required, including Math 123 or a math course requiring Math 123 as its prerequisite. Math 102 and Math 120 may be used towards graduation requirements for the IS-STS degree. Students should consult with their advisors on the most appropriate math/computer science courses for their career paths.

² A minimum of twenty-four (24) semester hours of university-approved humanities and social sciences is required. This minimum includes six (6) hours of general education coursework in Humanities, six (6) hours of general education coursework in Social Sciences, six (6) hours of upper division Humanities, and six (6) hours of upper division Social Sciences.

³ All IS specializations require a minimum of 30 semester hours of natural sciences including a minimum of three (3) semester hours in chemistry at the CHEM 112 level or higher, three (3) semester hours in biology at the BIOL 121 level or higher, and twelve (12) semester hours at the upper division level. Of the thirty hours required in natural sciences, a minimum of six (6) credits must be sequential. Students pursuing the science, technology, and society specialization are expected to choose a science concentration. A minor in a science field (e.g., atmospheric science, biology, computer science, geology, geospatial technology, mathematics, physics) is highly encouraged. A total of 60 hours in math, computer sciences, and natural sciences is required. Students should consult with their advisors to determine the most appropriate science courses and sequence for their minors and for their career paths. The worksheet for the IS-STS specialization is available from the IS website: www.sdsmt.edu/is.

⁴ Program Approved elective credits may include additional college coursework at the 100 level or above in math, computer science, sciences, humanities, social sciences, business, military science, or engineering as needed to meet the required minimums or to qualify for a science minor. Students should consult with their advisors to determine the most appropriate elective courses for their career goals.

Mechanical Engineering, B.S.

Contact Information

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Faculty

Professors Abata, Larochelle, and Muci-Kuchler; Associate Professors Ash, Shabazi, and Widener; Assistant Professors Bruno, Degen, Fekrmandi, Huang, Lessani, and Romkes; Professors Emeritus Buck, Chiang, Dolan, Gnirk, Kjerengtroen, Krause, Langerman, and Pendleton; Instructors Knudson and Lalley.

Mechanical Engineering

Mechanical engineering (ME) 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 students a thorough knowledge of the fundamental principles of engineering and science within the major areas of mechanical engineering: thermal science, mechanics, and robotics and controls. Beyond this basic foundation, the curriculum also develops:

1. The various aspects of engineering design including design theory and teamwork;
2. An effective integration of computer technology;
3. Communication skills and effective presentations; and
4. Improved understanding of engineering theory through practical laboratory experience.

In the senior year, students select from course electives that best reflect their interests and career objectives. Students may select courses from one or more of the following general areas:

1. Manufacturing, e.g., control, design, development, and manufacture of diverse equipment and processes;
2. Thermal Science/Energy, e.g., design of power systems and heating/air conditioning systems.
3. Mechanical Systems/Design, e.g., design of machines, structures, and systems.

The bachelor of science program in mechanical engineering is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>, 415 North Charles Street, Baltimore, MD, 21201; Phone +1.410.347.7700.

Vision

Our vision is to become one of the leading undergraduate mechanical engineering programs in the nation by offering a premier engineering design curriculum and by providing our graduates with a superior educational experience through teaching and learning, research and development, and service and responsibility. Most immediately, our goal is to be recognized as the mechanical engineering program-of-choice within South Dakota and among our peer groups of specialized science and engineering schools across the nation.

Mission

The mission of the mechanical engineering program is to prepare our graduates for leadership roles in the mechanical engineering profession by:

- Offering a quality education to foster a distinctive curriculum accentuating design and project-based learning;
- Committing to individual development while emphasizing the values of teamwork in a culturally diverse, multidisciplinary environment; and
- Encouraging undergraduate and graduate research to nurture creative solutions to complex engineering problems.

Objectives

Building upon the department's tradition of excellence requires continual development of active partnerships among the faculty, the students, and our constituents. In keeping with this tradition, the mechanical engineering program produces graduates who are able to perform at a level that meets or exceeds industry expectations. ME students will be able to achieve the objectives listed below within a few years of graduation through attainment of the outcomes listed below at the time of graduation.

OBJECTIVE 1: Lead and/or manage effective engineering design analyses

Outcomes

- Apply skills in engineering, science, and mathematics
- Practice effective analysis
- Conduct data analyses and analyses verification

OBJECTIVE 2: Lead and/or manage effective engineering design teams

Outcomes

- Apply effective engineering design skills
- Demonstrate teaming proficiency
- Participate in research and professional development

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. The mechanical engineering department does not offer a minor.

Mechanical Engineering Curriculum/Checklist

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog. To graduate, students must attain a grade of C or better in all ME core courses (noted below with an *)

Freshman Year

First Semester

- MATH 123 Calculus I **Credits: (4-0) 4**
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- ME 110/110L Introduction to Mechanical Engineering/Lab **Credits: (2-0) 2**
- ENGL 101 Composition I **Credits: (3-0) 3**
- 1 Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 16

Second Semester

- MATH 125 Calculus II **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- CSC 170/170L Programming for Engineers and Scientists **Credits: (3-0) 3**
- Humanities or Social Sciences Elective(s) **Credits: 6**
- ME 125 Product Design and Development, Design for Manufacturing **Credits: (1-0) 1**
- ME 126L Product Design and Development, Design for Manufacturing Lab **Credits: (0-1) 1**

Total: 18

Sophomore Year

First Semester

- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- ME 210 Statics of Mechanisms **Credits: (3-0) 3 ***
- MATH 225 Calculus III **Credits: (4-0) 4**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- PHYS 213L University Physics II Laboratory **Credits: (0-1) 1**
Choose 4 credits from either:
- ME 264 Electromechanical Systems Product Development and Design **Credits: (2-0) 2**
- ME 264L Electromechanical Systems Product Development and Design Lab **Credits: (0-2) 2**
OR
- ME 265/265L Product Design and Development- Introduction to Systems Engineering/Lab **Credits: (2-2) 4**
OR
- ME 269/269L Energy Systems Product Development and Design/Lab **Credits: (2-2) 4**

Total: 18

Second Semester

- ME 221 Dynamics of Mechanisms **Credits: (3-0) 3 ***
- ME 211 Introduction to Thermodynamics **Credits: (3-0) 3 ***
- MATH 321 Differential Equations **Credits: (3-0) 3**
- ME 216 Introduction to Solid Mechanics **Credits: (3-0) 3 ***
- MET 231 Structures and Properties of Materials Lab **Credits: (0-1) 1**
- MET 232 Properties of Materials **Credits: (3-0) 3**

Total: 16

Junior Year

First Semester

- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- ME 316 Solid Mechanics **Credits: (3-0) 3 ***
- EE 301/301L Introduction to Circuits, Machines, and Systems/Lab **Credits: (3-1) 4**
- ME 331 Thermo Fluid Dynamics **Credits: (3-0) 3 ***
- MATH 373 Introduction to Numerical Analysis **Credits: (3-0) 3**

Total: 16

Second Semester

- ME 312 Thermodynamics II **Credits: (3-0) 3 ***
- ME 313 Heat Transfer **Credits: (3-0) 3 ***
- ME 352 Introduction to Dynamic Systems **Credits: (3-0) 3 ***
- ME 322 Machine Design I **Credits: (3-0) 3 ***
- ME 351/351L Mechatronics and Measurement Systems/Lab **Credits: (3-1) 4 ***

Total: 16

Senior Year

First Semester

- ME 477 Mechanical Engineering Design I **Credits: (0-2) 2**
- ME 481L Advanced Production Development Lab I **Credits: (0-1) 1**
- IENG 301 Basic Engineering Economics **Credits: (2-0) 2**
- ME 4XX Mechanical Engr Elective #1 **Credits: 4**
- Humanities or Social Sciences Elective(s) **Credits: 3**
- ME 4XX Mechanical Engr Elective # 2 **Credits: 3**

Total: 15

Second Semester

- ME 479 Mechanical Systems Design II **Credits: (0-2) 2**
- ME 482L Advanced Product Development Lab II **Credits: (0-1) 1**
- ME 4XX Mechanical Engr Elective #3 **Credits: 3**
- ME 4XX Mechanical Engr Elective #4 **Credits: 3**
- Humanities or Social Sciences Elective(s) **Credits: 3**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**

Total: 15

130 credits required for graduation

Curriculum Notes

* A minimum grade of C required for graduation

¹ Many courses are prerequisites for other courses, and their sequencing is important. A faculty advisor should be consulted for any deviation from the above schedule.

Metallurgical Engineering, B.S.

Contact Information

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Faculty

Douglas W. Fuerstenau Professor Kellar; Professors Cross and Salem; Associate Professors Crawford, West, and Widener; Assistant Professors Jasthi and Safarzadeh; Research Scientist Meruga; Adjunct Professors Bendler, Kustas, and Medlin; Distinguished Professor Emeritus Han; Professor Emeriti Howard and Stone.

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 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.

Modern materials are exotic and so are the methods of producing them. Metallurgy is based upon the principles of chemistry, physics, and mathematics. These sciences provide an understanding of the methods of metal production processes and the behavior of materials. In addition to familiar materials such as steel, aluminum, copper, glass, gold, and silver, metallurgical engineers produce many exotic materials such as metals with shape memories, ultrahigh-purity materials for integrated circuits, materials for surgical implants, ceramics for space vehicles, nano-scale metal particles and superconductors. There are three areas of specialization in metallurgical engineering: mineral processing, extractive metallurgy, and materials engineering. Mineral processors concentrate ores and recycled materials so that extractive metallurgists can produce pure, high-quality metals and non-metals for use by materials engineers who transform these materials into the marvels of our advanced civilization, ranging from space craft to thin diamond films. Metallurgical engineers are actively involved in nanotechnology and the production and utilization of nano-scale materials.

Advances made by metallurgical and material engineers make advances possible in other engineering fields. This happens because virtually every engineering field is in constant search of higher-performing materials. Metallurgical engineers are responsible for the production of materials and also for the evaluation of metals, ceramics, and polymer-based composites. The evaluation of materials includes tests to determine strength, hardness, toughness, corrosion behavior, and many other properties. It is the role of metallurgical engineers to develop processing methods to create materials with specific and exacting properties for every conceivable application.

The primary source for materials continues to be extracted as ores and petroleum from the Earth. However, recycled materials are an increasingly important material source for metallurgical engineers.

Materials and metallurgical engineers are employed throughout the nation and the world.

The Bachelor of Science Degree in Metallurgical Engineering is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>, 415 North Charles Street, Baltimore, MD 21201; Phone +1.410.347.7700.

The Objectives of the B.S. Metallurgical Engineering Degree Program

The program graduates will:

- Successfully apply metallurgical engineering principles in their employment.
- Meet societal needs through science and technology.
- Grow professionally and personally.
- Serve their profession and community.

Curriculum

Metallurgical Engineering Curriculum/Checklist

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

- ⁵ MATH 123 Calculus I **Credits: (4-0) 4**
- ⁶ CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- ¹ ENGL 101 Composition I **Credits: (3-0) 3**
- ^{3,4} Humanities or Social Science Elective(s) **Credits: 6**

Total: 17

Second Semester

- MATH 125 Calculus II **Credits: (4-0) 4**
- ⁶ CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- CSC 170/170L Programming for Engineers and Scientists **Credits: (3-0) 3**
- ^{3,4} Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 17

Sophomore Year

First Semester

- MET 232 Properties of Materials **Credits: (3-0) 3 ***
- MET 231 Structures and Properties of Materials Lab **Credits: (0-1) 1**
- MATH 321 Differential Equations **Credits: (3-0) 3**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- ⁷Science Elective **Credits: 3**
- EM 214 Statics **Credits: (3-0) 3**

Total: 17

Second Semester

- MATH 225 Calculus III **Credits: (4-0) 4**
- EM 321 Mechanics of Materials **Credits: (3-0) 3**
OR
- ME 216 Introduction to Solid Mechanics **Credits: (3-0) 3**
- MET 220 Mineral Processing and Resource Recovery **Credits: (3-0) 3 ****
- MET 220L Mineral Processing and Resource Recovery Laboratory **Credits: (0-1) 1**
- ¹ ENGL 279 Technical Communications I **Credits: (3-0) 3**
- ^{3,4} Humanites or Social Sciences Elective(s) **Credits: 3**

Total: 17

Junior Year

The courses on the checklist correspond with the first semester of junior year beginning in an EVEN-numbered year. Course offering cycle information for Sets A, B, C, and D are provided in Curriculum Notes.

First Semester

- ² ENGL 289 Technical Communications II **Credits: (3-0) 3**
- MET 320 Metallurgical Thermodynamics **Credits: (4-0) 4**
- Free Elective **Credits: 1**

Set A- Fall Even Years or Set C- Fall Odd Years

- MET 422 Transport Phenomena **Credits: (4-0) 4**
- ⁸Directed MET Elective **Credits: 3**

Total: 15

Second Semester

- MET 352/352L Principles of Metallurgical Design **Credits: (2-0) 2**
- MATH 373 Introduction to Numerical Analysis **Credits: (3-0) 3**
- ⁸Directed MET Elective **Credits: 3**

Set B- Spring Odd Years or Set D- Spring Even Years

- MET 321/321L High Temperature Extraction, Concentration, and Recycling/Lab **Credits: (3-1) 4**
- EE 301/301L Introduction to Circuits, Machines, and Systems/Lab **Credits: (3-1) 4**

Total: 16

Senior Year

The courses on the checklist correspond with the first semester of senior year beginning in an ODD-numbered year. Course offering cycle information for Sets A, B, C, and D are provided in Curriculum Notes.

First Semester

- MET 464 Senior Design I **Credits: (0-2) 2**
- IENG 301 Basic Engineering Economics **Credits: (2-0) 2**
- Free Elective **Credits: 3**
- Humanities or Social Sciences Elective(s) **Credits: 3**

Set A- Fall Even Years or Set C- Fall Odd Years

- MET 330 Physics of Metals **Credits: (3-0) 3**
- MET 330L Physics of Metals Lab **Credits: (0-1) 1**
- MET 332 Thermomechanical Processing **Credits: (3-0) 3**

Total: 17

Second Semester

- MET 433 Process Control **Credits: (3-0) 3**
- MET 465 Senior Design II **Credits: (0-1) 1**
- ⁷Science Elective **Credits: 3**

Set B- Spring Odd Years or Set D- Spring Even Years

- MET 440/540 Mechanical Metallurgy **Credits: (3-0) 3**
- MET 440L/540L Mechanical Metallurgy Lab **Credits: (0-1) 1**
- MET 310 Aqueous Extraction, Concentration, and Recycling **Credits: (3-0) 3**
- MET 310L Aqueous Extraction, Concentration, and Recycling Lab **Credits: (0-1) 1**

Total: 15

130 credits required for graduation

Curriculum Notes

* A Minimum Grade of "C" Required to Proceed

** A Minimum Grade of "C" Required for Graduation

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

⁷ See Advisor for approved Science Electives

⁸ See Advisor for approved Directed Met Electives

Set A-Fall Even Years

- MET 422 Transport Phenomena **Credits: (4-0) 4**
- ⁸Directed MET Elective **Credits: 3**

Set B-Spring Odd Years

- MET 321/321L High Temperature Extraction, Concentration, and Recycling/Lab **Credits: (3-1) 4**
- EE 301/301L Introduction to Circuits, Machines, and Systems/Lab **Credits: (3-1) 4**

Set C-Fall Odd Years

- MET 330 Physics of Metals **Credits: (3-0) 3**
- MET 330L Physics of Metals Lab **Credits: (0-1) 1**
- MET 332 Thermomechanical Processing **Credits: (3-0) 3**

Set D-Spring Even Years

- MET 440/540 Mechanical Metallurgy **Credits: (3-0) 3**
- MET 440L/540L Mechanical Metallurgy Lab **Credits: (0-1) 1**
- MET 310 Aqueous Extraction, Concentration, and Recycling **Credits: (3-0) 3**
- MET 310L Aqueous Extraction, Concentration, and Recycling Lab **Credits: (0-1) 1**

Mining Engineering, B.S.

Contact Information

Dr. Lance Roberts

Professor and Department Head
Mining Engineering and Management Department
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Faculty

Professors Roberts, Tukkaraja, Brickey, McCormick, and Allard.

Emeritus Professor Kliche

Adjunct Faculty

Mr. Rick Chancellor.

Mining Engineering

The mining engineering program, introduced as a new program in 2003, is designed to better meet the needs of the mining industry. It combines traditional mining engineering education with selected management-related concepts in order to better prepare the graduates for the modern mining industry.

Mining engineering is the application of engineering and scientific principles to the discovery, appraisal, and extraction of minerals from the Earth and sea. The Department of Mining Engineering and Management takes traditional mining engineering education one step farther by including management-related education in the curriculum.

The curriculum provides students with fundamental training in the basic sciences, engineering sciences, engineering design, geology, the humanities, and mining engineering. Principles of mine operations, mine planning, mining technology, advanced 3-D design and modeling, rock mechanics, explosives technology and computer applications receive special emphasis. Key management-related concepts are introduced at all levels of the curriculum.

Significant design experience is built into the curriculum and is enhanced by the use of sophisticated 3-D design software in many of the mining courses. Teamwork is stressed in the program. As students work together in small, specialized teams during many of the laboratory exercises and to complete the final capstone design project. The students present their final design project both orally and in written form.

The mining engineering degree is accredited by the Engineering Accreditation Commission of ABET, www.abet.org, 415 North Charles Street, Baltimore, MD 21201; Phone +1.410. 347.7700.

Mining Engineering Program Objectives

The program in mining engineering is designed to meet the changing needs of the mining industry all over the nation and the world by providing graduates who are technically sound in mining engineering and can progress quickly through supervision and into management.

The curriculum has been designed to meet accreditation requirements in mining engineering. The core mining engineering curriculum provides technical training in areas such as rock mechanics, mine ventilation, ore reserve evaluation, mine design, explosive application, mining equipment selection, mining method selection, and mine land reclamation. The curriculum also includes a strong emphasis on management-related topics: health and safety, economics and finance, labor relations, project management, environmental management, international business, and communication skills.

The educational objectives of the program are:

- Graduates from the mining engineering program will have the analytical, technical and mine design abilities necessary to work effectively in the field of mining engineering and will be informed of recent technical advances in the field.
- Graduates from the mining engineering program will be cognizant of societal issues and their role as future professional engineers working for the general benefit of society.

Professional Development

Students in the program are encouraged to become student members of their primary professional organization-the Society for Mining, Metallurgy, and Exploration (SME). Upon graduation, they are further encouraged to continue professional membership in SME. In addition, the students can become student members of the International Society of Explosives Engineers (ISEE). Both SME and ISEE have local chapter meetings, which students are encouraged to attend.

During their senior year, students in the mining engineering program are encouraged to take the Fundamentals of Engineering (FE) examination. Passing the FE examination is the first step toward registration as a Professional Engineer (PE). The second and final step in the registration process is the successful completion of the Professional Engineering examination, which is normally taken at least four years after graduation.

The mining engineering program participates in a cooperative education program that provides an opportunity for students to combine coursework with 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 four and one half to five years to graduate.

Mining Engineering Curriculum/Checklist

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- MATH 123 Calculus I **Credits: (4-0) 4**
- MEM 110L Introduction to Geological and Mining Engineering **Credits: (0-1) 1**
- ENGL 101 Composition I **Credits: (3-0) 3**
- Humanities or Social Sciences Elective(s) **Credits: 3**
- Physical Education **Credits: 1**

Total: 16

Second Semester

- MATH 125 Calculus II **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- MEM 120 Introduction to Mining, Sustainable Development, and Safety **Credits: (3-0) 3**
- Humanities or Social Sciences Elective(s) **Credits: 6**

Total: 16

Sophomore Year

First Semester

- MATH 205 Mining and Management Mathematics I **Credits: (2-0) 2**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- EM 216 Statics and Dynamics **Credits: (4-0) 4**
- MEM 201L Surveying for Mineral Engineers **Credits: (0-2) 2**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- ECON 201 Microeconomics **Credits: 3**
- **OR**
- ECON 202 Macroeconomics **Credits: 3**

Total: 17

Second Semester

- MATH 321 Differential Equations **Credits: (3-0) 3**
- GEOE 221/221L Geology for Engineers/Lab **Credits: (2-1) 3**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- MET 220 Mineral Processing and Resource Recovery **Credits: (3-0) 3**
- MEM 204 Surface Mining Methods and Unit Operations **Credits: (3-0) 3**

Total: 15

Junior Year

First Semester

- MEM 301/301L Computer Applications in Mining/Lab **Credits: (1-1) 2**
- MEM 303 Underground Mining Methods and Equipment **Credits: (3-0) 3**
- MEM 305 Introduction to Explosives Engineering **Credits: (3-0) 3**
- MEM 314/314L Mineralogy and Petrology for Mining Engineers/Lab **Credits: (3-1) 4**
- EE 303/303L Basic Circuits/Lab **Credits: (2-1) 3**
- MEM 376 Managerial Finance for Mining Engineers **Credits: (3-0) 3**

Total: 18

Second Semester

- MEM 302 Mineral Economics and Finance **Credits: (3-0) 3**
- MEM 304/304L Theoretical and Applied Rock Mechanics/Lab **Credits: (2-1) 3**
- EM 331 Fluid Mechanics **Credits: (3-0) 3**
- IENG 366 Engineering Management **Credits: (3-0) 3**
- AES 404/504 Atmospheric Thermodynamics **Credits: 2 or 3**
- MEM 307 Mineral Exploration and Geostatistics **Credits: (3-0) 3**

Total: 17

Senior Year

First Semester

- MEM 476 International Business for Mining Engineers **Credits: (3-0) 3**
- MEM 401/401L Theoretical and Applied Mine Ventilation/Lab **Credits: (3-1) 4**
- MEM 466 Mine Management **Credits: (2-0) 2**
- MEM 464 Mine Design and Feasibility Study **Credits: (0-4) 4**
- ¹MEM 4XX Mining Technical Elective **Credits: 3**

Total: 16

Second Semester

- ¹MEM 4XX Mining Technical Elective **Credits: 3**
- GEOL 322/322L Structural Geology/Lab **Credits: (2-1) 3**
- MEM 405 Mine Permitting and Reclamation **Credits: (3-0) 3**
- MEM 446 Human Resource Management for Mining Engineers **Credits: (3-0) 3**
- Department Approved Elective **Credits: 3**

Total: 15

130 credits required for graduation

Curriculum Notes

¹ Elective chosen from a list of approved mining or business courses.

Physics, B.S.

Contact Information

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Department of Physics

Electrical Engineering/Physics 235A

(605) 394-2364

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Faculty

Professors Corey, Detwiler, Petukhov, Sobolev, Wells; Associate Professors Schnee and Strieder, Assistant Professors Bai, Corwin, French, Oszwaldowski, and Reichenbacher; Instructor Dowding; Emeriti Professors Foygel and Helsdon.

Physics

The goal of a program of study in physics is to provide students with an understanding of the basic laws of physics and to develop skills that will enable students to further explore physical phenomena and to solve related problems.

Students should have a sense of curiosity about their surroundings and a strong desire, not only to find solutions to problems that are encountered, but also to develop a deeper understanding of the basic principles involved. Students 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, students 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. In a rapidly changing economy where one field of engineering may be in a slump while others are not, understanding physics can assist students in moving across disciplines. For these reasons, students are encouraged to consider double majors.

Graduate studies leading to the degree of Master of Science in Physics and Materials Science and Ph.D. in Materials Science and Nanoscience are offered. Research is primarily in condensed matter and particle physics. At this level of study, students are expected to assume much of the responsibility for carrying out a research project. For details of graduate programs in physics, see the graduate section.

Physics Curriculum Checklist

Students are responsible for checking with their advisors for any program modifications that may occur after the publication of this catalog.

Freshman Year

First Semester

- MATH 123 Calculus I **Credits: (4-0) 4**
- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- ENGL 101 Composition I **Credits: (3-0) 3**
- Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 14

Second Semester

- MATH 125 Calculus II **Credits: (4-0) 4**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**
- CENG 244/244L Introduction to Digital Systems/Lab **Credits: (3-1) 4**
- CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**
- Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 17

Sophomore Year

First Semester

- MATH 225 Calculus III **Credits: (4-0) 4**
- PHYS 213/213-A University Physics II/Recitation **Credits: (3-0) 3**
- PHYS 213L University Physics II Laboratory **Credits: (0-1) 1**
- PHYS 225 Vibrations, Waves, and Optics **Credits: (3-0) 3**
- ENGL 279 Technical Communications I **Credits: (3-0) 3**
- Humanities or Social Sciences Elective(s) **Credits: 3**

Total: 17

Second Semester

- MATH 321 Differential Equations **Credits: (3-0) 3**
- EE 220/220L Circuits I/Lab **Credits: (3-1) 4**
- ENGL 289 Technical Communications II **Credits: (3-0) 3**
- PHYS 275 Relativity **Credits: (3-0) 3**
- Humanities and Social Sciences Elective(s): **Credits: 3**

Total: 16

Junior Year

First Semester

- MATH 432 Partial Differential Equations **Credits: (3-0) 3**
- PHYS 341 Thermodynamics **Credits: (2-0) 2**
- PHYS 343 Statistical Physics **Credits: (2-0) 2**
- PHYS 331 Introduction to Modern Physics **Credits: (3-0) 3**
- PHYS 312 Experimental Physics Design I **Credits: (0-2) 2**
- PHYS 451/551 Classical Mechanics **Credits: (4-0) 4**

Total: 16

Second Semester

- MATH 315 Linear Algebra **Credits: (3-0) 3**
- PHYS 471/571 Quantum Mechanics **Credits: (4-0) 4**
- PHYS 314 Experimental Physics Design II **Credits: (0-2) 2**
- Physics/Math/Computer Science/Gen Chemistry Elective(s) **Credits: 3**

Total: 12

Senior Year

First Semester

- PHYS 421/521 Electromagnetism **Credits: (4-0) 4**
- PHYS 412 Advanced Design Projects I **Credits: (0-3) 3**
- * PHYS 361 Optics **Credits: (3-0) 3**
- * PHYS 481/581 Mathematical Physics **Credits: 4**

Total: 14

Second Semester

- * PHYS 433/533 Nuclear and Elementary Particle Physics **Credits: (3-0) 3**
- PHYS 439/539 Solid State Physics **Credits: 4**
- PHYS 414 Advanced Design Projects II **Credits: (0-4) 4**
- Math/Physics Elective(s) **Credits: 3**

Total: 14

120 credits required for graduation

Curriculum Notes

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

The electives must contain a minimum of 12 (has been changes in catalog 2015) hours in social sciences and humanities and 3 hours of mathematics or computer science at the 200 level or above. 10 credit hours of military science may also be used as electives.

* Courses offered alternate years.

Master of Engineering

Master of Engineering

Master of Engineering, M.Eng.

The Master of Engineering program at SDSM&T is a course-based professional master's degree program. The Master of Engineering (M.Eng.) program builds upon the undergraduate engineering degree as a 'capstone' sequence composed of advanced engineering discipline courses and applied management and leadership courses. The M. Eng. degree is a coursework-only professional program with a substantive management component for engineers employed in or preparing to enter technical management roles in business and industry.

Contact Information:

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605-394-1763

Civil & Environmental Engineering Emphasis:
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Electrical Engineering Emphasis:
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(605) 394-6133

Materials Engineering & Science Emphasis:
Dr. Jon Kellar
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(605) 394-2343

Faculty:

Civil & Environmental Engineering Emphasis:

Professors Kenner and Stone; Associate Professors Benning, Capehart, Gadhamshetty and Robinson; Assistant Professors Arneson-Meyer, Geza, Lingwall, Shearer, Waterman, and Whitaker; Instructor Bienert.

Electrical Engineering Emphasis:

Department Head Rajan, Professor Whites; Associate Professors Anagnostou, Hoover, Montoya, and Tolle; Assistant Professor Zhao; Instructor Linde.

Materials Engineering & Science Emphasis:

Douglas W. Fuerstenau Professor Kellar; Professors Corey, Cross, Fong, Petukhov, Salem, Sinden, and Sobolev; Associate Professors Crawford, Heglund, West, Widener, and Zhu; Assistant Professors Bai, Corwin, Jasthi, Oszwaldowski, Safarzadeh, and Smirnova; Emeritus Professors Howard and Stone, Distinguished Professor Emeritus Han.

Admission Requirements

A bachelor's-level degree in an area related to the emphasis area you wish to enroll in is required. A GPA of 3.0 or higher is generally required for admission. Applicants with a GPA of less than 3.0 will be considered, particularly those possessing substantial work experience.

Degree requirements: The program requires 30 credits for graduation, of which 15-24 credits of engineering content must be selected from one of three available technical emphasis areas in either Civil & Environmental Engineering (CEE), Electrical Engineering (EE), and Materials Engineering & Science (MES). The remaining 6-15 credits must be management courses that complement the student's professional goals. All courses must be approved in advance by the program coordinator of the student's emphasis area.

A thesis or final examination is not required. A project report is optional.

Technical Emphasis area	15 credits
Management	6 credits
<u>Technical or Management</u>	<u>9 credits</u>
Total	30 credits

CEE Emphasis Credit Requirements

- At least 15 credit hours of CEE approved graduate coursework (500 level courses and above)
- No more than 3 credits may be from CEE 691, CEE 788, CEM 788, CEE 791, or CP 697
- The following courses may not be applied to the M. Eng. degree: CEE 790 and CEE 798.
- At least 15 credit hours used toward degree requirements (technical and management courses combined) must be at the 600 level or higher.

EE Emphasis Credit Requirements

- EE 626 Wireless Communications **Credits: (3-0) 3**
- EE 655 Linear System Theory **Credits: (3-0) 3**
- EE 680 Engineering Electromagnetics **Credits: (3-0) 3**
- EE 431/431L/531/531L Power Systems/Lab **Credits: (3-1) 4**
- Technical Elective **(3 credits)**
- A maximum of 2 credits of MES 788 (Master's Research Problems/Projects) may be counted toward graduation requirements

MES Emphasis Credit Requirements

- MES 601 Fundamentals of Materials Engineering **Credits: (3-0) 3**
- MES 603 Condensed Matter Physics **Credits: (4-0) 4**
- MES 604 Chemistry of Materials **Credits: (4-0) 4**
- Technical Elective **(3 credits)**
- A maximum of 2 credits of MES 788 (Master's Research Problems/Projects) may be counted toward graduation requirements

Management Core Courses

Courses are available in any of our three online M.S. professional programs of [MHP1] Engineering Management, Construction Engineering and Management, and Mining Engineering and Management. Students select a minimum of two of the courses listed below to meet the management course requirement.

Engineering Management courses

- ENGM 640 Business Strategy **Credits: (3-0) 3**
- ENGM 661 Engineering Economics for Managers **Credits: 1 to 4**
- ENGM 642 Engineering Management and Labor Relations **Credits: (3-0) 3**
- IENG 466/566 Project Planning and Control **Credits: (3-0) 3**
- ENGM 620 Quality Management **Credits: (3-0) 3**
- ENGM 663 Operations Planning **Credits: (3-0) 3**
- ENGM 621 Statistical Process Control **Credits: (3-0) 3**
- ENGM 745 Forecasting for Business and Technology **Credits: (3-0) 3**

Construction Engineering & Management Courses

- CEM 619 Construction Company Management **Credits: (3-0) 3**
- CEM 620 Leading and Managing Design Organizations **Credits: (3-0) 3**

Mining Engineering & Management Courses

- MEM 435/535 Resource Industry Finance and Accounting **Credits: (3-0) 3**
- MEM 430/530 Resource Industry Mergers and Acquisitions **Credits: (3-0) 3**
- MEM 410/510 Advanced Mineral Economics for Managers **Credits: (3-0) 3**
- MEM 630 Mining Law and Environment **Credits: (3-0) 3**

Master of Science

Atmospheric and Environmental Sciences, M.S.

Contact Information

Dr. William Capehart, Program Coordinator

Atmospheric and Environmental Sciences Program

Mineral Industries 201

(605) 394-1994

E-mail: William.Capehart@sdsmt.edu

Faculty

Associate Professors Capehart, French, Kliche; Assistant Kunza; Emeritus Professors Detwiler, Helsdon, Hjelmfelt and Smith.
Instructor Clabo.

Masters of Science Study in Atmospheric and Environmental Sciences

The Atmospheric and Environmental Sciences (AES) program offers graduate courses leading to the Master of Science degree in Atmospheric and Environmental Sciences with specializations in meteorology or environmental science, and the doctor of philosophy degree in Atmospheric and Environmental Sciences. See here for more detail in the AES Doctoral Program: Atmospheric and Environmental Sciences, Ph.D.

Meteorology Specialization

The meteorology specialization in the AES graduate program is designed to give students experience in atmospheric science-related research while developing a broad understanding of the factors influencing atmospheric phenomena, including solar and terrestrial radiation, fluid dynamics, mesoscale processes, regional climate processes, thermodynamics, microphysical and electrical processes in clouds, and atmospheric chemistry. Instruction is offered in the interpretation of conventional weather, satellite and radar data; observations collected by state-of-the art research instrumentation; and output from numerical models of atmospheric processes. Program requirements are specified below

Environmental Science Specialization

The environmental science specialization in the AES graduate program is designed to give students experience in environmental science research while learning about global environmental change, biogeochemistry, aquatic ecology, atmosphere biosphere interactions, hydrology, experimental design and analyses, and environmental modeling. Program requirements are specified below.

Admission to the Masters of Science in Atmospheric and Environmental Sciences

A student applying for admission to the master's degree program in the Atmospheric and Environmental Sciences Program should have a baccalaureate degree in meteorology or atmospheric sciences, environmental science, biology, chemistry, physics, mathematics, or engineering. For the meteorology specialization, undergraduate courses in physics and in mathematics through ordinary differential equations are required and experience with computer programming is recommended. For the environmental science specialization an undergraduate course in calculus is required and courses in biology, chemistry, and physics are desirable. Graduate Record Examination (GRE) scores from the General Test are required for all students except School of Mines graduates. Test of English as a Foreign Language (TOEFL) scores are required of all applicants from colleges outside the U.S.

Thesis and Non-Thesis Options

The M.S. AES Program has both thesis and non-thesis options. The thesis option requires a total of 32 credit hours of which a minimum of 6 credit hours (but no more than 9 credit hours) of research credits reserved for completing a thesis. The non-thesis option requires 32 credit hours of which 3 credit hours are reserved for an M.S. research project.

Requirements for the M.S. degree in Atmospheric and Environmental Sciences

Thesis Option requirements (both Meteorology and Environmental Science Specializations):

- 32 credit hours of course work and thesis research as approved by the student's graduate advisory committee.
 - Fifteen credit hours of coursework in atmospheric and environmental sciences (AES prefix) at the 500-level or above.
 - Registration in 2 credits of AES 690 Seminar (offered in the spring semester only).
 - Six to nine additional credit hours of non-atmospheric and environmental sciences electives at the 400-level or above (300-level non-atmospheric sciences courses can be accepted if approved by the Council on Graduate Education), or atmospheric and environmental sciences electives at the 500-level. (For specific policies on transferring undergraduate credits to the M.S. degree program, review Graduate Education Enrollment Policies).
 - Thesis research - 6-9 credit hours.
- Selection of a graduate committee and completion of a Program of Study by mid-term of the second semester at SDSM&T.
- Completion of a master's thesis. The thesis must adhere to the format and content guidelines as set forth by the graduate school, and be approved by the student's graduate advisory committee and the Dean of Graduate Education.

Specific requirements for the Meteorology Specialization

All students are required to complete AES 406/506 (Global and Environmental Change) and a course focused on computer applications for research. This includes one of AES 419/519 Computing Methods in Atmospheric Sciences, or another appropriate course involving computer applications as approved by the student's graduate advisory committee.

Students entering the program with a bachelor's degree in fields outside of atmospheric sciences or meteorology must take the following courses:

- AES 450 Synoptic Meteorology I **Credits: (3-0) 3** (not for graduate credit)
 - AES 401/501 Atmospheric Physics **Credits: (3-0) 3**
 - AES 455/555 Synoptic Meteorology II **Credits: (3-0) 3**
 - AES 460/560 Atmospheric Dynamics **Credits: (3-0) 3**
- Additional coursework may be determined by the student's graduate advisory committee

Specific requirements for the Environmental Science Specialization

All students under the Environmental Science specialization are required to complete AES 406/506 Global Environmental Change. Additional coursework will be decided by the student's graduate advisory committee and outlined in the student's program of study.

Non-Thesis Option requirements (both Meteorology and Environmental Science specializations):

- 32 credit hours of coursework and thesis research as approved by the student's graduate advisory committee
- Up to 3 credits may be counted for research related activities. AES 788 (Master's Research Project)
- 2 Credit Hours Applied to AES 690 (Seminar)
- A scholarly paper will be required for the non-thesis option
- For the Meteorology Specialization, the following courses are required at the graduate (500) level:
 - AES 401/501 (Atmospheric Physics)
 - AES 406/506 (Global Environmental Change)
 - AES 419/519 (Computing Methods in Atmospheric Sciences)
 - AES 430/530 (Radar Meteorology)
 - AES 455/555 (Synoptic Meteorology II), and
 - AES 460/560 (Atmospheric Dynamics)
- For the Environmental Science Specialization, the following courses are required at the graduate (500) level:
 - AES 403/503 (Biogeochemistry)
 - AES 406/506 (Global Environmental Change), and
 - AES 775 (Applied Fresh Water Sciences)

Accelerated MS option (both Meteorology Environmental Sciences specializations)

SD Mines undergraduate students admitted to the "accelerated" program may apply up to 9 credits of approved 400/500/600 level AES course work taken as undergraduate or approved electives for the B.S. degree requirements to the M.S. All elective courses must be approved in advance of registration by major professor or program coordinator. (For specific policies on transferring undergraduate credits to the M.S. degree program, review Graduate Education Policies on M.S. Degree Requirements)

Biomedical Engineering, M.S.

Contact Information

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Biomedical Engineering

Offered jointly with University of South Dakota (USD). Biomedical engineering (BME) is concerned with the application of engineering and science methodologies to the analysis of biological and physiological problems and to the delivery of health care. The biomedical engineer serves as an interface between traditional engineering disciplines and living systems and may work in either direction, applying the patterns of living organisms to engineering design or engineering new approaches to human health.

Both the master of science and doctor of philosophy degrees are cross-disciplinary degrees. The objective of the M.S. program is to prepare a student for research and development careers in biomedical industry and further research at the doctoral level.

Current focus areas of faculty activity within the program are (1) biomaterials (nanomaterials, bioadhesives, tissue engineering, etc.), (2) computational biomedical engineering (biomechanics, imaging, advanced modeling/simulations, etc.), (3) assistive technology/rehabilitation engineering (advanced prosthetics, control, biomimetrics, etc.), and (4) biomolecular and genetic engineering. Students in the programs may be associated with one or more of several SDSM&T research centers and laboratories.

Admission will be based on the established graduate admission standards at the South Dakota School of Mines and Technology. The Graduate Record Examination (GRE), three letters of recommendation, and a GPA of 3.00 or better are expected of all applicants for the program. The TOEFL exam is required for students whose native language is not English. Students seeking exceptions warranted by special circumstances are requested to contact the biomedical engineering graduate program coordinator.

Students completing their M.S. degrees will graduate with a high level of competence in

- the application and characterization of various forms of biomaterials;
- knowledge of molecular biology and genetic engineering;
- the computation and simulation of phenomena in biomechanical systems; and
- transferring their understanding of biomaterials, biomechanics, and molecular biology to the creation of new biomedical applications.

Courses are offered at both SDSM&T and USD campuses. Courses offered at SDSM&T are relayed to students at USD by video, and vice versa.

Financial Support

The Biomedical Engineering program has a limited number of Research Assistantships. All students admitted to the program are automatically considered for financial support. Financial support is dependent upon maintaining good academic standing and acceptable research progress in the laboratory.

M.S. Curriculum Requirements, Thesis Option

- BME 601 Biomaterials **Credits: (3-0) 3**
- BME 602 Anatomy and Physiology for Engineers **Credits: (3-0) 3**
- BME 603 Molecular Biology for Engineers **Credits: (3-0) 3**
- BME 408/508 Biomedical Engineering **Credits: (3-0) 3**
- BME 710 Experimental Design and Data Analysis in Biological Engineering **Credits: (3-0) 3**
- BME Electives **Credits: 3**
- BME 690 Seminar **OR** BME 790 Seminar **Credits: (3-0) 3**
- BME 798 Thesis **Credits: 12**

Total: 33

Note(s):

Elective courses in the area of the student's intended research are to be selected in consultation with the student's advisory committee.

M.S. Curriculum Requirements, Non-Thesis Option

- BME 601 Biomaterials **Credits: (3-0) 3**
- BME 602 Anatomy and Physiology for Engineers **Credits: (3-0) 3**
- BME 603 Molecular Biology for Engineers **Credits: (3-0) 3**
- BME 408/508 Biomedical Engineering **Credits: (3-0) 3**
- BME 710 Experimental Design and Data Analysis in Biological Engineering **Credits: (3-0) 3**
- BME Electives **Credits: 15**
- BME 675 Non-Thesis Practical Experience and Technical Communication **Credits: 1 to 3**

Total: 33

Note(s):

Elective courses in the area of the student's intended research are to be selected in consultation with the student's advisor committee.

Accelerated Master's Option: BS/MS

The accelerated master's degree programs will enable a student to complete both a B.S. and M.S. degree in as little as 5 years. Up to 12 credits applied toward the B.S. program may be used to satisfy graduate credit requirements. A minimum undergraduate cumulative GPA of 3.0 is required at the time the student applies to the program.

Course Requirements

Courses must be taken at the 400/500/600 level. Courses taken at the 400 level are subject to the other requirements listed in the catalog. Only courses taken at SD Mines are eligible for dual credit. No transferred courses will be allowed to count toward the accelerated MS degree.

An additional 12 semester hours of graduate level credits taken as an undergraduate and not used to fulfill requirements for the undergraduate degree may be used toward a graduate degree (courses must be approved by the student's graduate student advisory committee or advisor).

The following restrictions apply.

- a. The courses must be taken at the 400/500/600 level as an undergraduate. Dual-listed courses taken at the 500-level can be applied to both the B.S. and M.S. degrees. Dual-listed courses must be taken at the 500-level.
- b. The student must apply to, and be admitted to, the accelerated program prior to taking courses to be credited toward the accelerated program.
- c. No courses taken prior to admission to the accelerated program may be counted toward an accelerated graduate degree. No exceptions to this policy will be approved.
- d. Courses that are "double counted" must be approved by the program coordinator for inclusion in the program of study prior to registration for the course or the credits will not be applied toward the accelerated graduate degree. No exceptions to this policy will be approved.
- e. For accelerated track students only, a 500 level cellular physiology course may be used as an approved substitute for BME 602, a 500 level molecular biology course may be substituted for BME 603, and a 500 level biochemistry, physiology, and anatomy course will substitute for BME 608.
- f. Only courses taken at the student's home institution are eligible for dual credit. No transferred courses from other institutions will be allowed to count toward the accelerated master's degree.
- g. Students admitted to the accelerated M.S. program may register for all courses included on his/her program of study, and these credit hours may apply to both undergraduate and graduate degree requirements.

Chemical Engineering, M.S.

Contact Information

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<http://www.sdsmt.edu/CBE/>

Faculty

Professors Dixon, Gilcrease, Menkhaus (CBE Graduate Program Coordinator), Puszynski, Salem and Winter; Associate Professors Benjamin, Sani, and Shende; Assistant Professors Brenza, Groven, and Hadley; Lecturer Pinkelman.

Chemical Engineering

The Department of Chemical and Biological Engineering offers programs of study leading to the master degree in chemical engineering (ChE). Students may consider either a thesis or non-thesis executive program option. A student who elects the thesis option will be required to present a thesis based upon an original investigation for which 6 credits must be earned toward a total requirement of 30 credits in an approved program of study. For the non-thesis executive program option, a student must earn 32 credits in an approved program of study and complete a special project. In the non-thesis executive program, which is oriented primarily toward industrial needs, students take at least one course in engineering management (for example, ENGM 625, ENGM 640, or ENGM 661) management as part of their required courses for the M.S. in chemical engineering.

The Department of Chemical and Biological Engineering offers an accelerated BS/MS degree program which will enable a student to complete both the B.S. and M.S. degrees in as little as 5 years. The accelerated BS/MS program is highly selective, for which students must apply for admission. Students interested in the accelerated program are strongly encouraged to apply at the end of their junior year. A minimum undergraduate cumulative GPA of 3.0 at the time the student applies to the program is required. Programs may grant exceptions to the GPA requirement under situations approved by the Dean of Graduate Education. Up to 12 credits applied toward the B.S. program may also be used to satisfy graduate credit requirements. Dual-counted courses must be taken at the 400/500/600 level as an undergraduate. Only courses taken at SDSM&T are eligible for dual credit. No transferred courses will be allowed to count toward the accelerated master's degree.

Students applying to the Chemical Engineering accelerated BS/MS program must fill out an accelerated BS/MS Advising Plan and find an interim advisor or major professor prior to admission to the BS/MS program. The accelerated BS/MS Advising Plan can be revised at any time, with the concurrence of the interim advisor or major professor and the department/program head or coordinator. Please contact Dr. Todd Menkhaus, CBE Graduate Program Coordinator, for further information.

Chemical engineers with a M.S. degree obtain graduate education that provides them with an in-depth understanding of the chemistry, mathematics, and physical laws describing systems at both molecular and macroscopic levels. With this knowledge, the chemical engineer can participate in interdisciplinary research, development, and implementation of new and improved technologies in areas such as: biotechnology, catalysis, nanotechnology, chemical technology, energy, environmental processes, as well as manufacturing of high-performance materials for electronic and structural applications. A student who does not have a bachelor's degree in chemical engineering will be expected to take several additional undergraduate chemical engineering courses to provide a solid ChE foundation. The current research interest of the faculty can be found on the departmental website at: <http://www.sdsmt.edu/CBE/research/>.

Core Curriculum

A core curriculum for all M.S. candidates in chemical engineering includes the following courses or approved substitutions:

- CBE 450/550 Systems Analysis Applied to Chemical Engineering **Credits: 2 to 3**
(MS Students take 3 credits)
- CBE 612 Transport Phenomena: Momentum **Credits: (3-0) 3**
- CBE 613 Transport Phenomena: Heat **Credits: (3-0) 3**
- CBE 621 Advanced Chemical Engineering Thermodynamics I **Credits: (3-0) 3**
- Kinetics Elective Credits: 3 ¹
- Applied Computation Elective Credits: 3 ²
- CBE 790 Seminar **Credits: (1-0) 1**

Curriculum Notes

¹ Kinetics Elective: CBE 444/544 or MES 728

² Applied Computation Elective: CBE 616/ME 616, CBE 424/524 MATH 432, or IENG 486.

³ A total of one credit hour of seminar is required.

In addition to the core curriculum

Students pursuing the non-thesis option must complete a minimum of 2 credits of non-thesis research, CBE 788, 3 credits in engineering management, and 8 credits of chemical engineering approved electives. Students pursuing the thesis option are required to complete, in addition to the core curriculum, a minimum 6 credits of thesis research, CBE 798, and 5 credits of chemical engineering approved electives.

An oral thesis defense for the thesis degree or oral project examination for the non-thesis degree, as well as final examination in the field of chemical engineering, are required prior to the completion of the graduate study.

Civil and Environmental Engineering, M.S.

Contact Information

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Department of Civil and Environmental Engineering

CM 243

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Faculty

Professors Kenner and Stone; Associate Professors Robinson, Capehart, Benning, and Gadhamshetty; Assistant Professors Arneson-Meyer, Lingwall, Shearer, Whitaker, Geza, and Waterman; Instructor Bienert.

Program Information

The Department of Civil and Environmental Engineering offers coursework and research opportunities leading to the Master of Science degree in civil and environmental engineering (M.S. CENE) in the following emphasis areas: environmental, geotechnical, water resources, and structural engineering.

Entrance Requirements

A GPA of 3.00 or better is required of all applicants for the M.S. CENE program. The Graduate Record Examination (GRE) and three letters of recommendation are required of all applicants for the thesis option except School of Mines graduates. The TOEFL exam is required for students whose native language is not English.

Incoming students should have completed three semesters of calculus, one semester of probability and statistics, one semester of differential equations, two semesters of chemistry, at least one semester of physics, and statics. Deficiencies in these areas must be remedied by taking the necessary coursework prior to, or in the first year of enrollment in the graduate program.

All incoming students, including those without a B.S. degree in civil or environmental engineering, are expected to have completed the appropriate background courses for their intended emphasis area. Additional subjects may be required by the student's graduate committee depending on selected emphasis area. These requirements will be documented as a formal component of a student's program of study.

An accelerated Master of Science (B.S./M.S.) degree program is available for qualified seniors enrolled in engineering B.S. programs at the South Dakota School of Mines and Technology. The accelerated master's degree program allows B.S. engineering students to take up to nine (9) graduate level credits to simultaneously meet undergraduate and graduate degree program requirements. The following restrictions apply to the accelerated B.S./M.S. program:

1. The courses must be taken at the 500/600 level as an undergraduate.
2. Only courses taken at SDSM&T are eligible for dual credit. Transferred courses from other institutions will not be allowed to count toward the accelerated master's degree.

Background courses are posted on the CEE webpage.

For more information about the M.S. CENE program, contact the graduate coordinator, Dr. Marc Robinson (Marc.Robinson@sdsmt.edu).

Curriculum

All rules and regulations of the graduate office, included elsewhere, apply to candidates for the degree of Master of Science in Civil and Environmental Engineering. Thesis and non-thesis options are available. All full-time M.S. CENE thesis students are required to attend the CEE graduate student seminar series during the course of their studies.

Thesis Option

The M.S. CENE thesis degree option consists of a program of graduate coursework and independent thesis research. Candidacy for the M.S. CENE degree with the thesis option is contingent upon the student's aptitude to do research. The thesis must constitute an original contribution to knowledge in civil and environmental engineering and must be successfully defended at a final oral presentation and examination. Students are required to complete a written thesis proposal, and present it publically at least one semester before defending the thesis with the recommendation of a major professor.

The requirements for the M.S. CENE thesis degree are as follows:

1. A program of at least 31 credit hours of coursework and research. At least 16 credit hours must be at the 600 level or higher.
2. At least 15 credit hours of CEE approved graduate coursework (500 level courses and above) to include Research Methods (CEE 600). Non-thesis Research (CEE 788) is not applicable toward the thesis option.
3. At least 6 credit hours of thesis research. No more than 6 credit hours of thesis research will count toward degree requirements.
4. Completion of a satisfactory thesis based upon independent research.
5. Meeting or exceeding prescribed academic standards.
6. Successfully defending the thesis in a public forum.

Non-thesis Option

The non-thesis M.S. CENE degree consists of a program of graduate coursework. A thesis, project paper, or final examination is not required; this is a course-work only degree. The requirements for the M.S. CENE **non-thesis** degree are as follows:

1. A program of at least 33 credit hours of course work, of which no more than 3 credits may be from CEE 691, CEE 788, CEE 790, CEE 791, CEE 798, or CP 697. At least 18 credit hours must be at the 600 level or higher.
2. At least 20 credit hours of approved CEE graduate coursework (500 level courses and above).
3. Meeting or exceeding prescribed academic standards.

Research Opportunities

Our faculty have established reputations of excellence and provide exciting opportunities for making your own contributions to cutting-edge research projects such as:

Geotechnical: liquefaction, subduction zone earthquakes, seismic fault rupture simulation, stream bank erosion, buried pipe corrosion, mechanistic-empirical pavement design, LRFD shallow foundation design

Structures and Materials: shotcrete mixture design with macrosynthetic fibers, fundamental reaction mechanisms in alkali-activated geopolymers, reuse of reclaimed fly ash, speciation and distribution of heavy metals in flyash, advanced light weight composite structures, multifunctional structural materials, finite element analysis

Environmental: Life Cycle Assessment, fate and transport of uranium from historical legacy mine sites, insitu solution recovery (ISR) uranium operations, water quality impacts from mountain pine beetle infestation in the Black Hills, anaerobic digestion and bioenergy production, graphene coatings for microbial corrosion applications, bioenergy conversion of organic wastes, air quality

Water Resources and Atmospheric Sciences: hierarchical functioning of river macrosystems in temperate steppes, geomorphology and climate relationships as they relate to biological systems of rivers, time variable land cover change and the hydrologic response with application to mountain pine beetle influences in the Black Hills, monitoring, characterization and modeling of storm water runoff and performance of best management practices, 2D modeling of fisheries habitat and performance of stream BMPs; real-time weather forecasting, regional climate modeling and climate science, integrated weather, land-surface and hydrologic modeling, climate-infrastructure resiliency

Computational Sciences and Robotics, M.S.

Contact Information

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www.sdsmt.edu/CSR

Faculty

Professors McGough and Weiss; Associate Professors Pyeatt, Qiao, and Riley; Assistant Professors Karlsson, Hinker, and Rebenitsch; Lecturer Schrader.

Computational Sciences and Robotics

The Master of Science in Computational Sciences and Robotics (CSR) is a distinctive degree that combines the intelligent power of the computational sciences with the cutting edge utility present in modern day robotics.

The CSR graduate program provides students with the advanced skills they will need in a rapidly evolving field. The program has the specialized courses to develop technical skills along with a strong emphasis on teamwork, including research projects which involve faculty and students from a variety of disciplines.

The core of the program covers the fundamentals and the students have the opportunity to gain advanced knowledge in focus areas such as pattern recognition, machine intelligence, simulation, computer vision, nonlinear control, digital signal processing and communications.

The primary objective of the CSR program is to give students a basic understanding of the tools required to implement intelligent systems in a dynamic context.

Two options for the degree are offered: thesis and non-thesis. The thesis program provides a research experience which is more focused. The non-thesis option provides the opportunity for students to expand their technical background with additional course work.

Graduates of this program should have a variety of career options in industrial applications, defense, homeland security, space exploration, or graduates can elect to continue their studies with a more advanced degree.

General Background

The entering student will normally have completed a four year degree (B.S.) in either computer science, computer engineering, electrical engineering, mechanical engineering, or a closely related field of study. The admission committee also expects a minimum of 3.0 GPA or higher in the undergraduate program of study. However, any capable and highly motivated student interested in this program is encouraged to apply regardless of academic background. Credit by examination may be available for certain courses. In the case of deficits in background, the student may be admitted on a probationary status while they make up missing coursework.

Mathematics Background

- Year of Calculus (Calculus I and II)
- One semester of Multivariate Calculus (Calculus III)
- Discrete Mathematics
- One semester of Linear Algebra
- One semester of Probability and Statistics

Physics Background

- Two semesters of calculus-based physics are suggested but not required.

Computing Background

- Three semesters of programming including a semester of data structures.

GRE

- Recommended but not required.

English Proficiency

International students must meet the Graduate School English requirements. See Graduate School website for details:
www.sdsmt.edu/GraduateEducation

Thesis

The candidate who qualifies for the thesis degree must satisfy the following requirements:

1. A minimum of 30 credits is required.
2. A minimum of 6 credits of CSC 798 (Master's Thesis) and 24 credit of course work is required.
3. The twenty-four credits of course work is divided into core and elective courses.
 - a. CSC 415/415L/515/515L Introduction to Robotics/Lab is required.
 - b. A minimum of 18 credits of elective courses.
 - c. Two credits of seminar.
4. A satisfactory thesis based on individual research. The student must present a formal defense of his or her thesis research.

Non-thesis

The candidate who qualifies for the non-thesis degree must satisfy the following requirements:

1. A minimum of 33 credits is required.
2. The 33 credits of course work is divided into core and elective courses.
 - a. CSC 415/415L/515/515L Introduction to Robotics/Lab is required.
 - b. A minimum of 24 credits of elective courses.

- c. Three credits of a Master's Project, CSC 788
- d. Two credits of seminar.

Language Requirements

There is no foreign language requirement for the M.S. degree in CSR.

CSR Electives

The CSR electives may be found at the CSR website: www.sdsmt.edu/CSR

Note(s)

The CSR program is highly interdisciplinary and we have several successful students from outside disciplines with Mechanical Engineering, Computer Engineering, and Chemical Engineering being a few recent examples. The CSR program also allows for courses from a variety of disciplines to be included in the program of study. Please contact the program director for details on allowed electives within the CSR program.

BS-MS Program

The CSR program has established agreements with the B.S. in Computer Science and the B.S. in Applied and Computational Mathematics to allow for students to complete both the B.S. program and the M.S. program in five years. Students interested in this program need to apply to the CSR program before or during their junior year. Students accepted into the program can apply up to ten credits of graduate courses towards their undergraduate degree and these same courses will apply to their graduate program of study. Students should inquire about this program at the department office or contact the CSR program coordinator.

Research Areas and Resources

Currently active research areas include: Autonomy, Computer Vision, Controls, Localization, Mapping, Motion Planning, Security, High Performance Computing, Parallel Computing, and Navigation.

Some of the active research projects include: Unmanned Aerial Vehicle, Unmanned Ground Vehicle, 3D Printing, and Intelligent Controls.

The CSR program has a variety of computing platforms available. Resources include an extensive PC network, a Linux lab, a Tablet PC lab, the L-3 Communications Embedded Systems and Robotics Lab, a 3D Printing Lab, Robotics Lab and a Mobile Computing Lab. The Linux lab is fully equipped with multi-core desktops. In addition, the interdisciplinary nature of the research and project teams allows students to utilize a variety of resources from around campus. Please see the CSR website for additional information: www.sdsmt.edu/CSR

Construction Engineering and Management, M.S.

Contact Information

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Head Professor
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Construction Engineering and Management

The Master of Science in Construction Engineering and Management (MSCM) degree is designed to provide a program of advanced study for candidates anticipating a managerial career in the design and construction industry. In addition to an available parallel course delivery in a distance mode, flexibility is built into the program to provide an optimum educational experience for working students.

Background Requirements

The construction engineering and management coursework is geared towards the working construction professional. Many students enter the program immediately after completing an appropriate undergraduate degree in the traditional disciplines of civil, electrical, mechanical, architectural, or industrial engineering. The successful applicant will have:

1. A GPA of 3.00 or better is required of all applicants.
2. Mathematics courses to include algebra, basic calculus, and statistics; and
3. Six semester hours of natural and physical science typically completed as a general education requirement in the fields of geology, astronomy, biology, meteorology, chemistry, and physics to include at least 3 credit hours of chemistry or physics.

The Graduate Record Examination (GRE) is recommended for all applicants from non-ABET accredited institutions. The TOEFL exam is required for students whose native language is not English.

An accelerated Master of Science (B.S./M.S.) degree program is available for qualified seniors enrolled in engineering B.S. programs at the South Dakota School of Mines and Technology. The accelerated master's degree program allows B.S. engineering students to take up to nine (9) graduate level credits to simultaneously meet undergraduate and graduate degree program requirements. The following restrictions apply to the accelerated B.S./M.S. program:

1. The courses must be taken at the 500/600 level as an undergraduate.
2. Only courses taken at SDSM&T are eligible for dual credit. No transferred courses from other institutions will be allowed to count toward the accelerated master's degree.

Background courses required for admission are posted on the CEE webpage.

Curriculum

The 33 hour non-thesis MSCEM degree program is an interdisciplinary curriculum that includes 18 hours of construction engineering and management oriented courses and 15 hours of electives allowing a candidate's program of study to reflect both individual interests and career goals.

The requirements for the MSCEM degree are as follows:

1. A program of at least 33 credit hours of coursework, of which at least 18 credit hours must be CEM graduate coursework.
2. At least 18 credit hours of coursework at the 600 level or higher.
3. No more than 3 credits may be CEM 691 or CEM 791.
4. Undergraduate courses (400 level and below) will not count toward graduation.
5. Meeting or exceed prescribed academic standards.
6. All rules and regulations of the graduate office, including elsewhere, apply to candidates for the degree of master of science in construction management.

CEM Courses available in person or in distance format

- CEM 608 Construction Contracts **Credits: (3-0) 3 Fall**
- CEM 610 Construction Project Management **Credits: (3-0) 3 Fall and Spring**
- CEM 612 Construction Estimating **Credits: (3-0) 3 Spring**
- CEM 614 Construction Project Scheduling **Credits: (3-0) 3 Spring**
- CEM 615 Engineering and Construction Ethics **Credits: (3-0) 3 Summer**
- CEM 616 Codes and Standards **Credits: (3-0) 3 Fall**
- CEM 619 Construction Company Management **Credits: (3-0) 3 Summer**
- CEM 620 Leading and Managing Design Organizations **Credits: (3-0) 3 Summer**
- CEM 665 Construction Equipment Management **Credits: (3-0) 3 Fall**
- CEM 706 Managing Sustainable Projects **Credits: (3-0) 3 Spring**
- CEM 710 Advanced Construction Management **Credits: (3-0) 3 Spring**
- CEM 715 Construction Operations **Credits: (3-0) 3 Fall**
- CEM 750 Environmental Permitting **Credits: (3-0) 3 Fall**
- CEM 788 Master's Research Problems and Projects **Credits: Credit to be arranged. Fall, Spring, Summer**

Electrical Engineering, M.S.

Contact Information

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Faculty

Steven P. Miller Endowed Chair and Professor Whites; Professor Sohraby; Associate Professors Montoya, Tolle, and Anagnostou; Assistant Professors Zhao, Zhang, and Hoover; Instructor Linde and Rausch.

Electrical Engineering

The mission of the graduate program in electrical and computer engineering graduate program is to provide quality student learning at an advanced level and to disseminate new knowledge in electrical engineering, while at the same time working to increase resources in support of these objectives.

The graduate program in electrical engineering consists of research and study leading to the master of science degree in electrical engineering (M.S. EE) and multidisciplinary Ph.D. degrees in materials engineering and science, nanoscience and nanoengineering, and biomedical engineering. In special cases, with the consent of the graduate committee of the electrical and computer engineering department, students may elect to do research in association with another engineering or science department.

The prospective student should have completed a baccalaureate degree in electrical engineering or computer engineering. Applicants from universities that are not accredited by the Accreditation Board for Engineering and Technology (ABET) are generally required to submit Graduate Record Exam (GRE) scores from the General Test with their application.

Depending on the student's undergraduate background, and at the discretion of the electrical and computer engineering graduate committee, graduates of other institutions may also be required to take one or more courses of preparatory undergraduate work in addition to their graduate program of study.

Master of Science in Electrical Engineering Graduate Program:

A student may pursue a Master of Science in Electrical Engineering (M.Sc. EE) via one of the following three options: (i) M.Sc. with thesis, (ii) an accelerated M.Sc. (for SDSMT undergrad only), or (iii) a M.Sc. non-thesis (a course work only) degree. The student must focus within one of the following discipline focus areas, as well as complete the specified requirements for the chosen degree option given below.

- Applied Electromagnetics
- Communications and Networking
- Controls and Autonomous Robotics Systems (CARS)

- Power Systems and Power Electronics

The courses for each area of focus are listed in Section H. Section A describes the detailed requirements for each of the M.Sc. EE degree options offered by the Electrical and Computer Engineering Department. Sections B-G describe additional department requirements, policies and capabilities.

A. Degree Options

(I) M.Sc. EE with Thesis

The thesis M.Sc. EE degree consists of a program of graduate course work and thesis research. Candidature for the M.Sc. EE degree with thesis is contingent on an aptitude to do research and/or development. A limited number of students are accepted into the M.Sc. EE thesis option, on the recommendation of a major professor. Teaching and research assistantships are normally reserved for thesis students. Upon commencement of this program, transfer from a M.Sc. EE thesis degree program to a non-thesis degree would require additional approvals from the student's existing major professor and department head, and usually is not granted.

The requirements for the M.Sc. EE thesis degree are as follows:

1. A program of at least 30 credit hours of course work and research approved by the student's major advisor and committee.
2. No more than 15 credit hours (included in the 30 credits required for graduation) can be taken at the 500 level or below (i.e. additional classes should be taken at the 600 level or above).
3. At least 6 credit hours, but no more than 9 credit hours, of thesis research may be included in the 30 credits required for graduation.
4. A satisfactory thesis based upon individual research and development.
5. Meeting or exceeding prescribed ECE and graduate program academic standards.
6. Successfully defending one's thesis.

An example M.Sc. EE with thesis program of study would be:

- 4 courses within focus area, from the set specified in section G.
- 2 courses outside one's focus area but within the discipline of Electrical and Computer Engineering- also specified in section G.
- 2 courses outside of the discipline of Electrical and Computer Engineering.
- 6-9 credits of thesis research, EE 798

(II) M.Sc. EE Accelerated Option (SDSMT Undergrads Only)

The accelerated M.Sc. EE degree consists of a program of graduate course work and a significant engineering project resulting in a project report and/or a peer-reviewed conference or journal paper. This degree is meant as an honors type of degree available to SDSMT students in good standing at the beginning of their junior year, i.e., a student with a GPA 3.0 or above within ECE related course work. Students desiring to be a part of the program need to apply to the M.Sc. EE graduate program at the beginning of their junior year and be accepted into the M.Sc. EE Accelerated option graduate program. The student must also be accepted into a focus track before taking any classes counted towards their master degree, i.e. obtain a major professor that will mentor their project research within a focus track. These degree students are normally not supported by the department via teaching or research assistantships. However, as an undergraduate student they may qualify for any available undergraduate scholarships. **It is encouraged that the student aligns senior project with graduate research project.** The degree is designed to allow the student to complete both their B.Sc. EE or B.Sc. CENG, and their M.Sc. EE within a five-year time frame. The student's engineering project is meant to be completed during the summer between the senior and graduate year and/or the summer just after their graduate year, if needed. Students in this program are assumed to be able to complete their B.Sc. and M.Sc. degree requirement in 5 years.

The requirements for the M.Sc. EE accelerated degree are as follows:

1. A program consisting of at least 32 credit hours of course work is required for this degree approved by the student's major advisor and the M.Sc. EE Graduate Coordinator (or designee). A student must apply and be admitted into a track at the beginning of their junior year before taking any of their "double counted" courses (specified below) towards the M.Sc. degree. Furthermore, the student must complete one of the following focus area tracks to be eligible for this degree. Courses taken within a focus area track (specified below) are considered "double counted" and apply towards both BS and MS degree program requirements. By completing a track, the 10 credits taken within the track as an undergraduate will then be applied towards both the undergraduate degree as well as their graduate degree. The tracks are listed below:

Applied Electromagnetics Track Required Courses:

- # EE 481/481L/581/581L Microwave Engineering/Lab Credits: **(3-1) 4**
- # EE 483/483L/583/583L Antennas for Wireless Communications/Lab Credits: **(3-1) 4**
- EE 465 Senior Design Project II Credits: **(0-2) 2** Senior Design II topic selected should have some Applied EM component (not necessarily focused 100% on Applied EM). Counts towards EE 788 and EE 798 5 credit limit within degree.

Communications and Networking Track Required Courses:

- # CENG 444/444L/544/544L Computer Networks/Lab Credits: **(3-1) 4***
- # EE 421/421L/521/521L Communication Systems/Lab Credits: **(3-1) 4**
- EE 626 Wireless Communications Credits: **(3-0) 3**

Controls and Autonomous Robotics Systems Track Required Courses:

- # EE 453/453L/553/553L Feedback Control Systems/Lab Credits: **(3-1) 4**
- EE 655 Linear System Theory Credits: **(3-0) 3**
- # CENG 414/514 Introduction to Computer Vision Credits: **(3-0) 3**

Power Systems and Power Electronics Track Required Courses:

- # EE 431/431L/531/531L Power Systems/Lab Credits: **(3-1) 4***
- # EE 439/539 Grid-Connected Power Electronics Devices Credits: **(3-0) 3****
- # EE 432/432L/532/532L Power Electronics/Lab Credits: **(3-1) 4**

Courses **MUST** be taken at **500-level**.

* Lab credit not double-counted.

** In the future, EE 547 will replace this course.

2. In addition to completing one of the focus area tracks above, the candidate's program of study must include the following four "common" courses:
 - EE 655 Linear System Theory Credits: **(3-0) 3 ****
 - EE 626 Wireless Communications Credits: **(3-0) 3**
 - EE 680 Engineering Electromagnetics Credits: **(3-0) 3 ****
 - # EE 431/431L/531/531L Power Systems/Lab Credits: **(3-1) 4 ***

Course **MUST** be taken at 500 level.

* Lab section not taken.

** Planned curriculum change requests.

3. At least 4 credit hours of project research must be part of the candidate's program of study, i.e. EE 788 Master's Research Problems/Projects. (No more than 5 credit hours of project research may be applied to the degree requirements. This limit includes any EE 465 credits that are double counted.) These credits are generally taken during the summer between the senior year and graduate year as well as the summer following the graduate year.
4. **A student must prepare, submit, and have accepted a completed project report and/or have an accepted peer-reviewed conference article based upon the individual's research and development contributions under the direction and collaboration of their major professor, with their major professor's approval.**
5. No more than 16 credit hours (included in the 32 credits required for graduation) can be taken at the 500 level (i.e., additional classes should be taken at the 600 level or above).
6. No more than 9 credits may be taken from outside the ECE department and count towards the 32 credits to graduate.
7. The student must meet or exceed the prescribed academic standards by the department and the graduate school.

An example M.Sc. EE accelerated program of study would be:

- 3 courses within a focus area track (double counted)
- 2 additional courses within a focus area (from the set specified in section G)
- 4 courses from the "common" courses prescribed above (one of these might be double counted within the focus track).
- 1 course outside of the discipline of Electrical and Computer Engineering 4-5 credits of EE 788 (includes any double counted EE 465 credits taken as part of a track above).

(III) M.Sc. EE with Non-Thesis Option:

The non-thesis M.Sc. EE degree consists of a program of graduate course work. A project and/or research are not required and are normally discouraged for the M.Sc. EE non-thesis option. These degree students are normally not supported by the department via teaching or research assistantships.

The requirements for the M.Sc. EE non-thesis degree are as follows:

1. A program of at least 32 credit hours of course work approved by the M.Sc. EE's graduate coordinator (or designee), which must include the following four "common" courses, is required:
 - EE 655 Linear System Theory Credits: **(3-0) 3****
 - EE 626 Wireless Communications Credits: **(3-0) 3**
 - EE 680 Engineering Electromagnetics Credits: **(3-0) 3****
 - # EE 431/431L/531/531L Power Systems/Lab Credits: **(3-1) 4***

Course **MUST** be taken at the 500 level.

* Lab section not taken.

** Planned curriculum change requests.

2. In addition to the required common courses, the candidate's program of study must focus within the field of electrical engineering by including a depth of at least four courses within a focus area listed in section G (as in the accelerated program).

3. No more than 16 credit hours (included in the 32 credits required for graduation) can be taken at the 500 level (i.e., additional classes should be taken at the 600 level or above).
4. No more than 12 credits may be taken from outside the ECE department and count towards the 32 credits to graduate.
5. No more than 3 credits of EE 788 Master's Research Problems/Projects, may be counted towards the 32 credits to graduate.
6. Meeting or exceeding prescribed academic standards by the department and the graduate school.

An example M.Sc. EE non-thesis program of study would be:

- 4 common courses specified above in requirement 1
- 3 courses within a focus area track in addition to the common courses as given above, specified in section G
- 2 courses outside one's focus area (as specified in section G) but within the discipline, of Electrical and Computer Engineering
- 2 courses outside of the discipline of Electrical and Computer Engineering

B. Language Requirements:

1. Students whose native language is not English are generally required to take the Test of English as a Foreign Language Test (TOEFL).
2. Graduate students with a TOEFL score below 560 are required to attend a remedial course in English.
3. Meeting or exceeding prescribed academic standards in English composition and oral presentations.

C. Graduate Credit Taken as an Undergraduate

Undergraduate students taking 600 level graduate courses and petitioning these courses for graduate credit should realize that application of these credits to the program of study is subject to the approval of the student's graduate committee. A student's graduate program will come under the control of the graduate committee at the time the student is accepted into the graduate program.

D. Graduate Committee and Program of Study

The ECE Graduate Committee is the graduate committee for all M.Sc. EE non-thesis degree students, with the ECE Graduate Coordinator or designee serving as the advisor. M.Sc. EE thesis and accelerated students must form a graduate committee with a major professor who has agreed to supervise the research/project of the student. In both cases, the student must arrange to have a faculty member external to the Department of Electrical and Computer Engineering serve on their committee.

Each student must submit a program of study to the candidate's graduate committee by the end of the first semester of study within their program. Approval of the program of study is necessary in order to register for the second and subsequent semesters.

The student's graduate committee has the right to disallow any course proposed in the student's program of study that they feel is not appropriate for a graduate degree in electrical engineering.

E. ECE Faculty Research Areas and Resources

The M.Sc. EE degree offers emphases in the areas of applied electromagnetics, antennas, and microwave, power systems and power electronics, robotics and autonomous systems, communications and networking. In addition to the more discipline-specific equipment listed below, the ECE department has well-equipped laboratories of networked PCs, general purpose test and measurement equipment such as high-speed oscilloscopes, arbitrary function generators, logic analyzers, and printed circuit board prototyping machines and software.

Research activities in the **Applied Electromagnetics** area include:

- *Electromagnetic materials* (development of accurate and novel materials characterization methods; artificial materials analysis, design, fabrication, and measurement; materials with tailorable properties).
- *Antennas* (electrically small antennas; miniaturization of ultrawideband antennas; reconfigurable / autonomous robotic antennas and antenna arrays; novel antenna reconfiguration methods and phase-change materials; "green" antennas on paper for security applications; resistively loaded antennas; wideband, coplanar and flexible antennas; metamaterial-inspired antennas).
- *Artificial electromagnetic surfaces* (high impedance and textured surfaces).
- *Microwaves* (Design of passive microwave components and baluns; applications of metamaterial-inspired designs for microwave components and antennas from MHz to THz).
- *Direct-write manufacturing of electromagnetic devices* (antennas and microwave frequency devices; MEMS).

Resources in support of this program include an anechoic chamber, many vector network analyzers, a number of electromagnetic materials characterization systems, impedance analyzers, fast rise time pulse generators and detectors, Agilent Advanced Design System, Microwave Studio, and IE3D. In addition, the Steven P. Miller Endowed Chair in electrical engineering was established in 2001 to support telecommunications in the ECE department.

Research activities in the area of **controls, and autonomous robotics systems (CARS)** include: unmanned systems, autonomous systems, robotics, machine control, fuzzy logic control, nonlinear and adaptive control, visual servo-ing, system identification, fault analysis, modeling of power systems, power systems stability, generator dynamics, and wind power. In addition, a number of robotics and controls projects are performed in association with the School of Mines Center of Excellence in Advanced Manufacturing and Production (CAMP) and Advanced Material Processing Center (AMP). Resources in support of this program include logic analyzers, a variety of microcontroller and microprocessor development systems, FPGA and CPLD prototyping boards, VHDL and Verilog compilers, Analog Devices DSP development tools, Mentor Graphics Computer Aided Design Toolset, Matlab/Simulink embedded coding tool sets, Kiel compiler tool chains, and printed circuit board manufacturing equipment.

Research activities in the area of **power systems and power electronics** include: the design, analysis and modeling of power system, control and protection of power transmission and distribution grids, electric machines and motor drives, design and control of power electronics converters based on semiconductor switching devices (Si, SiC, and GaN), integration of renewable energy resources (wind, solar, fuel-cell, etc.), and applied power electronics devices in power systems. Resources in support of this program include high-voltage dc power supply, DSpace board with toolbox embedded in Matlab for hardware-in-loop experiment, electric machines, DSP control boards, power modules, various relays, and many other related equipments, tools, and software for lab research.

Research activities in the area of **communications and networking** include problems in the physical layer, MAC, and networking layers, coding and modulation, flow and congestion control; mathematical and simulation techniques for the analysis of networks and communications systems; protocol design, performance evaluation and experimental implementation for wireless networking including cognitive radio networks, vehicular networks, wireless autonomous networks; optical and other technologies.

F. Deficiencies for Non-ECE Undergrads:

Students wishing to pursue a Master degree in Electrical Engineering that come from non-accredited Electrical or Computer Engineering Degree programs or equivalent, i.e. programs not equivalent to US-ABET accredited ECE programs, are generally deemed deficient in basic Electrical Engineering skills and knowledge required to perform basic EE tasks at the graduate level. As such, said students will be required to complete additional undergrad classes before full acceptance into the MSEE degree program. Non-ECE undergrad students are accepted into the MSEE degree program as probationary students until they pass all of their classes listed as deficient. Deficiencies are mastered via successful completion of core competence classes. These classes must be taken by non-major undergrad students and do not count directly towards the required MSEE degree credits. They must be taken and passed with an individual grade of C or better and an overall cumulative grade of B or better within the first two semesters of a students program of study (additional details below). During this period, the student will remain on probationary status within the MSEE degree program.

Required core undergrad deficiency classes:

- EE 220/220L Circuits I/Lab Credits: **(3-1) 4**
- EE 221/221L Circuits II/Lab Credits: **(3-1) 4**
- EE 320/320L Electronics I/Lab Credits: **(3-1) 4**

Plus two additional classes from the following list depending on student's MSEE focus area:

- EE 311/311L Systems/Lab Credits: **(3-0.5) 3.5**
- EE 312/312L Signals/Lab Credits: **(3-0.5) 3.5**
- EE 322/322L Electronics II/Lab Credits: **(3-1) 4**
- EE 330/330L Energy Systems/Lab Credits: **(3-1) 4**
- EE 381 Electric and Magnetic Fields Credits: **(3-0) 3**
- EE 382 Applied Electromagnetics Credits: **(3-0) 3**

Additional classes may be required and listed as deficiencies depending on the student's focus area and the student's entering background.

The formal list of deficiency classes for each MSEE student must be approved by the students' graduate advisor (generally for thesis students) or the MSEE Graduate Coordinator (or designee) (generally for non-thesis MS students) before deficiency classes can be formally taken. Said deficiency classes will be cleared, credited and marked complete when a grade of at least a C or better has been earned for each class with an overall cumulative grade point average (GPA) of B or higher for the complete deficiency class list. Said classes will be formally recorded on the student's undergrad transcript and their cumulative GPA of B or higher will be calculated based solely on the deficiency class list, i.e. no additional classes will be taken into account when calculating the minimum passing cumulative deficiency GPA. After the deficiency class list has been completed as described above and the student is in good standing, they will be removed from probationary status and accepted as a full MSEE degree student within the program.

G. Additional ECE Graduate Policies:

1. Non-US Undergraduate Student Admissions:

WES (or similar) translation of foreign transcripts is required for regular admissions within the M.Sc. EE applications.

2. Regular Admissions:

Engineering graduates from an accredited US or Canada ABET-accredited school are required to have a minimum GPA of 3.0 on a 4.0 scale (i.e., a B average is required). Likewise, international students are required to have a minimum equivalent GPA of 3.0 on a 4.0 scale. Moreover, students from a non-ABET-accredited US Canada school or from an international school are additionally required to have a minimum score of 50% on the Quantitative Reasoning section of the GRE test.

In addition, to the minimums listed above, all students must submit a statement of purpose discussing why they wish to obtain a masters degree in electrical engineering at SDSMT. They must also submit three letters of reference in support of their pursuit of a graduate degree at SDSMT.

3. Probationary Admission:

A student not meeting the minimum requirements for regular admissions can be admitted under a probationary status with a minimum GPA of 2.75 on a scale of 4.0 given the additional requirements that a department faculty member agrees to serve as the students advisor. The student is then converted to a non-probationary student after passing, with a B average, at least 9 credits of approved M.Sc. EE program of study courses while attending SDSMT.

4. Probationary Status:

A student may continue their studies within the M.Sc. EE program at SDSMT while on probation for up to 2 semesters,

if the student has not cleared up the issues that placed them in probation at the end of the second semester on probation the student will be required to end their graduate work in the M.Sc. EE program at SDSMT at that time.

5. GPA Graduation Policy:

In order to be eligible to graduate from the M.Sc. EE graduate program a student must obtain at least a 3.0 GPA on SDSMT's 4.0 GPA scale within the classes listed on their approved program of study, i.e. the student must have a program of study GPA of B or better for graduation.

H. M.Sc. EE Classes Organized by Area of Focus:

Students should select their program of study classes from the list below with consultation and approval by their major advisor and/or committee or by the M.Sc. EE graduate program coordinator (or his designee) (depending on the degree option being sought). Classes not from this list maybe approved on a case-by-case basis by a student's advisor and/or committee or by the M.Sc. EE graduate program coordinator (or his designee) (depending on the degree option being sought).

Applied Electromagnetics focus area courses:

- # EE 481/481L/581/581L Microwave Engineering/Lab **Credits: (3-1) 4**
- # EE 483/483L/583/583L Antennas for Wireless Communications/Lab **Credits: (3-1) 4**
- EE 680 Engineering Electromagnetics **Credits: (3-0) 3**
- EE 792 Topics **Credits: 1 to 4** (Topics Options Below)
- Topics: Advanced Antenna Engineering **Credits: 3**
- Topics: Computational Electromagnetics **Credits: 3**
- Topics: Advanced Microwave Engineering **Credits: 3**
- Topics: Finite Difference Time Domain **Credits: 3**
- Topics: Guided Waves and Material Measurements **Credits: 3**
- # **Courses MUST be taken at 500 level.**

Communications and Networking (CN) focus area courses:

- # CENG 444/444L/544/544L Computer Networks/Lab **Credits: (3-1) 4**
- # EE 421/421L/521/521L Communication Systems/Lab **Credits: (3-1) 4**
- EE 623 Random Signals and Noise **Credits: (3-0) 3**
- EE 626 Wireless Communications **Credits: (3-0) 3**
- # EE 483/483L/583/583L Antennas for Wireless Communications/Lab **Credits: (3-1) 4**
- EE 655 Linear System Theory **Credits: (3-0) 3**
- EE 621 Information and Coding Theory **Credits: (3-0) 3**
- EE 622 Statistical Communication Systems **Credits: (3-0) 3**
- # **Courses MUST be taken at 500 level.**

CN out of department -- out of discipline courses:

- MATH 421 Complex Analysis **Credits: (3-0) 3**
- MATH 423 Advanced Calculus I **Credits: (4-0) 4**
- MATH 424 Advanced Calculus II **Credits: (4-0) 4**

- MATH 432 Partial Differential Equations **Credits: (3-0) 3**
- # MATH 451/551 Math Modeling **Credits: (3-0) 3**
- MATH 471 Numerical Analysis I **Credits: (3-0) 3**
Course **MUST** be taken at 500 level.

Controls and Autonomous Robotics Systems (CARS) focus area courses:

- # EE 453/453L/553/553L Feedback Control Systems/Lab **Credits: (3-1) 4**
- # EE 456/456L/556/556L Digital Control Systems/Lab **Credits: (3-1) 4**
- # CENG 414/514 Introduction to Computer Vision **Credits: (3-0) 3**
- EE 655 Linear System Theory **Credits: (3-0) 3**
- EE 757 Intelligent Control Systems **Credits: (3-0) 3**
- EE 623 Random Signals and Noise **Credits: (3-0) 3**
- EE 641 Digital Systems Design **Credits: (3-0) 3**
- EE 643 Advanced Digital Systems **Credits: (3-0) 3**
- EE 751 Advanced Digital Control Systems **Credits: (3-0) 3**
- EE 753 Optimal Control Theory **Credits: (3-0) 3**
- EE 754 Nonlinear Control Theory **Credits: (3-0) 3**
- EE 792 Topics **Credits: 1 to 4** (Topics Options Below)
- Topics: Adaptive Control **Credits: 3**
- Topics: System Identification **Credits: 3**
- Topics: State Space Digital Control **Credits: 3**
- Topics: Linear Control Systems **Credits: 3**
- EE 755 Linear State Space Control **Credits: (3-0) 3**
Course **MUST** be taken at 500 level.

CARS out of department -- out of discipline courses:

- # CSC 415/415L/515/515L Introduction to Robotics/Lab **Credits: (3-1) 4**
- # CSC 416/516 Advanced Algorithms for Robotics **Credits: (3-0) 3**
- # CSC 449/549 Advanced Topics in Artificial Intelligence **Credits: (3-0) 3**
- CSC 752 Computer Vision **Credits: (3-0) 3**
- CSC 761 Advanced Artificial Intelligence **Credits: (3-0) 3**
- CSC 762 Neural Networks **Credits: (3-0) 3**
- MATH 421 Complex Analysis **Credits: (3-0) 3**
- MATH 423 Advanced Calculus I **Credits: (4-0) 4**
- MATH 424 Advanced Calculus II **Credits: (4-0) 4**
- MATH 432 Partial Differential Equations **Credits: (3-0) 3**
- # MATH 451/551 Math Modeling **Credits: (3-0) 3**
- MATH 471 Numerical Analysis I **Credits: (3-0) 3**
- ME 455/455L Vehicle Dynamics/Lab **Credits: (2-1) 3**
- ME 673 Applied Engineering Analysis I **Credits: (3-0) 3**
- ME 683 Advanced Mechanical System Control **Credits: (3-0) 3**
- ME 781 Robotics **Credits: (3-0) 3**
Courses **MUST** be taken at 500 level.

Power Systems and Power Electronics focus area courses:

- # EE 431/431L/531/531L Power Systems/Lab **Credits: (3-1) 4**
 - EE 547 Advanced Power Systems **Credits: 3 ***
 - # EE 432/432L/532/532L Power Electronics/Lab **Credits: (3-1) 4**
 - # EE 435/535 Power Transmission and Distribution **Credits: (3-0) 3**
 - # EE 448/548 Power Generation **Credits: (3-0) 3**
 - # EE 439/539 Grid-Connected Power Electronics Devices **Credits: (3-0) 3**
 - EE 437 Electronic Motor Drives **Credits: (3-0) 3**
 - EE 449 Power Conversion **Credits: (3-0) 3**
 - EE 633 Power Systems Analysis I **Credits: (3-0) 3**
 - EE 634 Power System Analysis II **Credits: (3-0) 3**
- * This course will be offered in future terms**
- # Courses MUST be taken at 500 level.**

Engineering Management, M.S.

Contact Information

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School of Mines Faculty

Professor Woldstad, Kellogg, and Kerk; Associate Professors Matejcik, Jensen, and Piper; Assistant Professor Dubey; and Instructor Jensen.

Engineering Management

The M.S. degree in Engineering Management (MSEM) is designed to provide a program of advanced study in technically oriented disciplines for candidates anticipating a managerial career. It is a multi-disciplinary applications-oriented degree, which draws from the fields of engineering, management, business, operations research and management science.

The intent of the program is to provide an interface between training received in engineering and scientific disciplines with the management of resources and personnel in a technical environment. In addition to being available in distance mode, flexibility is built into the program in order to provide an optimum educational experience to students. Graduates of the EM program are likely to find an initial position as a mid level supervisor within a broad range of applications requiring the use of quantitative models to integrate human and material resources necessary to perform an integrated function. Program specific information and resources may be found at the department of industrial engineering website: <http://ie.sdsmt.edu>.

The Engineering Management (ENGM) program has an accelerated BS/MS degree option that will enable a student to complete both the B.S. and M.S. degrees in as little as 5 years. The accelerated B.S./M.S. program is highly selective, for which students must apply for admission. Students interested in the accelerated program are strongly encouraged to apply at the end of their junior year. A minimum undergraduate cumulative GPA of 3.0 at the time the student applies to the program is required. The MS program may grant exceptions to the GPA requirement under situations approved by the Dean of Graduate Education. Up to 12 credits of 400/500/600 credits applied toward the B.S. program may also be used to satisfy graduate credit requirements. Dual-counted courses must be taken at the 400/500/600 level as an undergraduate. Only courses taken at SDSM&T are eligible for dual credit. No transferred courses will be allowed to count toward the accelerated master's degree.

Students applying to the ENGM accelerated B.S./M.S. program must fill out an accelerated B.S./M.S. Advising Plan and find an interim advisor or major professor prior to admission to the B.S./M.S. program. The accelerated B.S./M.S. Advising Plan can be revised at any time, with the concurrence of the interim advisor or major professor and the ENGM program coordinator. Please contact the program coordinator (Dr. Frank Matejcik) for further information.

Application should be made through the graduate office at School of Mines <http://graded.sdsmt.edu/prospective/apply> All candidates for this degree must possess a bachelor's degree from a four-year accredited institution, in which satisfactory performance has been demonstrated. In addition to these requirements, the following minimum bachelor's level credits shall have been completed:

1. Mathematics one year minimum, to include algebra and basic calculus (Equivalent to School of Mines MATH 123).

2. Six 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 of probability and statistics. (Students may complete prerequisite requirements in probability and statistics through an Internet-based study option. Students desiring this option should contact the program coordinator.)

In addition, individual elective courses may have additional prerequisite requirements. A maximum of 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 the School of Mines.

Requirements for the degree include the completion of a minimum of 24 credits of coursework and 6 credits of research for the thesis option, or 32 credits of coursework for the non-thesis option. A cumulative GPA of 3.0 must be obtained by the end of the program of study and other general and master's level grade requirements must be maintained as specified in this catalog. The probation policy outlined in this catalog applies to all credits taken.

The continuing registration requirement must be satisfied at the School of Mines campus. Students utilizing transfer credits should plan accordingly and ensure that they are officially enrolled in a minimum of the two credits from the School of Mines the semester in which they graduate.

In the early stages of the candidate's program, a student advisor will be appointed by the program director of School of Mines. The advisor will meet with the student to prepare a program along the direction of the specific emphasis desired. The advisor and student will then organize an advisory committee, and file their committee program of study with the School of Mines graduate office according to the directions specified under "Supervision of the Master's Program" of the Master of Science Programs section of this catalog.

Core Course Requirements

A minimum of 3 semester hours of required coursework must be completed in each of four discipline areas. Discipline areas and allowable courses are shown below.

Business/Finance

- ENGM 661 Engineering Economics for Managers **Credits: 1 to 4**
- ENGM 640 Business Strategy **Credits: (3-0) 3**

Management

- ENGM 642 Engineering Management and Labor Relations **Credits: (3-0) 3**
- IENG 466/566 Project Planning and Control **Credits: (3-0) 3**

Quantitative Methods

- ENGM 435/535 Optimization Techniques **Credits: (3-0) 3**
- ENGM 632 Stochastic Models in Operations Research **Credits: (3-0) 3**
- ENGM 745 Forecasting for Business and Technology **Credits: (3-0) 3**

Operations Management

- ENGM 663 Operations Planning **Credits: (3-0) 3**
- ENGM 620 Quality Management **Credits: (3-0) 3**

Note(s):

Students wishing to utilize transfer courses to satisfy core requirements should contact their advisor or the program coordinator for suitability of transfer credits. In some cases, agreements with other state institutions are already available.

Recommended Elective Courses

Any core course not used to satisfy core requirements may be used as an elective. Students may use any graduate School of Mines course provided it is approved by their committee. ENGM courses are available in distance learning mode and are listed below.

- ENGM 640 Business Strategy **Credits: (3-0) 3**
- ENGM 650 Safety Management **Credits: (3-0) 3**
- ENGM 655 Ergonomics for Managers **Credits: (3-0) 3**
- ENGM 675 Legal and Ethical Issues in Engineering Management **Credits: (3-0) 3**
- ENGM 625 Innovation and Commercialization **Credits: (3-0) 3**
- ENGM 621 Statistical Process Control **Credits: (3-0) 3**
- ENGM 632 Stochastic Models in Operations Research **Credits: (3-0) 3**
- ENGM 745 Forecasting for Business and Technology **Credits: (3-0) 3**
- ENGM 792 Topics **Credits: 1 to 3**

Transfer Credits

Students may transfer up to 12 credits from another accredited institution or from another SDSM&T graduate degree program provided they meet the graduate office guidelines and program approval.

Sample Programs

The following are sample programs for the project 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

- ENGM 661 Engineering Economics for Managers **Credits: 1 to 4**
- ENGM 642 Engineering Management and Labor Relations **Credits: (3-0) 3**
- IENG 466/566 Project Planning and Control **Credits: (3-0) 3**
- ENGM 663 Operations Planning **Credits: (3-0) 3**
- ENGM 435/535 Optimization Techniques **Credits: (3-0) 3**
- Elective **Credits: 3**
- ENGM 620 Quality Management **Credits: (3-0) 3**
- ENGM 632 Stochastic Models in Operations Research **Credits: (3-0) 3**
- ENGM 650 Safety Management **Credits: (3-0) 3**
- ENGM 745 Forecasting for Business and Technology **Credits: (3-0) 3**
- ENGM 788 Master's Research Problems/Project **Credits: Credit to be arranged.**

Total: 32

Student B

- ENGM 661 Engineering Economics for Managers **Credits: 1 to 4**
- ENGM 642 Engineering Management and Labor Relations **Credits: (3-0) 3**
- IENG 466/566 Project Planning and Control **Credits: (3-0) 3**
- ENGM 663 Operations Planning **Credits: (3-0) 3**
- ENGM 435/535 Optimization Techniques **Credits: (3-0) 3**
- Elective **Credits: 3**
- ENGM 632 Stochastic Models in Operations Research **Credits: (3-0) 3**
- ENGM 621 Statistical Process Control **Credits: (3-0) 3**

Total: 3

Geology and Geological Engineering, M.S.

Contact Information

Dr. Laurie Anderson

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Geology Faculty

Professors L. Anderson, Duke, Masterlark, Price and Uzunlar; Associate Professor Pagnac; Assistant Professors Baran and Ustunisik; Professors Emeritus Fox, Lisenbee, Martin, Paterson, and Redden; Adjunct Faculty Benton and McCormick.

Geological Engineering Faculty

Professor Stetler; Associate Professors Katzenstein and Sawyer; Assistant Professor and Li; Professors Emeritus Davis and Rahn; Adjunct Faculty M. Anderson, Iles, Long, Roggenthen, and Valder.

Geology and Geological Engineering

The Department of Geology and Geological Engineering offers advanced study leading to M.S. and Ph.D. degrees in geology and geological engineering. Students must elect to pursue either a Geology Specialization or a Geological Engineering Specialization, each of which has different background and program requirements. The available coursework and current faculty expertise support the following areas of concentration.

1. Energy Resources
2. GIS, Geoinformatics, and Remote Sensing
3. Groundwater and Environment
4. Paleontology*
5. Petrology and Mineral Resources
6. Structure, Tectonics, and Geodynamics
7. Geomechanics

* Students concentrating in paleontology at the Master's level may apply for the separate M.S. in Paleontology.

The Accelerated B.S./M.S. option is available for this degree.

Graduate Programs Outcomes

A graduate of the M.S. in Geology/Geological Engineering is expected to:

- Demonstrate knowledge of concepts and terminology of the discipline
- Explore and evaluate scientific and technical literature

- Analyze, interpret, and evaluate scientific and/or engineering data and methods
- Communicate effectively (in writing and orally)
- Act professionally and ethically
- Impact the profession with research

Background Requirements for M.S.

The Graduate Record Examination (GRE) is required of all applicants. The TOEFL, IETS, or PTE exam is required for students whose native language is not English. Many factors contribute to the success of an application, including the goals statement, coursework, grades, test scores, work experience, recommendations, and availability of a faculty member in the student's anticipated research area. In general we prefer to see a GPA of 3.0 or above and GRE scores greater than the 50th percentile. Different specializations have different background coursework requirements, as described below.

Background Expected for Geology Specialization

Incoming students are expected to have substantial preparation in general science, math, and geological sciences; successful applicants will ideally have completed the subjects listed below. The student's graduate committee may require that deficiencies important to the student's area of interest be remedied by taking additional undergraduate courses that will not count towards the graduate degree credit requirements.

- Calculus I and II
- Statistics
- General Chemistry I and II
- General Physics I and II, or General Biology I and II
- Stratigraphy/Sedimentation
- Petrology
- Structural Geology
- Field Geology

Background Expected for Geological Engineering Specialization

Incoming students are expected to have substantial preparation in science, math, geological sciences, and engineering; successful applicants will ideally have completed the subjects listed below. The student's graduate committee may require that deficiencies important to the student's area of interest be remedied by taking additional undergraduate courses that will not count towards the graduate degree credit requirements.

- Calculus I, II, and III
- Differential Equations
- General Chemistry I and II
- General Physics I and II
- Stratigraphy/Sedimentation
- Petrology
- Structural Geology
- Statics
- Mechanics of Materials
- Fluid Mechanics, or Rock Mechanics

MS in Geology and Geological Engineering Program Requirements

The M.S. thesis option requires 30 credits, including six (6) credits of thesis research and twenty-four (24) credits of coursework. No more than 15 credits may come from courses at the 500-level or below. The non-thesis option includes 32 credits of coursework and is available to students at the discretion of the department head (see below for non-thesis M.S. guidelines). Candidates for the M.S. degree must fulfill all degree requirements of the graduate office and the program, including an oral comprehensive exam covering course material. This exam should be scheduled through the student's major advisor with committee approval when the student has substantially completed the required 24 credits of coursework for the M.S., and at least three months prior to the thesis defense.

Geology Specialization Requirements

The candidate's committee is responsible for assisting the student in developing a program of study that prepares the student for his/her intended field of study. GEOL 700 Developing and Planning Research is required the first fall semester of enrollment. In addition, the program of study must include at least one GEOL/GEOE course emphasizing field/analytical methods and one GEOL/GEOE course emphasizing computational methods. The student's advising committee determines the courses that meet these criteria.

Geological Engineering Specialization Requirements

All M.S. students in the Geological Engineering specialization are expected to focus in one of the three areas of groundwater/environmental, geomechanics, or energy/mineral resources. The candidate's committee is responsible for assisting the student in developing a program of study that prepares the student for his/her intended focus area. GEOE 700 Developing and Planning Research is required the first fall semester of enrollment. In addition, the program of study must include at least one GEOL/GEOE course emphasizing field methods, one GEOL/GEOE course emphasizing analytical methods and one GEOL/GEOE course emphasizing computational methods. The student's advising committee determines the courses that meet these criteria.

Non-Thesis Option Guidelines

The department considers the thesis option to be its primary degree and strongly prefers that all M.S. students complete a thesis. However, in some cases a non-thesis degree may be granted to accommodate special circumstances. Central to the decision is the judgment whether the student constitutes a quality graduate of the program as compared to other graduates, despite the lack of a completed thesis.

Students considering the non-thesis option are strongly encouraged to discuss it with their committee prior to making a request. The request must be made in writing to the department head with a justification as to why the non-thesis option is being requested. The department head will provide the letter to the student's graduate committee and ask for a written recommendation regarding the request. Both the student and committee letters will be provided to the department Graduate Committee, which will also consider the request and write a recommendation. These recommendations may include conditions that must be completed before the degree may be awarded. The department head will make the decision guided by the input from these two committees, and inform the student of the decision, including any conditions that may be attached to completing the non-thesis option.

The following conditions must be met by the student to be eligible to apply for the non-thesis option:

1. The student should have a graduate GPA of 3.5 or higher.
2. The student must have been continuously registered in the program or on a formally approved leave of absence since the first semester in residence to be eligible for a non-thesis option.

3. The student must have been actively working towards a thesis project with regular communication with the advisor during the months prior to the non-thesis request.
4. The student must complete a significant project and write up the results in a project report, in lieu of a formal thesis. The student's committee will make the determination whether the student's work may be deemed a significant contribution to the profession. This requirement may include content-appropriate work performed for an employer.
5. If the student has received research funding, he or she is obligated to work with the faculty member who provided the funds to establish a written plan to fulfill any outstanding obligations to the research effort, which shall be submitted with the non-thesis request. Should they not be able to agree on the plan, the matter will be referred to the department Graduate Committee for resolution.

The following circumstances should be considered when deciding whether the non-thesis option is appropriate.

1. Has the student encountered external circumstances that would make the completion of the thesis unreasonably difficult or time-consuming?
2. Does the student have outstanding obligations to a funded or important project that might not otherwise be completed?

Materials Engineering and Science, M.S.

Contact Information

Dr. Jon J. Kellar

Department of Materials and Metallurgical Engineering
Mineral Industries 112
(605) 394-2343
E-mail: Jon.Kellar@sdsmt.edu

Steering Committee

Steering Committee members are from the Departments of Materials and Metallurgical Engineering, Physics, and Chemistry.

Faculty

Douglas W. Furstenu Professor Kellar; Professors Corey, Cross, Fong, Petukhov, Salem, Sinden, and Sobolev; Associate Professors Crawford, Heglund, West, Widener, and Zhu; Assistant Professors Bai, Corwin, Crawford, Jasthi, Oszwaldowski, Safarzadeh, and Smirnova; Emeritus Professor Boyles, Howard, Stone, Distinguished Professor Emeritus Han.

Master of Science in Materials Engineering and Science

This interdisciplinary degree program works in concert with other colleges and the Ph.D. in materials engineering and science (Ph.D./MES).

The M.S./MES degree offers an education in the broad area of materials. Students pursuing this degree will expand their knowledge and understanding of the science and technology of materials synthesis, behavior, and production. Graduates of the program formulate solutions to materials problems through the use of multi-disciplinary approaches made possible with a broad background in basic materials science and engineering coupled with an area of specialization.

Two options are available in this degree program: one option involves a thesis component and the other option involves coursework only. In the thesis option, 24 hours of coursework and a minimum 6 credit hours of thesis research (MES 798) are required. With the second option, 32 hours of coursework must be taken and a minimum of two credit hours of MES 788 are required. In the latter option however, the students are required to undertake a project under the supervision of a faculty member. 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 four core courses (see below).

The Materials Engineering and Science (MES) program has an accelerated BS/MS degree option that will enable a student to complete both the B.S. and M.S. degrees in as little as 5 years. The accelerated B.S./M.S. program is highly selective, for which students must apply for admission. Students interested in the accelerated program are strongly encouraged to apply at the end of their junior year. A minimum undergraduate cumulative GPA of 3.0 at the time the student applies to the program is required. The MES program may grant exceptions to the GPA requirement under situations approved by the Dean of Graduate Education. Up to 12 credits of 400/500/600 credits applied toward the B.S. program may also be used to satisfy graduate credit requirements. Dual-counted courses must be taken at the 400/500/600 level as an undergraduate. Only courses taken at SDSM&T are eligible for dual credit. No transferred courses will be allowed to count toward the accelerated master's degree.

Students applying to the MES accelerated B.S./M.S. program must fill out an accelerated B.S./M.S. Advising Plan and find an interim advisor or major professor prior to admission to the B.S./M.S. program. The accelerated B.S./M.S. Advising Plan can be revised at any time, with the concurrence of the interim advisor or major professor and the MES program coordinator. Please contact the program coordinator (Dr. Jon Kellar) for further information.

Core Courses

- MES 601 Fundamentals of Materials Engineering **Credits: (3-0) 3**
- MES 602/602L Materials Characterization: Methods and Applications/Lab **Credits: (3-0) 3**
- PHYS 439/539 Solid State Physics **Credits: 4**
- MES 604 Chemistry of Materials **Credits: (4-0) 4**

In addition

- ¹ MES 790/890 Seminar **Credits: (1-0) 1** is a required course.

Additional Information

Areas of research currently carried out include inorganic, organic, and biological behavior/synthesis/treatments of materials, polymer chemistry, solid state physics, interfacial chemistry/physics, thermal, magnetic and transport properties of semiconductors, superconductors, metals and alloys, dielectric and composite materials, recovery and processing of minerals/materials/scrap, process simulation and optimization, thermodynamics of various materials, corrosion and corrosion inhibition, strengthening mechanisms, deformation induced transformation plasticity, security printing, and behavior/properties/synthesis of composites.

Program assessment includes student outcomes and satisfaction surveys.

¹MES 790 should be taken by M.S. students and MES 890 by Ph.D. students.

Mechanical Engineering, M.S.

Contact Information

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Faculty

Professors Abata, Larochelle, and Muci-Kuchler; Associate Professors Ash, Shahbazi, and Widener; Assistant Professors Bruno, Degen, Fekrmandi, Huang, Lessani, and Romkes; Professors Emeritus Buck, Chiang, Dolan, Gnirk, Kjerengtroen, Krause, Langerman, and Pendleton.

The master of science degree program in mechanical engineering can be pursued using either of two (2) equal options. They are:

1. Non-Thesis:

Total credit hours required: 32

4 Credit hours (maximum and minimum required)

- ME 788 Master's Research Problems/Projects **Credits: Credit to be arranged.**

Remaining 28 hours are taken

- (maximum) at the 400/500 level Credits: 9
- (minimum) at the 600/700 level Credits: 19

2. Thesis:

Total credit hours required: 30

6 Credit hours (maximum and minimum required)

- ME 798 Thesis **Credits: Credit to be arranged.**

Remaining 24 hours are taken

- (maximum) at the 400/500 level Credits: 9
- (minimum) at the 600/700 level Credits: 15

Accelerated Master of Science Option

The mechanical engineering department has an accelerated M.S. degree option for academically-motivated students. Students admitted to the accelerated program may apply up to nine (9) credits of 400/500/600 (see note below) level coursework taken as an undergraduate for M.S. degree requirements to either the thesis or non-thesis option. All elective courses must be approved in advance of registration by the major professor or program coordinator. Students must apply for normal graduate school admission and notate their desire for the accelerated option on the application. In order for credits to be double counted, students must be admitted into the program before beginning the courses.

Curriculum Notes

1. 300 level acceptable if outside department and on approved blanket waiver list.
2. Students may enroll in 300/400 level courses only if 500/600 level courses within the major are not being offered or by written permission of the student's major professor and the department head.

Within the first semester in residence, each student is requested to carefully evaluate their preference of study after discussion with the mechanical engineering faculty, and a decision must be made shortly after the beginning of the second semester in residence. In either case the student must by then choose a major professor, and with the major professor's assistance develop a plan of study. The plan is due by the mid-term of the student's second semester in residence. The plan will be submitted to the program coordinator, who will disseminate to :

1. Graduate office
2. The department head
3. Major professor
4. Copy to the student

Each master's degree candidate must select an advisory committee. In addition to the candidate's major professor, the committee must consist of at least one other mechanical engineering professor and a graduate office representative. The graduate office representative, whose appointment must be approved by the graduate dean, must be selected from outside of the mechanical engineering department. The student and his/her supervising professor will nominate the out-of-department committee member after the student has received the nominee's consent.

The core curriculum required of all M.S. students includes:

- ME 673 Applied Engineering Analysis I **Credits: (3-0) 3**
- ME 773 Applied Engineering Analysis II **Credits: (3-0) 3**

In addition

Students should select one course from each of the three areas listed below (or approved substitutions) for a total of five core courses.

Thermal Sciences

- ME 612 Transport Phenomena: Momentum **Credits: (3-0) 3**
- ME 613 Transport Phenomena: Heat **Credits: (3-0) 3**
- ME 616 Computations in Transport Phenomena **Credits: (3-0) 3**
- ME 618 Conduction Heat Transfer **Credits: (3-0) 3**
- ME 619 Convection Heat Transfer **Credits: (3-0) 3**
- ME 620 Radiation Heat Transfer **Credits: (3-0) 3**

Mechanical Systems

- ME 623 Advanced Mechanical Vibrations **Credits: (3-0) 3**
- ME 680 Advanced Strength of Materials **Credits: (3-0) 3**
- MES 713 Advanced Solid Mechanics I **Credits: (3-0) 3**
- ME 770 Continuum Mechanics **Credits: (3-0) 3**

Manufacturing and Controls

- ME 683 Advanced Mechanical System Control **Credits: (3-0) 3**
- ME 781 Robotics **Credits: (3-0) 3**
- ME 625 Smart Structures **Credits: (3-0) 3**

Additional Information

The details of the actual course selections must be developed by the student, the student's academic advisor, and the student's committee.

Entering students usually have a bachelor's degree in mechanical engineering. Qualifying examinations may be required of entering students. A minimum GPA of 3.00 is expected for regular (non-probationary) admission. Applicants who are graduates of institutions that are not accredited by the Accreditation Board of Engineering and Technology (ABET) are required to take the Graduate Record Examination (GRE) and have their scores submitted prior to consideration for admission.

Final Examination (MS 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 section of the academic catalog. A mechanical engineering graduate student with an accumulated GPA of 3.4 or better in the 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 the courses in their graduate program, a separate focused coursework oral examination will be administered by the student's graduate committee. The GPA will be computed using midterm grades for the semester in which the student is currently enrolled. The coursework examination

will examine primarily concepts and fundamentals of the courses in the student's program of study, 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 what courses have been selected. However, it is the student's responsibility to secure this information from the major professor.

Final Examination (MS Non-Thesis Option)

Mechanical engineering MS 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.

Mining Engineering and Management, M.S.

Contact Information

Dr. Purushotham Tukkaraja
Mining Engineering and Management Department
MI 229
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Mining Engineering

The Master of Science in Mining Engineering is designed to provide a program of advanced study in either management-oriented or technically-oriented disciplines for candidates planning a career in the mining, mine management or underground construction field. The available course work and current faculty expertise support the following emphasis areas:

1. Mining engineering technical track, including advanced rock mechanics, advanced ventilation, and advanced geostatistics; and tunneling;
2. Mining engineering management track, including mineral economics and finance, and mining business management.

The course delivery is geared towards both campus and hybrid-distance delivery modes.

Background Requirements

The mining engineering coursework is geared primarily towards the working professional in the mining industry who requires distance delivery of the courses, although students can be admitted directly to the on-campus program. In either case, the student should have completed an appropriate undergraduate engineering degree. For those holding a non-mining engineering undergraduate degree, the applicant should have significant experience in the mining or underground construction industry. Additionally, an undergraduate course in probability and statistics is highly recommended.

Thesis Option

- A minimum of 30 credits of which a minimum of 6 credit hours of core courses (must be 500-level, or above), 2 credit hours of seminar (MEM 790), 1 credit hour of Research Methods (GEOG/MEM 700), a minimum of 9 credit hours of elective courses and a minimum of 6 or a maximum of 12 research credits.
- A thesis and a final examination is required.
- Selection of a graduate advisory committee and completion of a program of study by end of the first semester at SDSMT.
- Completion of a master's thesis. The thesis must adhere to the format and content guidelines as set forth by the graduate school, and be approved by the student's graduate advisory committee and the Dean of Graduate Education.

Non-Thesis Option

- A program of at least 32 credits of course work (including 2 credit hours of seminar) which must include 9 credits of core courses in either the technical or management track.
- At least 18 credit hours of approved graduate-level elective coursework (500 level courses and above).

Other Program Requirements

- A maximum of up to 9 credit hours may be transferred from another accredited institution (400 level or above).
- For SD Mines undergraduate students only: Students admitted to the "accelerated" MS program may apply for up to 9 credits of SD mines 400/500 level course work taken as an undergraduate to their master's degree requirements.
- Students entering the program with a bachelor's degree in fields outside of mining engineering must take the undergraduate level deficiency courses recommended by the student's graduate advisory committee. These deficiency courses will not count towards the graduate degree credit requirements. Additional coursework may be determined by the student's graduate advisory committee.
- Meeting or exceeding prescribed academic standards.
- Complying with all rules and regulations of the Graduate Office, which are presented elsewhere in this catalog.

Curriculum

Core Courses for Technical Track:

- MEM 420/520 Advanced Tunneling and Underground Excavation **Credits: (3-0) 3**
- MEM 425/525 Advanced Rock Mechanics **Credits: (3-0) 3**
- MEM 433/433L/533/533L Advanced Mine Planning & Design **Credits: (2-1) 3**
- MEM 440/540 Advanced Mine Ventilation and Environmental Engineering **Credits: (3-0) 3**
- MEM 445/545 Advanced Geostatistics and Grade Estimations **Credits: (2-1) 3**
- MEM 450/550 Rock Slope Engineering **Credits: (3-0) 3**
- MEM 480/580 Advanced Explosives and Blasting **Credits: (3-0) 3**
- MEM 790 Seminar **Credits: (2-0) 2**
- * GEOL 700 Developing and Planning Research **Credits: (1-0) 1**
or
- * MEM 700 Developing and Planning Research **Credits: (1-0) 1**

*required only for thesis option

See department for additional courses that may apply to this track.

Core Courses for Management Track:

- MEM 410/510 Advanced Mineral Economics for Managers **Credits: (3-0) 3**
- MEM 430/530 Resource Industry Mergers and Acquisitions **Credits: (3-0) 3**
- MEM 435/535 Resource Industry Finance and Accounting **Credits: (3-0) 3**
- MEM 610 Topics in Mineral Economics, Sustainability and Mine Regulation **Credits: (3-0) 3**
- MEM 630 Mining Law and Environment **Credits: (3-0) 3**
- MEM 790 Seminar **Credits: (2-0) 2**
- * GEOL 700 Developing and Planning Research **Credits: (1-0) 1**
or
- * MEM 700 Developing and Planning Research **Credits: (1-0) 1**

*required only for thesis option

See department for additional courses that may apply to this track.

Elective Courses

Electives are subject to approval by the program, as evidenced by a signed Program of Study, choose 21 credits at the 500, 600 or 700 level from courses with any of the following prefixes: MEM, ENGM, CEM, IENG. Students may petition the program to allow electives of courses at the 400-level or with different prefixes than that above. In all cases, students must choose at least 6 credits of MEM electives.

Accelerated MS

An accelerated Master of Science (BS/MS) degree program is available for qualified seniors enrolled in engineering B.S. programs at the South Dakota School of Mines and Technology. The accelerated master's degree program allows B.S. engineering students to take up to nine (9) graduate-level credits to simultaneously meet undergraduate and graduate degree program requirements. For more information about the accelerated master's degree program, see the Mining Engineering and Management Department M.S. section of the catalog or contact Dr. Purushotham Tukkaraja (pt@sdsmt.edu) for more information.

Paleontology, M.S.

Contact Information

Dr. Laurie Anderson

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(605) 394-2461
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Faculty

Professors Anderson and Price; Associate Professor Pagnac; Associate Director and Instructor Shelton; Adjunct Faculty Benton; Professors Emeritus Fox and Martin.

M.S. in Paleontology

The Department of Geology and Geological Engineering offers advanced study leading to an M.S. degree in paleontology. Resources available to graduate students in paleontology include the extensive collections of the Museum of Geology. The M.S. in paleontology has a strong emphasis on field-based research as well as courses in museum studies.

At the South Dakota School of Mines and Technology, the paleontological research conducted spans diverse subject areas including paleobiology, paleoecology, taphonomy, biostratigraphy, biogeography, evolution and paleoclimatology. Faculty and students combine field research in both modern and ancient settings with museum studies and laboratory analyses to reconstruct past paleoenvironmental conditions and reveal their ecological and evolutionary consequences through geologic time. Collectively, research is focused on three key paleontological questions:

- How do organisms respond to environmental changes and adapt to different environments?
- How is biological diversity distributed across space and time?
- How are paleontologic resources best used and conserved for scientific study?

The Accelerated B.S./M.S. option is available for this degree.

The thesis option is the only option for the M.S. in paleontology.

Graduate Programs Outcomes

A graduate of the M.S. in Paleontology is expected to:

- Demonstrate knowledge of concepts and terminology of the discipline
- Explore and evaluate scientific and technical literature
- Analyze, interpret, and evaluate scientific and/or engineering data and methods
- Communicate effectively (in writing and orally)
- Act professionally and ethically

- Impact the profession with research

Background Requirements

The GRE exam is required of all applicants. The TOEFL, IELTS, or PTE exam is required for students whose native language is not English. Many factors contribute to the success of an application, including the goals statement, coursework, grades, test scores, work experience, recommendations, and availability of a faculty member in the student's anticipated research area. In general we prefer to see a GPA of 3.0 or above and GRE scores greater than the 50th percentile.

Incoming students are expected to have substantial preparation in general science, math, and geological sciences; successful applicants will ideally have completed the subjects listed below. The student's graduate committee may require that deficiencies important to the student's area of research be remedied by taking additional undergraduate courses that will not count towards the graduate degree credit requirements.

- Calculus I and II
- Statistics
- General Chemistry I and II
- General Physics I and II, or General Biology I and II
- Stratigraphy/Sedimentation
- Petrology
- Structural Geology
- Field Geology

Candidates for the M.S. degree must fulfill all degree requirements of the graduate office and of the program, including an oral comprehensive exam covering course material and a thesis defense. This exam should be scheduled through the student's major advisor with committee approval when the student has substantially completed the required 24 credits of coursework for the M.S., and at least three months prior to the thesis defense.

M.S. in Paleontology Degree Requirements

The M.S. thesis option requires 30 credits, including twenty-four (24) credits of coursework and six (6) credits of thesis research. No more than 15 credits may come from courses at the 500-level or below. Required courses include:

GEOL 700 Developing and Planning Research is required in the first fall semester of enrollment.

GEOL 771/771L Paleobiology/Lab

GEOL 471/571 Field Paleontology or GEOL 604 Advanced Field Geology

Candidates will work with their advisors and committee members to develop an approved program of study to fulfill the remaining coursework requirements.

Additional Information

All thesis samples, specimens, and their documentation collected while a registered student must be curated into the collections of the Museum of Geology.

Physics, M.S.

Contact Information

Dr. Andre G. Petukhov

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Electrical Engineering/Physics 235A

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Faculty

Professors Corey, Detwiler, Petukhov, and Sobolev; Associate Professors Schnee and Strieder, Assistant Professors Bai, Corwin, French, Oszwaldowski, and Reichenbacher; Instructor Dowding; Emeriti Professors Foygel and Helsdon.

Physics

The mission of physics graduate program is to provide students with quality graduate instruction and research experience suitable in many physics-related careers. Required coursework in physics along with elective courses selected from other disciplines such as mathematics, computer science, chemistry and engineering support a number of career options in industry, education and applied research. Graduates with this degree may also pursue a Ph.D. degree in physics. Areas of research concentration include astrophysics, condensed matter, materials science, nuclear and elementary particle physics, and theoretical physics.

Available Options for Degrees

A (thesis) and B (non-thesis). Option A requires a thesis based on research, while Option B substitutes additional coursework and a research paper/project for the thesis requirement. The non-thesis options are deemed appropriate for students who do not require Ph.D. preparation in physics in order to be successful in their careers. Examples of career tracks not requiring study in physics beyond the master's level include medical physics, science education at the k-12 and "community college" level as well as various industrial applications. While deemed less appropriate for students advancing to doctoral study in physics, the non-thesis options are a viable and even preferred course of study for some students.

Students should expect that completion of an M.S. degree take two academic years of full-time study.

Degree requirements

M.S. Physics Thesis Option (Option A) requires 19 credit hours of required core courses, 6 credit hours of electives, and 7 credit hours for thesis (PHYS 798) which leads to total of 32 credit hours.

M.S. Physics Non-thesis Option (Option B) requires 19 credit hours of required core courses, 11 credit hours of electives, and 2 credit hours for research/design paper (PHYS 788**) which leads to total of 32 credit hours.

Required Core Courses

- PHYS 721 Electrodynamics I **Credits: (3-0) 3**
- PHYS 723 Electrodynamics II **Credits: (3-0) 3**
- PHYS 743 Statistical Mechanics **Credits: (3-0) 3**
- PHYS 751 Classical Mechanics **Credits: (3-0) 3**
- PHYS 771 Quantum Mechanics I **Credits: (3-0) 3**
- PHYS 773 Quantum Mechanics II **Credits: (3-0) 3**
- PHYS 790 Seminar **Credits: 1 to 3**

Subtotals: 19

Research Credits (Thesis option only)

- PHYS 798 Thesis **Credits: 1 to 9**

Electives

- PHYS 433/533 Nuclear and Elementary Particle Physics **Credits: (3-0) 3**
- PHYS 439/539 Solid State Physics **Credits: 4**
- PHYS 481/581 Mathematical Physics **Credits: 4**
- MES 603 Condensed Matter Physics **Credits: (4-0) 4**
- PHYS 683 Mathematical Physics II **Credits: (3-0) 3**
- PHYS 691 Independent Study **Credits: 1 to 3**
- PHYS 692 Topics **Credits: 1 to 3**
- PHYS 739 Condensed Matter Physics I **Credits: (3-0) 3**
- PHYS 749 Condensed Matter Physics II **Credits: (3-0) 3**
- PHYS 761 Nuclear and Particle Physics **Credits: (3-0) 3**
- PHYS 763 Advanced Particle Physics **Credits: (3-0) 3**
- PHYS 765 Advanced Nuclear Physics **Credits: (3-0) 3**
- PHYS 775 General Relativity **Credits: (3-0) 3**
- PHYS 779 Group Theory **Credits: (3-0) 3**
- PHYS 783 Quantum Field Theory **Credits: (3-0) 3**
- PHYS 784 Advanced Quantum Field Theory **Credits: (3-0) 3**
- PHYS 785 Astrophysics and Cosmology **Credits: (3-0) 3**
- PHYS 787 Research Credits: 1-9 *
- PHYS 788 Master's Research Problems/Projects Credits: 1-5 **
- PHYS 791 Independent Study **Credits: 1 to 3**
- PHYS 792 Topics **Credits: 1 to 3**
- PHYS 798 Thesis **Credits: 1 to 9**

Subtotal: 29-58

Curriculum Notes

* Offered by SDSU

** Offered by SDSU/USD

Doctor of Philosophy

Atmospheric and Environmental Sciences, Ph.D.

Contact Information

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Faculty

Professors Kenner, Price and Stone; Associate Professors Capehart, French, Kliche; Assistant Kunza; Emeritus Professors Detwiler, Helsdon, Hjelmfelt and Smith.

Program Description

The Atmospheric and Environmental Sciences program aims to unravel the complex interactions between all the earth's components, such as the biosphere, the atmosphere and oceans, as well as the influence of human activity on the global environment. These interactions occur across many spatio-temporal scales and can profoundly affect living organisms, the atmosphere around them and the ecosystem. The atmosphere and biosphere are fundamentally coupled on a variety of time-scales and support a complex set of bi-directional interactions. Managing wildfire potential, for example, includes understanding atmospheric dynamics, precipitation patterns, vegetation distribution and condition, topographic factors, and more. Similarly, in terrestrial ecosystems, rapid exchange of CO₂, water and energy between the atmosphere and the land surface may dominate bi-directional interactions on short time-scales, whereas, on long time-scales, the interactions involve changes in ecosystem structure and composition in response to changes in climate. The key to success lies in training scientists to form interdisciplinary teams that can simultaneously tackle the broad range of processes needed to achieve understanding and prediction of such complex phenomena. Measuring, monitoring, and modeling earth and atmospheric systems increasingly demands an interdisciplinary approach, because problems in earth processes impacting society often cannot be solved by studying the atmosphere, hydrosphere, lithosphere, and/or biosphere in isolation.

The Atmospheric and Environmental Sciences Ph.D. program links expertise in atmospheric and environmental science, biogeochemistry, geology, hydrology, water quality and water resources to address regional and local issues that may also be nationally or globally significant. The fundamental objective lies in developing the ability to address linkages between earth system components and land management practices in a way that benefits decision-making at regional and national levels. We use the Black Hills of South Dakota and the surrounding Great Plains as a natural laboratory for the development of methodologies to link fundamental observations of the environment across a range of temporal and spatial scales, and integrate them with state-of-the-art modeling, visualization, and analysis.

Key interrelated research themes drive the research and teaching program, building on ongoing research and disciplinary strengths already present at the School of Mines, including meteorology, biogeochemistry, ecology, geology, climatology, hydrology, remote sensing, and geographic information systems.

Specific examples include:

- Physical meteorology and storm processes, including impacts on hydrology and wildfire issues.
- *In situ* atmospheric measurements of storms, aerosols, trace gas concentrations, and more using specially adapted storm-penetrating aircraft.
- Wildfire dynamics and associated issues related to fire prevention, suppression, and post-fire mitigation.
- Carbon cycling and the potential effects of local and regional climate change, including the frequency and severity of storms, drought cycles, and wildfire potential.
- Nutrient transformations in aquatic and terrestrial ecosystems, including Black Hills Forests and coastal salt marshes.
- Water quality and quantity as it impacts regional growth and environmental systems.
- A Geographic Information System (GIS) laboratory as well as state-of-the-art computers equipped with modeling and remote sensing analysis software.
- The Museum of Geology, located on campus and housing over 300,000 specimens, serves as a resource for paleontological instruction.

Many School of Mines faculty members who are actively involved in the AES Ph.D. program have externally funded research projects. These projects provide research assistantship opportunities for AES students. In addition to graduate research assistantships, support is also possible through graduate teaching assistantships and various fellowships and scholarships. AES students are strongly encouraged to work with their advisors and faculty colleagues to apply for research funding or fellowships to support their studies.

Program Requirements

Degree candidates in AES are expected to complete an approved multidisciplinary program of coursework and also perform original research in a focused area. A minimum total of 72 credit hours beyond the bachelor's degree is required. Students entering the AES program with a previous M.S. degree in a relevant discipline are allowed to apply a maximum of 24 course credit hours in an appropriate field toward the course credit requirement and 6 thesis research credits toward the research-credit requirement. There is no language requirement in the AES program. However, all AES students are expected to be proficient in speaking, understanding, and writing the English language. Graduate students who are enrolled full time in the AES program should be able to complete their degree requirements and graduate within three to four years starting with a master's degree, and four to five years starting from a bachelor's degree. The time required to complete the degree will vary depending on the transfer of previously earned credits, coursework recommendations specified by the student's committee, and individual research requirements.

The following key learning outcomes will be developed in all students:

- a. A core of basic and specialized scientific and technical knowledge;
- b. An understanding of the basic scientific tools of measuring, monitoring, and modeling;
- c. The ability to apply these tools to understand atmospheric, hydrologic and land-surface interactions;
- d. The professional skills crucial to research, including obtaining and reviewing research literature, proposing research problems, critically evaluating their own work and the work of others, and communicating in writing and orally with their colleagues;
- e. The understanding and application of professional methods and ethics in their work; and
- f. The ability to form interdisciplinary teams to solve complex problems.

Students entering the program will normally already possess a foundational degree (typically the M.S. degree) in atmospheric and environmental sciences, meteorology, geology, hydrology, or environmental sciences/engineering. Students will build on this foundation by pursuing elective courses that prepare them for advanced work in their chosen specialty. The student and his/her committee are charged to prepare a course of study that will help the student become proficient in a specific research area. Great emphasis is placed on the independent origination of a research problem that will yield a new, original scientific insight.

Ph.D. in Atmospheric and Environmental Studies

	Credit Hours
AES 808 Fundamental Problems in Engineering and Science	3
AES 690 Seminar	1
Research Program Academic Courses*	32
AES 898 Dissertation maximum credits	36
Total required for the degree	72

* Ph.D. Candidates can apply up to 24 supported classroom credit hours from their previous M.S. program into their Ph.D. program of study pending approval by the candidate's committee

** Ph.D. Candidates can apply up to 6 supported research credit hours from their M.S. program into their Ph.D. program of study pending approval by the candidate's committee.

The required academic courses include:

- AES 690 Seminar **Credits: (1-0) 1**
- AES 808 Fundamental Problems in Engineering and Science **Credits: (3-0) 3**

Program Elective in Measuring/Modeling of Earth Systems

Students must complete at least one course in measuring and/or modeling techniques, to be selected by the student's committee. Courses supporting the AES program are offered at the School of Mines to fulfill this 3 credit elective course requirement. These courses are offered in Atmospheric and Environmental Sciences and also programs on campus that include Civil and Environmental Engineering, Geology and Geological Engineering, Chemistry and Applied Biological Sciences, Chemical and Biological Engineering, and Mathematics and Computer Sciences. Listed below are examples of courses that might be included as electives in an AES program of study. These lists are intended as examples and are not intended to limit a student and committee as they construct an individual program.

Potential elective courses for AES:

Cross-listed 400/500-level coursework must be taken at the 500-level to apply.

- AES 643 Precipitation Physics and Cloud Modification **Credits: (3-0) 3**
- CEE 426/526 Environmental Engineering Unit Operations and Processes **Credits: (3-0) 3**
- CEE 427/527 Environmental Engineering Biological Process Design **Credits: (3-0) 3**

- AES 692 Topics **Credits: 1 to 3 OR**
- CEE 692 Topics **Credits: 1 to 3 OR**
- GEOL 692 Topics **Credits: 1 to 3 OR**
- GEOE 692 Topics **Credits: 1 to 3**

- CEE 739 Techniques of Surface Water Resource and Water Quality Investigations I **Credits: (3-0) 3**
- AES 401/501 Atmospheric Physics **Credits: (3-0) 3**
- AES 406/506 Global Environmental Change **Credits: (3-0) 3**
- AES 403/503 Biogeochemistry **Credits: (3-0) 3**
- AES 405/505 Air Quality **Credits: (3-0) 3**
- AES 615 Earth and Systems Modeling **Credits: (3-0) 3**
- AES 520 Remote Sensing for Research **Credits: (3-0) 3**
- AES 430/530 Radar Meteorology **Credits: (3-0) 3**
- AES 540 Atmospheric Electricity **Credits: (3-0) 3**
- AES 455/555 Synoptic Meteorology II **Credits: (3-0) 3**
- AES 460/560 Atmospheric Dynamics **Credits: (3-0) 3**
- AES 603 Biosphere-Atmosphere Interactions **Credits: (3-0) 3**
- AES 612 Atmospheric Chemistry **Credits: (3-0) 3**
- AES 625 Scaling in Geosciences **Credits: (3-0) 3**
- AES 744 Numerical Dynamics and Prediction **Credits: (3-0) 3**
- AES 660 Atmospheric Dynamics II **Credits: (3-0) 3**
- AES 770 Boundary Layer Processes **Credits: (3-0) 3**
- AES 773 Mesometeorology **Credits: (3-0) 3**
- AES 775 Applied Freshwater Science **Credits: (3-0) 3**
- CEE 634 Surface Water Hydrology **Credits: (3-0) 3**
- CEE 421/521 Aqueous Geochemistry **Credits: (3-0) 3**
- CEE 433/533 Open Channel Flow **Credits: (3-0) 3**
- GEOL 417/517 Geospatial Databases **Credits: (3-0) 3**
- GEOL 419/519 Advanced Geospatial Analysis **Credits: (3-0) 3**
- GEOL 420/520 Introduction to Remote Sensing **Credits: (3-0) 3**
- GEOL 416/416L/516/516L Introduction to GIS/Lab **Credits: (2-1) 3**
- GEOL 633/633L Sedimentation/Lab **Credits: (2-1) 3**
- GEOE 663/663L Groundwater Geochemistry/Lab **Credits: (2-1) 3**
- GEOE 782/782L Fluvial Processes/Lab **Credits: (2-1) 3**

Additional Information

Student progress and mastery will be measured using the usual instruments in a doctoral program. A written or oral qualifying exam is used to assess the student's mastery of the M.S. coursework. A comprehensive examination is given to evaluate the student's ability to formulate a research problem based on substantive literature review, and to test the student's knowledge in the area of specialty. It is given in two parts: 1) a written examination consisting of a review paper in the student's field of study and a research proposal, and 2) an oral examination to evaluate the research proposal and verify the student's understanding of the basic sciences and specialized field of study. The dissertation forms the final test of the student's ability to perform and communicate research. The student must prepare a doctoral dissertation and successfully complete a public defense covering the scientific validity of the work, as well as the student's basic and specialized knowledge in the field of study.

Management of the AES Program

The AES program is managed by the Graduate Office. A program committee composed of 3-5 faculty representing different disciplines oversees the program, including setting policies and reviewing the curriculum. The program committee will also take measures to facilitate interaction by all faculty and students participating in the program. A program coordinator heads the program committee, and provides oversight of student affairs, including meeting with new and existing students, tracking student progress, and conducting orientations for new students.

The preceding committee is distinct from the graduate student advisory committees that provide guidance to individual AES students during the course of their academic studies. The graduate student's major professor serves as the head of this advisory committee.

Biomedical Engineering, Ph.D.

Contact Information

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Biomedical Engineering

Offered jointly with University of South Dakota (USD). Biomedical engineering (BME) is concerned with the application of engineering and science methodologies to the analysis of biological and physiological problems and to the delivery of health care. The biomedical engineer serves as an interface between traditional engineering disciplines and living systems and may work in either direction, applying the patterns of living organisms to engineering design or engineering new approaches to human health.

Both the master of science and doctor of philosophy degrees are cross-disciplinary degrees. The Ph.D. program will prepare a student for a career as a researcher who advances the frontiers of biomedical science and engineering with attention to generating new ideas for commercialization.

Current focus areas of faculty activity within the program are (1) biomaterials (nanomaterials, bioadhesives, tissue engineering, etc.), (2) computational biomedical engineering (biomechanics, imaging, advanced modeling/simulations, etc.), (3) assistive technology/rehabilitation engineering (advanced prosthetics, control, biomimetics, etc.), (4) biomechanics and human performance, and (5) biomolecular and genetic engineering. Students in the programs may be associated with one or more of several SDSM&T research centers and laboratories.

Admission will be based on the established graduate admission standards at the South Dakota School of Mines and Technology. The Graduate Record Examination (GRE), three letters of recommendation, and a GPA of 3.00 or better are expected of all applicants for the Ph.D. program. The TOEFL exam is required for students whose native language is not English. Students seeking exceptions warranted by special circumstances are requested to contact the biomedical engineering graduate program coordinator.

Doctoral students will possess a high level of expertise in their specialized area of research - biomaterials, computational biomedical engineering, rehabilitation engineering/assistive technology, or biomolecular/genetic engineering. This competency will be developed through focused research, which culminates in the doctoral dissertation. Graduates of the program will also demonstrate:

- the ability to communicate effectively in written and oral presentations,
- intellectual honesty when working with data and ideas, and
- the ability to make an original contribution to their field.

Ph.D. students are expected to participate in the creation of new knowledge and applications in biomedical engineering.

Courses are offered at both SDSM&T and USD campuses. Courses offered at SDSM&T are relayed to students at USD by video, and vice versa.

Financial Support

The Biomedical Engineering program has a limited number of Research Assistantships. All students admitted to the program are automatically considered for financial support. Financial support is dependent upon maintaining good academic standing and acceptable research progress in the laboratory.

Ph.D. Curriculum Requirements

- BME 601 Biomaterials **Credits: (3-0) 3**
- BME 602 Anatomy and Physiology for Engineers **Credits: (3-0) 3**
- BME 603 Molecular Biology for Engineers **Credits: (3-0) 3**
- BME 408/508 Biomedical Engineering **Credits: (3-0) 3**
- BME 710 Experimental Design and Data Analysis in Biological Engineering **Credits: (3-0) 3**
- BME Research and Dissertation **Credits: 36**
- *BME Electives **Credits: 6**
- **Additional Electives **Credits: 9**
- BME 690 Seminar **OR** BME 790 Seminar **Credits: (6-0) 6**

Total: 72

Note(s):

Elective courses in the area of the student's intended research are to be selected in consultation with the student's advisory committee.

*A list of possible BME electives can be found in the course description section of this catalog.

**Each Ph.D. program of study is individually designed to meet the goals of the student. Courses from a variety of areas, including materials and metallurgical engineering, mechanical engineering, chemistry, electrical and computer engineering, genetics and molecular biology, and mathematics and computer science, may be used to fulfill the elective requirements in a manner intended to complement the student's research.

Each student is also required to pass a comprehensive examination and defend the dissertation. There is no language requirement for the BME Ph.D. program. Detailed information on examination policies, admission to candidacy, and defense of dissertation may be found in the Graduate Education section of this catalog and the BME Graduate Handbook.

Chemical and Biological Engineering, Ph.D.

Contact Information

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<http://www.sdsmt.edu/CBE/>

Faculty

Professors Dixon, Gilcrease, Menkhaus (CBE Graduate Program Coordinator), Puszynski, Salem and Winter; Associate Professors Benjamin, Sani, and Shende; Assistant Professors Brenza, Groven, and Hadley; Lecturer Pinkelman.

CBE Ph.D. Program Advisory Council

Professors Dixon, Gilcrease, Menkhaus (Program Coordinator) and Winter; Associate Professor Benjamin, Sani, and Shende; Assistant Professor Brenza, Groven, and Hadley.

Chemical and Biological Engineering

The Department of Chemical and Biological Engineering (CBE) offers, in addition to B.S. and M.S. degrees in chemical engineering, a Ph.D. degree in chemical and biological engineering. The Ph.D. program provides the chemical and biological engineering Ph.D. graduate a core educational experience in transport phenomena, chemical kinetics, biochemical engineering, chemical thermodynamics, and biotechnology. This knowledge base, along with key electives, provides CBE graduate students the training to participate in biochemical and petrochemical processing, bio-based energy technologies, including biomass and biofuels; catalysis; bio-based and bio-compatible materials; biomedicine; bioremediation; emerging energy technologies; synthesis and functionalization of nanomaterials, and processing of polymers and composite materials. These areas are aligned with the expertise of our faculty members. The current research interest of the faculty can be found on the departmental website <http://www.sdsmt.edu/CBE/research/>. The modern **Chemical and Biological Engineering and Chemistry (CBEC)** building houses the CBE research laboratories.

The CBE Faculty maintain a vibrant research enterprise with over \$9m of funded research from the Department of Defense, the National Science Foundation, NASA, other state and federal agencies, and industry. The State of South Dakota is recognized as a leader and major producer of ethanol from starch in the United States. Hence the State of South Dakota is well positioned to play an important role in development of new bio-based technologies and value-added agricultural products. The Department of Chemical and Biological Engineering was instrumental in establishing the **National Science Foundation Industry/University Cooperative Research Center (NSF I/UCRC) for BioEnergy Research and Development (CBERD)** and the **State of South Dakota Supported Center for Bioenergy Research (CBRD)**. The unique national NSF I/UCRC center was focused on bio-based energy and chemical feedstocks, was comprised of four universities, including the SDSM&T, North Carolina State University, State University of New York - Stony Brook, University of Hawaii, and more than 20 industries and state and federal laboratories.

The CBE Ph.D. program is also a strong supporter of the State-focused research area in materials and advanced manufacturing, which include advanced materials, polymers, composites, and nanotechnology. The **Composites and Polymer Engineering Laboratory (CAPE)** is a key resource utilized by our students <http://cape.sdsmt.edu/>. The CBE research laboratories along with

CAPE provide CBE Ph.D. students a wealth of modern resources to participate in cutting-edge research funded by the National Science Foundation, the Department of Energy, the Department of Defense, the Department of Agriculture, NASA, and industrial collaborators.

The Ph.D. Program in chemical and biological engineering is administered by the CBE Graduate Program Coordinator and the Program Advisory Council. The Program Advisory Council is responsible for the curriculum and program policies.

Curriculum

The curriculum is designed to provide the CBE Ph.D. graduate with the depth and breadth of engineering knowledge to become a leader in their chosen focus area. To facilitate this, each student is asked to complete a program of study plan that will provide the framework for the student's coursework and research. This should be filed with the Program Coordinator before the midterm of the second semester in residence. The CBE Ph.D. Advisory Council must approve all programs of study. Detailed information on examination policy, admission to candidacy, and defense of dissertation are included in the Chemical and Biological Engineering Ph.D. Program Handbook.

Students entering the program with B.S. or M.S. degrees from disciplines other than Chemical or Biochemical Engineering will be required to take several selected courses in Chemical Engineering at the undergraduate level, to provide a firm understanding of fundamental chemical engineering principles.

The Graduate Record Examination (GRE), three letters of recommendation, and a GPA of 3.00 or better are required of all applicants for the Ph.D. program. The TOEFL exam is required for students whose native language is not English.

All CBE Ph.D. candidates are required to successfully complete the required minimum credits and earn a grade of "C" or better, except for a final grade of "S" in CBE 898. However a 3.00 GPA must be maintained to receive graduate research assistantships (GRA).

Below is the summary of the basic required courses:

Category	Credits
Required courses ¹ (minimum 6 credits from Chemical Engineering and 6 credits from Biological Engineering focus areas) selected from the two focus area lists	24
Required seminar	4
Minimum required research credits	32
Minimum electives ^{1,2}	12
TOTAL	72

Curriculum Notes

¹ Students entering with a M.S. degree in Chemical Engineering or a closely related discipline may apply a maximum of twenty-four (24) course credit hours toward the required and elective course requirements subject to approval of the CBE Ph.D. Program Advisory Council.

² Elective courses may be selected from the two focus area lists, from the example elective list, or from other SDSM&T courses as a part of a student's program of study, subject to approval of his/her major professor and graduate committee.

Focus Area — Chemical Engineering

Students pursuing a Ph.D. in Chemical and Biological Engineering must take the 500 and above level courses, not the 400 level courses.

- CBE 444/544 Reactor Design **Credits: (3-0) 3**
OR
- CBE 450/550 Systems Analysis Applied to Chemical Engineering **Credits: 2 to 3**
- CBE 612 Transport Phenomena: Momentum **Credits: (3-0) 3**
- CBE 613 Transport Phenomena: Heat **Credits: (3-0) 3**
- CBE 616 Computations in Transport Phenomena **Credits: (3-0) 3**
- CBE 621 Advanced Chemical Engineering Thermodynamics I **Credits: (3-0) 3**
- CBE 714 Transport Phenomena: Mass **Credits: (3-0) 3**
- CBE 728 Heterogeneous Kinetics **Credits: (3-0) 3**

Focus area — Biological Engineering

Students pursuing a Ph.D. in Chemical and Biological Engineering must take the 500 and above level courses, not the 400 level courses.

- CBE 484/584 Fundamentals of Biochemical Engineering **Credits: (3-0) 3**
- CBE 484L/584L Biochemical Engineering Laboratory **Credits: (0-1) 1**
- CBE 603 Molecular Biology for Engineers **Credits: (3-0) 3**
- CBE 735 Bioseparations **Credits: (3-0) 3**
- CBE 741 Microbial and Enzymatic Processing **Credits: (3-0) 3**
- CBE 792 Topics **Credits: 1 to 4**

Required courses (Seminar and Research)

Four (4) credits of CBE 890 Seminar and a minimum of thirty-two (32) credits of CBE 898D Dissertation are required.

- CBE 890 Seminar **Credits: (1-0) 1**
- CBE 898D Dissertation **Credits: 1 to 12**

Example elective courses

Students pursuing a Ph.D. in Chemical and Biological Engineering must take the 500 and above level courses, not the 400 level courses.

- CBE 424/524 Molecular Modeling and Simulation **Credits: (3-0) 3**
- CBE 445/545 Oxidation and Corrosion of Metals **Credits: (3-0) 3**
- CBE 450/550 Systems Analysis Applied to Chemical Engineering **Credits: 2 to 3**
- CBE 455/555 Pollution Phenomena and Process Design **Credits: (3-0) 3**
- CBE 474/574 Polymer Technology **Credits: 2 to 3**
- CBE 474L/574L Experimental Polymer Technology **Credits: (0-1) 1**
- CBE 475/575 Advances in Processing and Nanoengineering of Polymers **Credits: (2-0) 2**

- CBE 476/576 Organosilicon Polymer Chemistry and Technology **Credits: (1-0) 1**
- CBE 482/582 Upstream Oil and Gas Processing **Credits: 1 or 3**
- CBE 483/583 Petroleum Refining **Credits: 2 or 3**
- CBE 485/585 Renewable and Sustainable Energy **Credits: (3-0) 3**
- CBE 485L/585L Renewable and Sustainable Energy Lab **Credits: (0-1) 1**
- CBE 486/586 Immuno-Engineering **Credits: 2 or 3**
- CBE 488/588 Applied Design of Experiments for the Chemical Industry **Credits: (2-0) 2**
- CBE 489/589 Composites Manufacturing **Credits: (1-0) 1**
- CBE 791 Independent Study **Credits: 1 to 4**
- CBE 792 Topics **Credits: 1 to 4**
- CBE 890 Seminar **Credits: (1-0) 1**
- CBE 894 Internship **Credits: 1 to 6**
- CHEM 482/582 Environmental Chemistry **Credits: (3-0) 3**
- MES 712 Interfacial Phenomena **Credits: (3-0) 3**
- NANO 701 Nano Materials **Credits: (3-0) 3**
- ENGM 435/535 Optimization Techniques **Credits: (3-0) 3**
- ENGM 621 Statistical Process Control **Credits: (3-0) 3**

Civil and Environmental Engineering, Ph.D.

Contact Information

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Faculty

Professors Kenner and Stone; Associate Professors Robinson, Capehart, Benning, and Gadhamshetty; Assistant Professors Lingwall, Shearer, Whitaker, Geza, and Waterman; Instructor Bienert.

Background and Requirements

The Department of Civil and Environmental Engineering offers a Ph.D. degree in civil and environmental engineering (Ph.D. CENE) in the following emphasis areas: environmental, geotechnical, water resources, materials, and structural engineering.

All SD Mines Graduate College admissions requirements apply to the Civil and Environmental Engineering (CENE) Ph.D. program. In addition, a GPA of 3.00 or better is required, as is the Graduate Record Examination (GRE) for all applicants except SD Mines graduates.

Incoming students should have completed the courses listed below. Deficiencies in these areas must be remedied by taking the necessary coursework prior to enrollment in the doctoral program.

Calculus I, II, and III
Differential Equations
Probability and Statistics
Chemistry I and II
University Physics I
Statics

All CENE doctoral students are also expected to have completed the appropriate background courses for their intended research emphasis area (refer to the CENE Ph.D. Program Handbook: <http://www.sdsmt.edu/Academics/Departments/Civil-and-Environmental-Engineering/Curriculum-and-Checklists/>). Additional subjects may be required by the student's graduate committee. These requirements will be documented as a formal component of a student's Program of Study.

Qualifying Exam

All CENE Ph.D. students must pass a qualifying examination, normally to be taken within the first two years of enrollment. The "Qualifying Exam" is a course-work based exam to test and demonstrate the doctoral student's proficiency in the foundational material of his or her discipline.

Comprehensive Examination and Admission to Ph.D. Candidacy

When the student's program of coursework has been substantially completed, she or he will undertake the comprehensive examination for admission to candidacy. The "Comprehensive Exam" is a wide-ranging exam to test and demonstrate the doctoral student's readiness to pursue doctoral research. It includes a defense of a written dissertation proposal, and may also include additional written or verbal exam components to demonstrate the student's proficiency in his or her field of study based on the student's coursework as a PhD student.

Dissertation

The dissertation is expected to advance knowledge and demonstrate the candidate's technical mastery of the field of study. The research results are expected to be of publishable quality. The student's major advisor may specifically require submission and/or publication of one or more peer-reviewed journal articles. In lieu of the conventional dissertation format, the dissertation may 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. Dissertations submitted in this form must have an introduction and conclusion to tie the journal papers into a cohesive manuscript.

Dissertation Defense

The dissertation defense will be scheduled at any time after the student has completed the required coursework and after the graduate student advisory committee is satisfied that the dissertation is an acceptable manuscript, in terms of both technical quality and proper expression. A schedule of exam and defense deadlines is provided on the Graduate Education web page.

For additional information regarding exams and dissertation requirements refer to the CENE PhD Handbook at <http://www.sdsmt.edu/Academics/Departments/Civil-and-Environmental-Engineering/Curriculum-and-Checklists/>.

Curriculum

The curriculum consists of a minimum of 72 credits for students entering with a BS degree (Table 1) and a minimum of 42 credits for those students entering with an MS degree (Table 2). The student's graduate advisory committee will assess the student's academic transcripts and approve a combination of required (Table 3) and elective coursework and dissertation credits that meets all degree requirements.

Table 1. Curriculum Requirements for Students Entering with a Bachelor's Degree

<u>Curriculum Requirement</u>	<u>Credit Hours</u>
Required Courses	9
Dissertation Research	21 - 33
Elective Courses ¹	30 - 42
Total Curriculum Credits	72

Table 2. Curriculum Requirements for Students Entering with a Masters Degree²

<u>Curriculum Requirement</u>	<u>Credit Hours</u>
Required Courses	9
Dissertation Research	15 - 27
Elective Courses ¹	6 - 18
Total Curriculum Credits	42

Table 3. Required Coursework

<u>Prefix & Number</u>	<u>Course Title</u>	<u>Credit Hours</u>
*MATH 447/547	Design of Experiments	3
CEE 808/AES 808	Fundamental Problems in Engineering and Science	3
CEE 790/AES 790/GEOE 790/MES 790/890	Seminar (1 credit hour per academic year) ³	3

Curriculum Notes

¹Elective courses are subject to approval of the major professor and advisory committee.

² Students entering with a M.S. degree in Civil or Environmental Engineering or a closely related discipline may apply a maximum of twenty-four (24) course credit hours toward elective course requirements and a maximum of six (6) credit hours toward the research credit requirements, subject to approval of the CENE graduate committee.

³ Course taken for credit 3 times for a total of 3 credits. CENE Ph.D. students are expected to attend and participate in the CENE seminar series whether they are taking it for credit or not.

Geology, Geological Engineering, and Mining Engineering, Ph.D.

Contact Information

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Geology Faculty

Professors L. Anderson, Duke, Masterlark, Price, and Uzunlar; Associate Professor Pagnac; Assistant Professors Baran and Ustunisik; Professors Emeritus Fox, Lisenbee, Martin, Paterson, and Redden; Adjunct Faculty Benton and McCormick.

Geological Engineering Faculty

Professor Stetler; Associate Professors Katzenstein and Sawyer; Assistant Professor Li; Professors Emeritus Davis and Rahn; Adjunct Faculty M. Anderson, Iles, Roggenthen and Valder.

Mining Engineering Faculty

Professor Roberts; Associate Professor Brickey; Assistant Professor Tukkaraja; Senior Lecturer McCormick; Lecturer Allard; Adjunct Faculty Chancellor.

Ph.D. in Geology, Geological Engineering, and Mining Engineering

Students must elect to pursue a specialization in Geology, Geological Engineering, or Mining Engineering. Each specialization has different background and program requirements. The available coursework and current faculty expertise support the following areas of concentration.

1. Energy Resources
2. GIS, Geoinformatics, and Remote Sensing
3. Groundwater and Environment
4. Paleontology
5. Petrology and Mineral Resources
6. Structure, Tectonics, and Geodynamics
7. Geomechanics

8. Mine Planning and Optimization
9. Mine Management
10. Mine Ventilation
11. Deep Water Mining
12. Mineral Economics

Graduate Programs Outcomes

A graduate of the Ph.D. in Geology/Geological Engineering/Mining Engineering is expected to:

- Demonstrate knowledge of concepts and terminology of the discipline
- Explore and evaluate scientific and technical literature
- Analyze, interpret, and evaluate scientific and/or engineering data and methods
- Communicate effectively (in writing and orally)
- Act professionally and ethically
- Impact the profession with research

Background Requirements for Ph.D.

The Graduate Record Examination (GRE) is required of all applicants. The TOEFL, IELTS, or PTE exam is required for students whose native language is not English. Many factors contribute to the success of an application, including the goals statement, coursework, grades, test scores, work experience, recommendations, and availability of a faculty member in the student's anticipated research area. In general we prefer to see a GPA of 3.0 or above and GRE scores greater than the 50th percentile. Different specializations have different background coursework requirements, as described below.

Background Expected for Geology Specialization (including Paleontology)

Incoming students are expected to have substantial preparation in general science, math, and geological sciences; successful applicants will ideally have completed the subjects listed below. The student's graduate committee may require that deficiencies important to the student's area of interest be remedied by taking additional undergraduate courses that will not count towards the graduate degree requirements.

- Calculus I and II
- Statistics
- General Chemistry I and II
- General Physics I and II, or General Biology I and II
- Stratigraphy/Sedimentation
- Petrology
- Structural Geology
- Field Geology

Background Expected for Geological Engineering Specialization

Incoming students are expected to have substantial preparation in science, math, geological sciences, and engineering; successful applicants will ideally have completed most of the subjects listed below. The student's graduate committee may require that deficiencies important to the student's area of interest be remedied by taking additional traditional undergraduate courses that will not count towards the graduate degree credit requirements.

- Calculus I, II, and III
- Differential Equations
- General Chemistry I and II
- General Physics I and II
- Stratigraphy/Sedimentation
- Petrology
- Structural Geology
- Statics
- Mechanics of Materials
- Fluid Mechanics, or Rock Mechanics

Background Expected for Mining Engineering Specialization

- Calculus I, II, and III
- Differential Equations
- General Chemistry I and II
- General Physics I and II
- Statics and Dynamics
- Fluid Mechanics

Ph.D. Degree Requirements

Admission to the Ph.D. program in Geology and Geological Engineering is normally limited to qualified students who have already earned an M.S. degree in geology, geological engineering, paleontology, or a related field. Students holding an M.S. but with extensive undergraduate deficiencies may be placed into the M.S. program in Geology and Geological Engineering until these deficiencies are remedied. Students with a B.S. degree who apply to the Ph.D. program will be admitted to the M.S. program in Geology and Geological Engineering until they have accumulated sufficient course credits for an M.S. degree, after which they will be transitioned to the Ph.D. program.

Geology and Geological Engineering, Paleontology, or Mining Engineering M.S. students in good standing may convert to the Geology, Geological Engineering, and Mining Engineering Ph.D. program by submitting a standard application for the Ph.D. program to be reviewed by the Geology and Geological Engineering or Mining Engineering faculty. The applicant is required to submit at least one recommendation letter from the current M.S. advisor and the future Ph.D. advisor (if they are different). Accepted students will follow Ph.D. requirements and submit an Intent to Transfer form to the Office of Graduate Education.

Curriculum

A minimum of seventy-two (72) credit hours are required beyond the B.S. degree. At least thirty-six (36) of these credits must be for coursework. No more than 36 credits may be from 500-level courses or lower. Up to twenty-four (24) course credits and six (6) research credits from the M.S. degree can be applied toward the total required credits if the student's committee agrees.

The candidate's committee is responsible for assisting the student in developing a program of study that prepares the student for his/her intended field as well as provides general knowledge for the discipline. It is recommended that six (6) to twelve (12) hours of coursework be taken outside the department.

Geology Specialization

The candidate's committee is responsible for assisting the student in developing a program of study that prepares the student for his/her intended research focus. The following courses are required for the Geology specialization:

GEOL 700 Developing and Planning Research (required the first fall semester of enrollment)

GEOL 808 Fundamental Problems in Engineering and Science

In addition, the program of study must include at least one GEOL/GEOE course emphasizing field methods, one GEOL/GEOE course emphasizing analytical methods, and one GEOL/GEOE course emphasizing computational methods. The student's advising committee determines the courses that meet these criteria.

Geological Engineering Specialization

All Ph.D. students in the Geological Engineering specialization are expected to focus in one of the three areas of groundwater/environmental, geomechanics, or energy/mineral resources.

The candidate's committee is responsible for assisting the student in developing a program of study that prepares the student for his/her intended research focus. The following courses are required for the Geological Engineering specialization:

GEOE 700 - Developing and Planning Research (required the first fall of enrollment)

GEOL 808 Fundamental Problems in Engineering and Science

In addition, the program of study must include at least one GEOL/GEOE course emphasizing field methods, one GEOL/GEOE course emphasizing analytical methods and one GEOL/GEOE course emphasizing computational methods. The student's advising committee determines the courses that meet these criteria.

Mining Engineering Specialization

The candidate's committee is responsible for assisting the student in developing a program of study that prepares the student for his/her intended research focus. The following courses are required for the Mining Engineering specialization:

MEM 700 - Developing and Planning Research (required the first fall of enrollment).

MEM 790 - Seminar

GEOL 808 - Fundamental Problems in Engineering and Science

In addition, the program of study must include at least twelve (12) credits of MEM electives. Other electives can be MEM or out of department.

Ph.D. EXAMINATIONS

When the student has substantially completed the required 36 credits of coursework for the PhD, and before work on the dissertation research commences in earnest, the student must complete a combined examination composed of two parts. The first part is the **Qualifying** exam, which is a course-work based exam to test and demonstrate the doctoral student's proficiency in the foundational material of his or her discipline. The second part is a "**Comprehensive** and Admission-to-Candidacy Exam," which is a wide-ranging exam to demonstrate the doctoral student's readiness to pursue doctoral research; it includes the submission and defense of the doctoral research proposal. After the successful completion of both exams, the student will be admitted to Ph.D. candidacy. The final defense must take place no earlier than 12 months after admission to candidacy.

The student must make a request to the student's committee to take the Qualifying and Comprehensive examinations no later than two months prior to the examination. Both exams must also be scheduled with the Graduate Office; students should review its policies regarding the scheduling and reporting of qualifying and comprehensive exams well in advance to ensure that all requirements are met. The department requires that the qualifying examination must take place within one working week. The

comprehensive examination must be held no sooner than five working days and no later than 10 working days after the completion of the qualifying exam.

If the student has not completed all requirements for the Ph.D. degree by the fifth year following the comprehensive examination, his/her active candidacy status will be automatically terminated and the comprehensive examination must be repeated.

The qualifying examination

The qualifying examination will consist of a written examination covering the student's field of study and related subjects. It will be prepared by the student's advisory committee, with potential suggestions from any faculty member from whom the student has taken a graduate course. The examination may be scheduled for spring and fall semesters only, and may not take place during the last week of classes or the week of final examinations.

The results of the qualifying examination must be determined prior to the comprehensive examination and should be reported to the student as soon as possible following the completion of the exam.

The qualifying examination will consist of three parts, all of which must be completed within one working week. Each part will be three hours in length. Students may not be required to take more than one part per day.

General	33%
Specific Topic 1	33%
Specific Topic 2	33%

For students in the **Geology Specialization**, the General part of the qualifying exam will include **General Geology**. Specific topics will be chosen by the student with approval by the student's committee; examples are listed below. A student may propose hybrid fields with other disciplines if approved by his or her graduate committee.

- Structural Geology
- Sedimentation/Stratigraphy
- Paleontology
- Igneous/Metamorphic Petrology
- Economic Geology/Mineral Exploration
- Geophysics/Geodynamics
- Geospatial/Geocomputation
- Petroleum Geology
- Groundwater/Hydrology

For students in the **Geological Engineering Specialization**, the General part of the qualifying exam will include **Geological Engineering, Geology, and Fundamentals of Engineering**. Specific topics will be chosen by the student with approval by the student's committee; examples are listed below. A student may propose hybrid fields with other disciplines if approved by his or her graduate committee.

A student may substitute successful completion of the Fundamentals of Engineering (F.E.) examination for one of the three (3) parts.

- Groundwater
- Engineering Geology
- Petroleum Engineering
- Mineral Exploration/Production
- Hydrology and Hydraulic Engineering
- Geophysics

- Geochemistry
- Rock Mechanics
- Geotechnical Engineering

For students in the **Mining Engineering Specialization**, the General part of the qualifying exam will include **Mining Engineering** and **Fundamentals of Engineering**. A student may substitute successful completion of the Fundamentals of Engineering (FE) examination for the General part of the exam. Specific topics will be chosen by the student with approval by the student's committee; examples are listed below. A student may propose hybrid fields with other disciplines if approved by his or her graduate committee.

- Rock Mechanics/Geomechanics
- Mine Ventilation
- Mine Planning
- Geostatistics
- Rock Fragmentation
- Mineral Economics
- Engineering Geology

The Comprehensive Examination and Admission to Candidacy

The comprehensive examination consists of the oral presentation and defense of the student's dissertation research proposal. All Ph.D. students are required to prepare a research proposal for the research to be accomplished for the dissertation. The proposal must be given to the student's committee at least one month before the qualifying examination takes place, so that the candidate's committee may review the proposal to evaluate whether it is defensible. If not, then the student will have an opportunity to resubmit, although this may alter the final dates of the qualifying and comprehensive examinations. After the proposal has been pre-approved by the committee, the student will petition the Graduate Office to formally schedule the examinations.

The comprehensive exam will last approximately three hours. The student will prepare a 20-30 minute oral presentation of the dissertation proposal to begin the examination. This presentation is open to the public. After the presentation, the student's committee may examine the candidate orally on the proposal itself, on science or engineering topics related to the work to be completed, or on topics from the qualifying examination. The oral examination section must include the student's full committee, and may also be attended by any department faculty, but is closed to the public. The examination is passed if the student demonstrates that the research proposal is workable and worthy of a dissertation, and that he or she possesses the requisite scientific and technical knowledge needed to successfully complete the research.

Graduate Education policies stipulate that satisfactory completion of the comprehensive examination requires that no more than one member of the graduate student advisory committee votes against passing. If the student passes with conditions, such as failure to pass a part of the examination, the committee shall inform the student promptly as to how and when the conditions may be removed. If, in the opinion of 2 or more members of the graduate student advisory committee, the student has failed the comprehensive examination, another such examination may not be attempted during the same semester. After failure to pass a second time, work toward the doctorate can be continued only with the consent of the graduate student advisory committee, the Council of Graduate Education, and the dean of graduate education, pending successful future completion of the comprehensive examination.

Additional Graduate School policies pertaining to PhD examinations are located in the SDSMT Catalog.

Materials Engineering and Science, Ph.D.

Contact Information

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Advisory Council

Advisory Council members are from the Departments of Metallurgical Engineering, Physics, and Chemistry.

Materials Engineering and Science

The doctor of philosophy program in materials engineering and science (MES) offers a student the opportunity to expand his/her knowledge and understanding of the science and technology of materials production, behavior, and applications. The student will undertake multidisciplinary approaches, combining the basic elements of both engineering and science, to the solution of materials-related problems. Because such problems are found in every science and engineering discipline, the degree applicant has considerable flexibility in the selection of the department in which to pursue dissertation research, within the confines of the applicant's academic preparation and interests. Candidates will study either a science or engineering emphasis within the MES Ph.D. program. For example, research emphasis may be placed on improving processes for the production of metallic, polymeric, ceramic, or other structural or electronic materials. Alternatively, the degree candidate may investigate mechanisms for improving material properties, which in turn, could lead to new or better applications. Classroom and individualized instruction will provide the necessary theory to complement such creative activities.

Example areas of specialization include but are not limited to

- Computational Modeling
- Polymer Synthesis
- Corrosion Inhibition
- Development of Multiphase Materials
- Fiber Reinforced Composites
- Geotechnology
- Magnetic Nanocomposites
- Nanoscale Electronic Materials
- Strengthening Mechanisms
- Surface Chemistry of Flotation
- Thermophysical Properties
- Thin Films
- Security Printing
- Hydrometallurgical Extraction
- Friction Stir Welding
- Cold Spray Processing
- Direct Write Technology

- Polymer Matrix Composites
- Semiconductor Materials and Devices

The program is administered directly by the Dean of Graduate Education and sponsored programs, with the head of the MES Ph.D. advisory council serving as program coordinator. The advisory council currently comprises faculty members from the Departments of Materials and Metallurgical Engineering, and the Departments of Physics, and Chemistry.

The Graduate Record Examination (GRE), three letters of recommendation, and a GPA of 3.00 or better are required of all applicants for the MES Ph.D. program. The TOEFL exam is required for students whose native language is not English.

All candidates for the MES Ph.D. program are required to successfully complete the following minimum credits and earn a grade of "C" or better, except for a final grade of "S" in MES 898:

Category	Credits
Analytical Mathematics	3
Numerical Mathematics	3
Program Major Emphasis (Engineering or Science)	44
Dissertation Research	22
Total beyond the B.S. degree	72

General Program Requirements

(Minimum program requirements: 72 credits)

Analytical Mathematics (3 credits)

- ME 673 Applied Engineering Analysis I **Credits: (3-0) 3**
- PHYS 481/581 Mathematical Physics **Credits: 4**

Numerical Mathematics (3 credits)

- MATH 447/547 Design of Experiments **Credits: (3-0) 3**
- ME 773 Applied Engineering Analysis II **Credits: (3-0) 3**
- MET 614 Advanced Metallurgical Simulation Techniques **Credits: (3-0) 3**
- MEM 433/433L/533/533L Advanced Mine Planning & Design **Credits: (2-1) 3**

Program Emphasis (44 credits)

Two program emphasis areas are available: materials science and materials engineering. See the two sections below.

Research (22 credits) and Seminar (1 credit)

- MES 898 Dissertation **Credits: Credit to be arranged.**
- ¹ MES 790/890 Seminar **Credits: (1-0) 1**

Materials Science Emphasis Requirements

Thermodynamics of Solids (3 credits)

- MES 712 Interfacial Phenomena **Credits: (3-0) 3**
- PHYS 743 Statistical Mechanics **Credits: (3-0) 3**
- CBE 613 Transport Phenomena: Heat **Credits: (3-0) 3**
- CBE 714 Transport Phenomena: Mass **Credits: (3-0) 3**
- MES 728 Heterogeneous Kinetics **Credits: (3-0) 3**

Crystal Structure/Chemistry of Solids (3 credits)

- MES 603 Condensed Matter Physics **Credits: (4-0) 4**
- MES 604 Chemistry of Materials **Credits: (4-0) 4**
- PHYS 771 Quantum Mechanics I **Credits: (3-0) 3**

Bulk or Surface Analysis (4 credits)

- NANO 703/703L Instrumentation and Characterization of Nano-Materials/Lab **Credits: (3-1) 4**

Fundamental Engineering Mechanics (6 credits)

Courses from the materials engineering emphasis section can also be used to fulfill this requirement.

- ME 425 Probabilistic Mechanical Design **Credits: (3-0) 3**
- MET 450/550 Forensic Engineering **Credits: (3-0) 3**
- MET 440/540 Mechanical Metallurgy **Credits: (3-0) 3**
- ME 443 Composite Materials **Credits: (3-0) 3 OR**
- MET 443 Composite Materials **Credits: (3-0) 3**

- MET 625 Strengthening Mechanisms in Metals **Credits: (3-0) 3**

Dissertation Related Topics (28 credits)

Materials Engineering Emphasis Requirements

Analytical Mechanics (3 credits)

- ME 623 Advanced Mechanical Vibrations **Credits: (3-0) 3**
- ME 613 Transport Phenomena: Heat **Credits: (3-0) 3**
- MES 713 Advanced Solid Mechanics I **Credits: (3-0) 3**
- MES 770 Continuum Mechanics **Credits: (3-0) 3**

Elasticity/Plasticity (3 credits)

- CEE 743 Advanced Soil Mechanics **Credits: (3-0) 3**
- MES 713 Advanced Solid Mechanics I **Credits: (3-0) 3**
- MEM 450/550 Rock Slope Engineering **Credits: (3-0) 3**

Failure Analysis Fracture Mechanics (3 credits)

- ME 715 Advanced Composite Materials **Credits: (3-0) 3**

Fundamental Materials Science (6 credits)

Courses from the materials science emphasis section can also be used to fulfill this requirement.

- CHEM 420/520 Organic Chemistry III **Credits: (3-0) 3**
- CHEM 452/552 Inorganic Chemistry **Credits: (3-0) 3**
- CHEM 426/526 Polymer Chemistry **Credits: (3-0) 3**
- MES 603 Condensed Matter Physics **Credits: (4-0) 4**
- MES 601 Fundamentals of Materials Engineering **Credits: (3-0) 3**
- MES 604 Chemistry of Materials **Credits: (4-0) 4**
- CBE 474/574 Polymer Technology **Credits: 2 to 3**
- PHYS 439/539 Solid State Physics **Credits: 4**
- MET 445/545 Oxidation and Corrosion of Metals **Credits: (3-0) 3**

Dissertation Related Topics (29 credits)

Additional Information

An assessment of the student's qualifications will be undertaken early in their program. The assessment is comprised of performance in pre-determined courses and a dissertation proposal. Further information is available in the School of Mines materials engineering and science Ph.D. Handbook.

Each student is also required to pass a comprehensive coursework examination and proposal defense. 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. It is not necessary that the student be associated with the department of affiliation of his or her major professor. The detailed information on examination policy, admission to candidacy, and defense of dissertation are included in the School of Mines Materials Engineering and Science Ph.D. Handbook.

Program assessment includes a student outcomes and satisfaction surveys.

¹MES 790 should be taken by M.S. students and MES 890 by Ph.D. students.

Mechanical Engineering, Ph.D.

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Faculty

Professors Abata, Larochelle, and Muci-Kuchler; Associate Professors Ash, Shahbazi, and Widener; Assistant Professors Bruno, Degen, Fekrmandi, Huang, Lessani, and Romkes; Professors Emeritus Buck, Chiang, Dolan, Gnirk, Kjerengtroen, Krause, Langerman, and Pendleton.

Curriculum

The following discussion assumes students are entering the program with a Bachelor's of Science degree. Students entering with a Master of Science degree will design their program of study in accordance with their graduate committee input, the department, and CGE policy.

Students entering the PhD program will be required to submit a plan of study and choose an advisor by the mid-term of the second semester of coursework. The degree requirements include a minimum of 72 credit hours beyond the Bachelor of Science degree. The 72 credit hours include a minimum of 36 credit hours of coursework (see below) and a minimum of 20 credit hours of research (ME 898D), such that the sum of course credits and research credits adds up to the minimum total of 72 credits. Of the minimum 36 course credits, the ME department requires a minimum of 18 ME department credits from the list below or equivalent courses approved by the student's graduate advisory committee. The remaining 18 course credits may be taken from outside the ME department, with the approval of the student's graduate advisory committee. The ME courses must be from the following courses or equivalent courses approved by the graduate student advisory committee. Of these ME courses, ME 673 and ME 773 (Engineering Analysis I and II) are mandatory (core) courses for all ME graduate students.

The department also adopts the CGE policy in counting limited undergraduate course credits (not applied toward the baccalaureate) toward the Ph.D. degree (see the CGE policy for details) and in transferring the relevant M.S. course and research credits to the Ph.D. credits.

In addition to the successful completion of the curriculum, the program of study requires passing a qualifying exam, submitting a research topic proposal, passing a comprehensive exam, and successfully defending the dissertation.

Course Credits

Minimum of 36 course credits is required. (Note that the sum of research and course credits must add up to at least 72 total credits.)

Mandatory ME Courses

- ME 673 Applied Engineering Analysis I **Credits: (3-0) 3** (Mandatory for all Ph.D. students)
- ME 773 Applied Engineering Analysis II **Credits: (3-0) 3** (Mandatory for all Ph.D. students)

Total: 6 Credits

Other ME Courses

- ME 612 Transport Phenomena: Momentum **Credits: (3-0) 3**
- ME 613 Transport Phenomena: Heat **Credits: (3-0) 3**
- ME 616 Computations in Transport Phenomena **Credits: (3-0) 3**
- ME 618 Conduction Heat Transfer **Credits: (3-0) 3**
- ME 619 Convection Heat Transfer **Credits: (3-0) 3**
- ME 620 Radiation Heat Transfer **Credits: (3-0) 3**
- ME 623 Advanced Mechanical Vibrations **Credits: (3-0) 3**
- ME 625 Smart Structures **Credits: (3-0) 3**
- ME 680 Advanced Strength of Materials **Credits: (3-0) 3**
- ME 683 Advanced Mechanical System Control **Credits: (3-0) 3**
- ME 691 Independent Study **Credits: 1 to 3**
- ME 692 Topics **Credits: 1 to 3**
- ME 713 Advanced Solid Mechanics I **Credits: (3-0) 3**
- ME 715 Advanced Composite Materials **Credits: (3-0) 3**
- ME 736 Advanced Finite Element Methods **Credits: (3-0) 3**
- ME 770 Continuum Mechanics **Credits: (3-0) 3**
- ME 781 Robotics **Credits: (3-0) 3**

Minimum: 18 Credits

Non-ME Courses

Out of the minimum 36 course credits required, a maximum of 18 credits may be taken from outside the ME department, with the approval of the student's graduate advisory committee.

Research Credits, Dissertation

A minimum of 20 research credits is required. (Note that the sum of research and course credits must add up to at least 72 total credits.) All the research credits taken by the Ph.D. student must be ME 898D Dissertation with the exception of 6 research credits which may be transferred from the M.S. degree with the approval of the student's graduate advisory committee. The 6 M.S. research credits transferred must be ME 798 or equivalent research credits.

Nanoscience and Nanoengineering, Ph.D.

Contact Information

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Advisory Council

Professors Ahrenkiel, Fong, Salem and Smith (Chair); Associate Professors Yang and Zhu; Assistant Professors Anderson and Wood; Dean Price (ex-officio).

Nanoscience and Nanoengineering

The Nano Science and Engineering Ph.D. (Nano SE Ph.D.) Program at the South Dakota School of Mines and Technology is an interdisciplinary Ph.D. program focusing on the science and engineering of nano-scale materials, nano-metrology, and nano-biotechnology. The goal of nanoscience and nanotechnology is to manipulate matter at the atomic and "nano" length scales (dimensions from a few to 100's of atomic radii), e.g. the molecular to mesoscopic levels, where new materials and phenomena have been discovered. The ability to engineer systems at these length scales will require professionals with a broad understanding of fundamental principles and the ability to cross-over into other fields. The nano program provides the training to allow scientists and engineers to address these challenges, and the opportunity for students to engage in such research at the School of Mines while pursuing the Ph.D.

The Nano SE Ph.D. program offers a research-intensive degree focused on nanoscience and nanotechnology, with an emphasis on nano-scale materials. A multi-disciplinary core curriculum is taken by students from diverse science and engineering backgrounds. These "core" courses are intended to introduce students to contemporary topics in nanoscience and nanotechnology, and to initiate a cross-disciplinary approach to research and learning. These courses can usually be completed in one, or at most two years. In addition to this core, students entering with an M.S. degree are required to take at least two electives outside the student's traditional area of training. Students entering at the B.S. level will be expected to pursue, or take coursework equivalent to, an M.S. degree, in addition to the nano core curriculum.

Students from traditional science and engineering backgrounds enter the program with well-defined research interests and affiliate themselves with a research group and a faculty mentor. Current nano program participants draw from the Departments of Nanoscience and Nanoengineering, Physics, Chemistry, Chemical, Electrical, Materials and Metallurgical Engineering. Students with traditional training in these areas participate in cross-disciplinary research with a nano focus. Three major focus areas of the program are Electronic-Photonic Materials, Nano-Bio Imaging, and Nano-composites. Examples of research projects are: synthesis and characterization of nanocomposite materials, photo-activated nano-inks for direct write applications, nano-energetic materials, polymer chemistry, theory of spintronic devices, structural and optical characterization of nano-materials for solar energy, bio-fuels and other forms of renewable energy, superresolution optical imaging methods and nonlinear optics applied to the imaging of nano-scale bio-materials and systems.

Convergent Beam Electron Diffraction montage of lattice	Scanning tunneling microscope image of self-	Fluorescence image of Electrospun conjugated polymer nanofibers (organic
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mismatched III-V multilayer (multi-junction solar cell research in Ahrenkiel Lab	assembled quantum dots grown by MBE (quantum dot solar cell research in Yang lab)	electronics for optoelectronics research in Zhu lab)
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The Nano SE Ph.D. program builds on traditional science and engineering disciplines, and offers a "core" curriculum which introduces students from varying science and engineering backgrounds to contemporary topics in nanoscience and nanotechnology. Students are expected to obtain graduate level training in a traditional discipline, designated as the "program major emphasis", and take a minimum of 6 elective credits outside their own area. Students entering the program with an M.S. may apply up to 24 transfer credits toward fulfilling the program major emphasis requirements. More information is available in the Nano SE Ph.D. Program Handbook.

Students with an M.S. degree in science or engineering are eligible for admission. However, students with a B.S. degree only will also be considered for admission when the student has proven to possess exceptional qualifications. The Graduate Record Examination (GRE), three letters of recommendation, and a GPA of 3.00 or better are required of all applicants for the Ph.D. program. The TOEFL exam is required for students whose native language is not English.

All candidates for the Ph.D. program are required to successfully complete the following minimum credits and earn a grade of "C" or better, except for a final grade of "S" in NANO 898:

The program of study must be filed with the graduate office, and approved by the Nano SE Ph.D. program director before midterm of the second semester of residence, and again before the qualifying exam. Below is the summary of the required course of study.

Requirements

- NANO 701 Nano Materials **Credits: (3-0) 3**
- NANO 702 Theory and Application of Nanoscale Materials **Credits: (3-0) 3**
- NANO 703/703L Instrumentation and Characterization of Nano-Materials/Lab **Credits: (3-1) 4**
- ¹ NANO 890 Seminar **Credits: (1-0) 1**
- Program Major Emphasis Credits: 27-37
- Dissertation Research Credits: 30-40

Total: 80

Curriculum Notes

¹ Course taken three times for a total of 3 credits.

General Program Requirements

(Minimum program requirements: (80 credits)

M.S. Degree (24 credits)

Students entering the Ph.D. program with a previous M.S. degree in a relevant discipline are allowed to apply a maximum of 24 semester course credit hours toward the course credit requirements subject to approval of the Dean of Graduate Education.

The following is a list of electives for each focus area of the program. Graduate level courses which serve the needs of our other graduate programs are also available as electives.

- NANO 401 Introduction to Nanoscience **Credits: (3-0) 3**
- NANO 445/545 Introduction to Nanomaterials **Credits: (3-0) 3**
- NANO 504 Nanophotonics **Credits: (3-0) 3**
- NANO 475/575 Advances in Processing and Nanoengineering of Polymers **Credits: (2-0) 2**
- NANO 604 Nanophotonic Materials **Credits: (3-0) 3**
- NANO 636 Photovoltaics **Credits: (3-0) 3**
- NANO 704 Crystallography and Structure of Nanomaterials **Credits: (3-0) 3**
- NANO 705 Nanoelectronics **Credits: (3-0) 3**
- NANO 706 Diffraction Methods for Nanomaterials Research **Credits: (3-0) 3**
- NANO 707 Defects in Nanomaterials **Credits: (3-0) 3**
- NANO 708 Nanomaterials for Photovoltaics **Credits: (3-0) 3**
- NANO 709 Scientific Instrumentation, Control, and Visualization **Credits: (3-0) 3**
- NANO 712/712L Electromagnetic Properties of Heterogeneous Materials/Lab **Credits: (2-1) 3**
- NANO 715 Polymeric Nanomaterials **Credits: (3-0) 3**
- NANO 716 Digital Fabrication: Materials and Processes **Credits: (3-0) 3**
- NANO 717 Nanochemistry **Credits: (3-0) 3**
- NANO 719 Nanomaterials for Biosensors **Credits: (3-0) 3**
- NANO 791 Independent Study **Credits: 1 to 3**
- NANO 792 Topics **Credits: 1 to 3**
- MES 601 Fundamentals of Materials Engineering **Credits: (3-0) 3**
- MES 603 Condensed Matter Physics **Credits: (4-0) 4**
- MES 604 Chemistry of Materials **Credits: (4-0) 4**

- ME 612 Transport Phenomena: Momentum **Credits: (3-0) 3 OR**
- CBE 612 Transport Phenomena: Momentum **Credits: (3-0) 3**

- ME 613 Transport Phenomena: Heat **Credits: (3-0) 3 OR**
- CBE 613 Transport Phenomena: Heat **Credits: (3-0) 3**

- CBE 714 Transport Phenomena: Mass **Credits: (3-0) 3**
- PHYS 721 Electrodynamics I **Credits: (3-0) 3**
- PHYS 743 Statistical Mechanics **Credits: (3-0) 3**
- PHYS 771 Quantum Mechanics I **Credits: (3-0) 3**
- PHYS 773 Quantum Mechanics II **Credits: (3-0) 3**
- MES 712 Interfacial Phenomena **Credits: (3-0) 3**
- MES 713 Advanced Solid Mechanics I **Credits: (3-0) 3**
- MES 728 Heterogeneous Kinetics **Credits: (3-0) 3**
- MES 770 Continuum Mechanics **Credits: (3-0) 3**

Additional Information

For program supervision purposes, the nano SE Ph.D. program director is the graduate advisor until the major professor is appointed. The major professor is responsible for the student's dissertation research. The graduate office representative on the student's dissertation committee must be selected from outside of the department with which the major professor is affiliated, and should also be a member of the Nano Ph.D. Advisory Council. It is not necessary that the student be associated with the department of affiliation of his or her major professor. Detailed information on examination policy, admission to candidacy, and defense of dissertation are included in the School of Mines nano science and engineering Ph.D. Program Handbook.

Physics, Ph.D.

Contact Information

Dr. Andre G. Petukhov

Department of Physics

Electrical Engineering/Physics 235A

(605) 394-2364

E-mail: Andre.Petukhov@sdsmt.edu

Faculty

Professors Corey, Detwiler, Petukhov, and Sobolev; Associate Professors Schnee and Strieder, Assistant Professors Bai, Corwin, French, Oszwaldowski, and Reichenbacher; Instructor Dowding; Emeriti Professors Foygel and Helsdon.

Program Description

The Ph.D. program in physics will prepare students for a variety of career paths, including positions in academia, industry and at national labs. While degree candidates may pursue specialized research foci based on the research expertise of individual faculty members, the most significant goal of the program is to focus on research areas germane to the needs and special resources of the Sanford Underground Research facility (SURF). Examples of specialized research areas connected to SURF include nuclear/particle physics and particle astrophysics involving next-generation neutrino detection; double beta-decay, dark matter searches and gravitational wave detection experiments, as well as condensed matter physics concentrating on novel low background radiation materials and devices.

Admissions Information/Application Process

The following items have to be submitted by students who apply:

- Completed application
- Three letters of recommendation from parent institution instructors
- General GRE scores
- Official transcripts from all universities attended (Applicants must have at least a 3.0 (B) grade point average in their undergraduate work.)
- International students should refer to the Graduate School policy for language requirements.

Scholarships

A limited number of graduate assistantships are awarded each year on a competitive basis to fully admitted, full-time, on-campus M.S. and Ph.D. students. Applications for graduate assistantships are due on February 1.

Physics (Ph.D)

72 CREDIT HOURS REQUIRED

- Required core 24 credit hours
- Electives 12 credit hours
- Dissertation 36 credit hours

Collaborative Program between the University of South Dakota and South Dakota School of Mines & Technology.

Required Core: Total 24 credit hours

- PHYS 721 Electrodynamics I **Credits: (3-0) 3**
- PHYS 723 Electrodynamics II **Credits: (3-0) 3**
- PHYS 743 Statistical Mechanics **Credits: (3-0) 3**
- PHYS 751 Classical Mechanics **Credits: (3-0) 3**
- PHYS 771 Quantum Mechanics I **Credits: (3-0) 3**
- PHYS 773 Quantum Mechanics II **Credits: (3-0) 3**
- PHYS 761 Nuclear and Particle Physics **Credits: (3-0) 3**
- PHYS 790 Seminar **Credits: 1 to 3**

Electives: Total 12 credit hours

- PHYS 683 Mathematical Physics II **Credits: (3-0) 3**
- PHYS 691 Independent Study **Credits: 1 to 3**
- PHYS 692 Topics **Credits: 1 to 3**
- PHYS 733 Experimental Particle Physics: Principles, Data Analysis, and Simulation **Credits: (3-0) 3**
- PHYS 739 Condensed Matter Physics I **Credits: (3-0) 3**
- PHYS 749 Condensed Matter Physics II **Credits: (3-0) 3**
- PHYS 763 Advanced Particle Physics **Credits: (3-0) 3**
- PHYS 765 Advanced Nuclear Physics **Credits: (3-0) 3**
- PHYS 775 General Relativity **Credits: (3-0) 3**
- PHYS 779 Group Theory **Credits: (3-0) 3**
- PHYS 783 Quantum Field Theory **Credits: (3-0) 3**
- PHYS 784 Advanced Quantum Field Theory **Credits: (3-0) 3**
- PHYS 785 Astrophysics and Cosmology **Credits: (3-0) 3**
- PHYS 791 Independent Study **Credits: 1 to 3**
- PHYS 792 Topics **Credits: 1 to 3**

Dissertation: Total 36 credit hours

- Dissertation 36 hours

Minors

Minors - General Information

Students interested in pursuing a specific minor offered by SDSM&T should contact the coordinator of that minor for more specific information on the application process and the appropriate forms.

- No undergraduate degree program requires a minor.
- Regental undergraduate minors consist of 18-24 semester credit hours.
- No fewer than nine (9) semester credit hours in a minor must be taken at School of Mines.
- A cumulative grade point average of 2.00 or better must be attained in the coursework defining the minor.
- The specific courses required for a minor in each department and program offering a minor can be found in the section of this catalog where that program is described.
- Notification of intent to seek a minor is to be in effect no later than the time of registration for the first semester of the senior year (90 or more credit hours completed) on a form available in the Registrar and Academic Services (RAS) office. This form must be approved and signed by the head of the department from which the degree will be awarded, and the head of the department from which the minor will be awarded.

Applied Biological Sciences Minor

Contact Information

Dr. Richard Sinden, Department Head

Department of Chemistry and Applied Biological Sciences

Chemical and Biological Engineering/Chemistry 2206

(605) 394-1678

E-mail: Richard.Sinden@sdsmt.edu

MINOR IN APPLIED BIOLOGICAL SCIENCES

Credits Required 19

The core curriculum requires students to complete 12 hours of core biology classes that are required in the ABS major program. The additional 7 hours of electives are chosen from a variety of biology classes that will supplement the student's major field to broaden the student's overall academic preparation for a science or engineering career.

A grade of 'C' or better will be required for all courses needed for the biology minor. At least 50% of biology courses applied toward a minor must be completed at SDSM&T.

Required Courses: 12 Credits

- BIOL 151 General Biology I **Credits: (3-0) 3**
- BIOL 151L General Biology I Lab **Credits: (0-1) 1**
- BIOL 153 General Biology II **Credits: (3-0) 3**
- BIOL 153L General Biology II Lab **Credits: (0-1) 1**
- BIOL 371 Genetics **Credits: (3-0) 3**
- BIOL 371L Genetics Lab **Credits: (0-1) 1**

Elective Courses: 7 Credits

- BIOL 311 Principles of Ecology **Credits: (3-0) 3**
- BIOL 221 Human Anatomy **Credits: (3-0) 3**
- BIOL 221L Human Anatomy Lab **Credits: (0-1) 1**
- BIOL 326 Biomedical Physiology **Credits: (3-0) 3**
- BIOL 326L Biomedical Physiology Lab **Credits: (0-1) 1**
- BIOL 331 Microbiology **Credits: (3-0) 3**
- BIOL 331L Microbiology Lab **Credits: (0-1) 1**
- BIOL 341 Microbial Processes in Engineering and Natural Sciences **Credits: (3-0) 3**
- BIOL 341L Microbial Processes Laboratory **Credits: (0-1) 1**
- BIOL 375 Current Bioethical Issues **Credits: (3-0) 3**
- BIOL 406/506 Global Environmental Change **Credits: (3-0) 3**
- BIOL 423 Pathogenesis **Credits: (3-0) 3**
- BIOL 423L Pathogenesis Lab **Credits: (0-1) 1**
- BIOL 438/538 Industrial Microbiology **Credits: (3-0) 3**
- BIOL 438L/538L Industrial Microbiology Lab **Credits: (0-1) 1**
- BIOL 455/555 DNA Structure and Function **Credits: (3-0) 3**
- BIOL 446/546 Molecular Cell Biology **Credits: (3-0) 3**
- BIOL 478/578 Microbial Genetics **Credits: (3-0) 3**
- BIOL 480/580 Bioinformatics **Credits: (3-0) 3**
- BIOL 498 Undergraduate Research/Scholarship **Credits: 1 to 12**
- CHEM 464/564 Biochemistry I **Credits: (3-0) 3**
- CHEM 464L/564L Biochemistry I Lab **Credits: (0-1) 1**
- CHEM 465/565 Biochemistry II **Credits: (3-0) 3**
- CHEM 465L Biochemistry Laboratory II **Credits: (0-1) 1**
- BIOL 383 Bioethics **Credits: (3-0) 3**

Atmospheric Sciences Minor

Contact Information

Dr. Adam French

Atmospheric and Environmental Sciences Program

Mineral Industries 208

(605) 394-1649

E-mail: Adam.French@sdsmt.edu

Undergraduate minor in Atmospheric Sciences

Atmospheric scientists apply background knowledge in mathematics, physics, chemistry, computer science and many other disciplines to improve our understanding of the wide variety of weather phenomena that affects peoples' lives on a daily basis. This includes weather forecasting, fundamental research in areas such as severe and hazardous weather, climate science, and numerical modeling, and supporting a number of weather-sensitive industries including renewable energy production, agriculture, environmental monitoring, and insurance.

Students from any discipline at SDSM&T may pursue a minor in atmospheric sciences by completing 18 credit hours of coursework as described below.

Required Courses (12 cr)

- AES 201 Introduction to Atmospheric Sciences **Credits: (3-0) 3**
- AES 406/506 Global Environmental Change **Credits: (3-0) 3**
- AES 404/504 Atmospheric Thermodynamics **Credits: 2 or 3 ***
- AES 450 Synoptic Meteorology I **Credits: (3-0) 3**
** AES 404/504 may be replaced with a suitable 3-credit thermodynamics course, including CBE 321, ME 211, or MET 320. PHYS 341 may also be used in place of AES 404, however an additional elective will be required to reach the 18 credit total.*

Atmospheric Science Electives (3-6 cr)

At least three, elective credit hours are selected from the following list of atmospheric science electives** (six hours total can be applied to the minor):

- AES 401/501 Atmospheric Physics **Credits: (3-0) 3**
- AES 403/503 Biogeochemistry **Credits: (3-0) 3**
- AES 405/505 Air Quality **Credits: (3-0) 3**
- AES 419/519 Computing Methods in Atmospheric Sciences **Credits: (3-0) 3**
- AES 430/530 Radar Meteorology **Credits: (3-0) 3**
- AES 460/560 Atmospheric Dynamics **Credits: (3-0) 3**
- AES 455/555 Synoptic Meteorology II **Credits: (3-0) 3**
*** Select graduate courses in Atmospheric and Environmental Science may also be counted, with permission of instructor and program coordinator.*

Other Electives (0-3 cr)

Up to three credit hours from the following electives may be selected:

- CBE 485/585 Renewable and Sustainable Energy **Credits: (3-0) 3**
- CEE 326 Environmental Engineering I **Credits: (3-0) 3**
- CEE 425/525 Sustainable Engineering **Credits: (3-0) 3**
- CEE 437/437L/537/537L Watershed and Floodplain Modeling/Lab **Credits: (2-1) 3**
- EM 328 Applied Fluid Mechanics **Credits: (3-0) 3**
- EM 331 Fluid Mechanics **Credits: (3-0) 3**
- GEOE 475/475L/575/575L Groundwater/Lab **Credits: (2-1) 3**
- ME 430 Introduction to Wind Energy Engineering **Credits: (3-0) 3**
- MEM 401/401L Theoretical and Applied Mine Ventilation/Lab **Credits: (3-1) 4**
- MEM 405 Mine Permitting and Reclamation **Credits: (3-0) 3**
- POLS 407 Environmental Law & Policy **Credits: (3-0) 3**

Chemistry Minor

Contact Information

Dr. Richard Sinden, Department Head

Department of Chemistry and Applied Biological Sciences

Chemistry/Chemical Engineering 2206

(605) 394-1678

E-mail: Richard.Sinden@sdsmt.edu

MINOR IN CHEMISTRY

The goal of this minor is to provide students with a solid, albeit limited, background in chemistry. The minor requires 20 hours of CHEM courses (8 hours of required courses; 12 hours of elective courses). A grade of 'C' or better is required for all courses needed for the chemistry minor. At least 50% of chemistry courses applied toward a minor must be completed at SDSM&T.

Required Courses: 8 Credit Hours

- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**
- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**

Elective Courses: 12 Credit hours

Twelve (12) credit hours of courses at the 300-level or above, including one 400-level course, are required. Elective courses must represent 3 of the 6 areas of chemistry (Analytical, Biochemistry, Inorganic, Organic, Polymer, and Physical Chemistry).

Laboratory courses are required for two (2) of these elective courses. For courses that are offered at 2 or 3 credits, the 3-credit option must be used.

Elective options include:

- CHEM 326 Organic Chemistry I **Credits: (3-0) 3**
- CHEM 326L Organic Chemistry I Lab **Credits: (0-2) 2**
- CHEM 328 Organic Chemistry II **Credits: (3-0) 3**
- CHEM 328L Organic Chemistry II Lab **Credits: (0-2) 2**
- CHEM 332 Analytical Chemistry **Credits: 2 or 3 ***
- CHEM 332L Analytical Chemistry Lab **Credits: (0-1) 1**
- CHEM 342 Physical Chemistry I **Credits: 2 to 3**
- CHEM 342L Physical Chemistry I Lab **Credits: (0-1) 1**
- CHEM 344 Physical Chemistry II **Credits: 2 to 3 ***
- CHEM 344L Physical Chemistry II Lab **Credits: 1 to 2**
- CHEM 420/520 Organic Chemistry III **Credits: (3-0) 3**

- CHEM 426/526 Polymer Chemistry **Credits: (3-0) 3**
- CHEM 434 Instrumental Analysis **Credits: (3-0) 3**
- CHEM 434L Instrumental Analysis Lab **Credits: (0-2) 2**
- CHEM 452/552 Inorganic Chemistry **Credits: (3-0) 3**
- CHEM 452L/552L Inorganic Chemistry Lab **Credits: (0-1) 1**
- CHEM 464/564 Biochemistry I **Credits: (3-0) 3**
- CHEM 464L/564L Biochemistry I Lab **Credits: (0-1) 1**

Curriculum Notes

*** Only the three (3) credit version of this course may be used for completion of the Chemistry Minor.**

Computational Statistics Minor

Contact Information

Dr. Kyle Riley

Department of Mathematics and Computer Science

McLaury 308

(605) 394-2471

E-mail: Kyle.Riley@sdsmt.edu

The South Dakota School of Mines and Technology offers a minor in computational statistics, which is a great way to prepare any graduate for a career that involves intensive use of data. A minor in computational statistics must be approved by the student's major department along with the approval of the Department Head for Mathematics and Computer Science. Students majoring in Applied and Computational Mathematics are not eligible for the minor in computational statistics.

The Core Coursework Includes

- MATH 225 Calculus III **Credits: (4-0) 4**
- MATH 315 Linear Algebra **Credits: (3-0) 3**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**
or
- IENG 381 Introduction to Probability and Statistics **Credits: (3-0) 3**

The Elective Coursework Includes

The elective courses are devised into three categories and a student that seeks to earn the minor must complete the requirements of each category.

Computation

At least 3 credits in computation, which can be satisfied from the following list:

- CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**
- CSC 170/170L Programming for Engineers and Scientists **Credits: (3-0) 3**
- CBE 117L Programming for Chemical and Biological Engineering **Credits: (0-1) 1**
- CBE 250 Computer Applications in Chemical Engineering **Credits: (2-0) 2**

Informatics/Statistics

And at least 3 credits from the informatics/statistics category, which can be satisfied from the following list:

- MATH 382 Probability Theory and Statistics II **Credits: (3-0) 3**
or
- IENG 382 Probability Theory and Statistics II **Credits: (3-0) 3**
- GEOL 419/519 Advanced Geospatial Analysis **Credits: (3-0) 3**

- BIOL 480/580 Bioinformatics **Credits: (3-0) 3**

Data Analysis

And at least 2 credits from the data analysis category, which can be satisfied from the following list:

- MATH 443/543 Data Analysis **Credits: (3-0) 3**
- MATH 447/547 Design of Experiments **Credits: (3-0) 3**
- CBE 488/588 Applied Design of Experiments for the Chemical Industry **Credits: (2-0) 2**

Computer Science Minor

Contact Information

Dr. Kyle Riley

Department of Mathematics and Computer Science

McLaury 308

(605) 394-2471

E-mail: Kyle.Riley@sdsmt.edu

A minor in the Department of Mathematics and Computer Science must be approved by the student's major department. The Office of the Registrar and Academic Services has forms that should be completed and signed by the department heads from both departments involved in this minor. The minor in computer science requires the completion of 21 credit hours.

The core coursework includes

- CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**
- CSC 250 Computer Science II **Credits: (4-0) 4**
- CSC 251 Finite Structures **Credits: 2 or 4**
- CSC 300 Data Structures **Credits: (4-0) 4**
- At least 6 credit hours from an approved list.

The approved list of courses for the minor:

- CSC 314/314L Assembly Language/Lab **Credits: (2-1) 3**
- CSC 317 Computer Organization and Architecture **Credits: (3-0) 3**
- CSC 372 Analysis of Algorithms **Credits: (3-0) 3**
- CSC 410/510 Parallel Computing **Credits: (3-0) 3**
- CSC 412/512 Cryptography **Credits: (3-0) 3**
- CSC 415/415L/515/515L Introduction to Robotics/Lab **Credits: (3-1) 4**
- CSC 416/516 Advanced Algorithms for Robotics **Credits: (3-0) 3**
- CSC 468/568 Graphical User Interface Programming **Credits: (3-0) 3**
- CSC 433/533 Computer Graphics **Credits: (3-0) 3**
- CSC 441/541 Networking and Data Communications **Credits: (3-0) 3**
- CSC 442/542 Digital Image Processing **Credits: (3-0) 3**
- CSC 445/545 Introduction to Theory of Computation **Credits: (3-0) 3**
- CSC 447/547 Artificial Intelligence **Credits: (3-0) 3**
- CSC 448/548 Machine Learning **Credits: (3-0) 3**
- CSC 449/549 Advanced Topics in Artificial Intelligence **Credits: (3-0) 3**
- CSC 456/456L Operating Systems/Lab **Credits: (3-1) 4**
- CSC 461 Programming Languages **Credits: (4-0) 4**
- CSC 470 Software Engineering **Credits: (3-0) 3**

- CSC 476/476L/576/576L Mobile Computing Development **Credits: (2-1) 3**
- CSC 484 Database Management Systems **Credits: (3-0) 3**

Environmental Engineering Minor

Contact Information

Dr. Venkata Gadhamshetty

Program Coordinator

Department of Civil and Environmental Engineering

Civil/Mechanical 237B

(605) 394-1997

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Environmental engineers design systems and solve pressing global problems in all areas related to the environment and public health: sustainable design of drinking water treatment and wastewater treatment, and solid hazardous waste disposal systems; development of air quality monitoring and pollution prevention programs; design of site remediation and mining reclamation programs; and development of ecosystem protection and restoration efforts, among others. Students may study environmental engineering as an emphasis area in the B.S. civil engineering degree program, and/or pursue an environmental engineering minor.

Students from any discipline at the School of Mines may pursue a minor in environmental engineering by completing 18 credit hours of coursework as described below. Students must complete the Notification of Intent to Seek a Minor form, with appropriate signatures and turn it into the registrar's office by the beginning of the first semester of the senior year.

Required core courses:

- CEE 326 Environmental Engineering I **Credits: (3-0) 3**
- CEE 327/327L Environmental Engineering II/Lab **Credits: (2-1) 3**
- CEE 426/526 Environmental Engineering Unit Operations and Processes **Credits: (3-0) 3**
- CEE 427/527 Environmental Engineering Biological Process Design **Credits: (3-0) 3**

Elective course

In addition, students select two 3-credit elective courses from the list below. To ensure that enrollees gain the broad and interdisciplinary background expected in the environmental engineering discipline, one elective must be taken from a discipline outside the student's major field of study.

- CBE 455/555 Pollution Phenomena and Process Design **Credits: (3-0) 3**
- BIOL 341 Microbial Processes in Engineering and Natural Sciences **Credits: (3-0) 3**
- CHEM 326 Organic Chemistry I **Credits: (3-0) 3**
- CHEM 482/582 Environmental Chemistry **Credits: (3-0) 3**
- GEOE 475/475L/575/575L Groundwater/Lab **Credits: (2-1) 3**
- IENG 331 Safety Engineering **Credits: (3-0) 3**
- MEM 405 Mine Permitting and Reclamation **Credits: (3-0) 3**
- MET 220 Mineral Processing and Resource Recovery **Credits: (3-0) 3**

- MET 220L Mineral Processing and Resource Recovery Laboratory **Credits: (0-1) 1**
- GEOE 421/521 Aqueous Geochemistry **Credits: (3-0) 3**

OR

- CEE 421/521 Aqueous Geochemistry **Credits: (3-0) 3**
- CBE 217 Chemical Engineering Material Balances **Credits: (3-0) 3**
- IENG 431/531 Industrial Hygiene **Credits: (3-0) 3**
- AES 405/505 Air Quality **Credits: (3-0) 3**
- GEOE 221/221L Geology for Engineers/Lab **Credits: (2-1) 3**
- CEE 428/528 Oil and Gas Development and the Environment **Credits: (3-0) 3**

Environmental Science Minor

Contact Information

Lisa A. Kunza

Assistant Professor

Chemistry and Applied Biological Sciences

MI 206

(605) 394-2449

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MINOR IN ENVIRONMENTAL SCIENCE

Credits Required 19

The core curriculum requires students to complete a minimum of 19 credit hours, including 13 credit hours of required courses in Biology and Chemistry, and 6 credit hours of elective courses from various disciplines. The Environmental Science Minor will supplement the student's major field to broaden the student's overall academic preparation for a science or engineering career.

Required Courses: 13 Credits

- BIOL 151 General Biology I **Credits: (3-0) 3**
- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- BIOL 311 Principles of Ecology **Credits: (3-0) 3**
- BIOL 311L Principles of Ecology Laboratory **Credits: (0-1) 1**
One of the following:
- BIOL 406/506 Global Environmental Change **Credits: (3-0) 3**
or
- AES 406/506 Global Environmental Change **Credits: (3-0) 3**

Elective Courses: 6 Credits

- **BIOL 333/333L Aquatic Ecology and Watershed Management (4-0) 4**
- BIOL 331 Microbiology **Credits: (3-0) 3**
- BIOL 331L Microbiology Lab **Credits: (0-1) 1**
- AES 401/501 Atmospheric Physics **Credits: (3-0) 3**
- AES 403/503 Biogeochemistry **Credits: (3-0) 3**
- AES 404/504 Atmospheric Thermodynamics **Credits: 2 or 3**
- AES 405/505 Air Quality **Credits: (3-0) 3**
- CBE 485/585 Renewable and Sustainable Energy **Credits: (3-0) 3**
- CEE 325 Introduction to Sustainable Design **Credits: (3-0) 3**
- CEE 326 Environmental Engineering I **Credits: (3-0) 3**
- CEE 327/327L Environmental Engineering II/Lab **Credits: (2-1) 3**
- CEE 337 Engineering Hydrology **Credits: (3-0) 3**
- CEE 425/525 Sustainable Engineering **Credits: (3-0) 3**

- CEE 428/528 Oil and Gas Development and the Environment **Credits: (3-0) 3**
- CHEM 482/582 Environmental Chemistry **Credits: (3-0) 3**
- GEOE 475/475L/575/575L Groundwater/Lab **Credits: (2-1) 3**
- GEOL 416/416L/516/516L Introduction to GIS/Lab **Credits: (2-1) 3**
- MEM 401/401L Theoretical and Applied Mine Ventilation/Lab **Credits: (3-1) 4**
- MEM 405 Mine Permitting and Reclamation **Credits: (3-0) 3**
- POLS 407 Environmental Law & Policy **Credits: (3-0) 3**

Geology Minor

Contact Information

Dr. Laurie Anderson

Department of Geology and Geological Engineering
Mineral Industries 303
(605) 394-2461
E-mail: Laurie.Anderson@sdsmt.edu

Geology Courses

Science and engineering majors may pursue a minor in geology by completing eighteen (18) credit hours of geology courses (courses with a GEOL prefix) including the following:

- GEOL 201 Physical Geology **Credits: (3-0) 3**
- GEOL 201L Physical Geology Laboratory **Credits: (0-1) 1**
- GEOL 212/212L Mineralogy and Crystallography/Lab **Credits: (2-1) 3**
- GEOL 331/331L Stratigraphy and Sedimentation/Lab **Credits: (2-1) 3**
- GEOL 341/341L Igneous and Metamorphic Petrology/Lab **Credits: (2-1) 3**
- GEOL 322/322L Structural Geology/Lab **Credits: (2-1) 3**

Note(s):

GEOE 221/221L and one additional geology elective credit may be substituted for GEOL 201/GEOL 201L. No other substitutions are permitted for this minor.

Geospatial Technology Minor

Contact Information

Dr. Laurie Anderson

Department of Geology and Geological Engineering
Mineral Industries 303
(605) 394-2461
E-mail: Laurie.Anderson@sdsmt.edu

Geospatial Technology is a rapidly expanding field that covers the management and analysis of spatial data from many sources, such as satellites, airborne remote sensing, geographic information systems (GIS), global positioning systems (GPS), surveying, and more. It has many applications in the sciences, engineering, business, planning, and transportation.

Science and engineering majors may pursue a Minor in Geospatial Technology by completing eighteen (18) credit hours of courses, including

GEOL 416/416L/516/516L Introduction to GIS/Lab **(2-1) 3**
GEOL 417/517 Geospatial Databases **(3-0) 3**
GEOL 419/519 Advanced Geospatial Analysis **(3-0) 3**
GEOL 420/520 Introduction to Remote Sensing **(3-0) 3**.

Six additional credits taken from any of the groups below complete the minor. Up to three credits of a senior capstone, research, or design project with a significant proportion of geospatial content may be substituted for one elective, with permission of the Dr. Laurie Anderson. E-mail: Laurie.Anderson@sdsmt.edu

One of these surveying courses may be applied to the minor:

- CEE 206/206L Engineering Surveys I/Lab **Credits: (2-1) 3**
- MEM 201L Surveying for Mineral Engineers **Credits: (0-2) 2**

One of these statistics courses may be applied to the minor:

- MEM 307 Mineral Exploration and Geostatistics **Credits: (3-0) 3**
- MATH 281 Introduction to Statistics **Credits: (3-0) 3**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3**

One of these programming courses may be applied to the minor:

- CEE 284 Applied Numerical Methods **Credits: (3-0) 3**
- CBE 117L Programming for Chemical and Biological Engineering **Credits: (0-1) 1**

Any of these courses may be applied to the minor:

- CEE 437/437L/537/537L Watershed and Floodplain Modeling/Lab **Credits: (2-1) 3**
- CSC 111/111L Introduction to Computer Programming/Lab **Credits: (2-0) 2**
- CSC 150/150L Computer Science I/Lab **Credits: (2-1) 3**
- CSC 250 Computer Science II **Credits: (4-0) 4**
- CSC 442/542 Digital Image Processing **Credits: (3-0) 3**
- CSC 484 Database Management Systems **Credits: (3-0) 3**
- MEM 301/301L Computer Applications in Mining/Lab **Credits: (1-1) 2**

Global Engineering Minor

Contact Information

Dr. Jennifer Benning

Program Coordinator

Department of Civil and Environmental Engineering

Civil/Mechanical 241

(605) 394-2425

E-mail: Jennifer.Benning@sdsmt.edu

Well prepared engineers must possess skills and attitudes needed for working on multidisciplinary teams that are increasingly multicultural and global in nature. In a recent survey of employers recruiting on campus, 68% said that competence in cultural and global diversity was important for career success in their organizations.

An immersion experience in a different culture is the best way to learn to meet cross-cultural challenges in the areas of communication, values, beliefs, politics, language, and ethics. Students will gain this experience by creating and completing an engineering project in a culture that is significantly different than their own. The project will develop skills in verbal and non-verbal communication and working on a multicultural team. Earning this minor will provide evidence to employers of the ability to understand client expectations and unspoken priorities and select appropriate and indigenous technology. Students from any engineering discipline at the School of Mines may pursue a minor in global engineering by completing 18 credit hours of coursework.

The minor will more fully prepare graduates as global professionals and give graduates competitive advantages in seeking employment.

Students from any engineering discipline at the School of Mines may pursue a minor in global engineering by completing 18 credit hours of coursework as described below.

Required Core Courses:

Students must complete the Notification of Intent to Seek a Minor form, with appropriate signatures and turn it into the Registrar's Office by the beginning of the first semester of the senior year. Students must complete a three (3) cross-cultural engineering design activity (e.g., an approved design project, co-op, or engineering design course in a foreign culture or country). This design activity can take the form of (1) an approved design project in a foreign country or culture, or (2) a co-op or engineering design course in a foreign country or culture. The design credit activity must be pre-approved by the program coordinator and a technical advisor. Select 3 credits from the list below:

- CP 297/397/497 Cooperative Education **Credits: 1 to 3**
- EXPL 285/385/485/585/685 Study Abroad Experiences **Credits: 1 to 3**
- EXCH 289 Student Exchange - International **Credits: 0 to 18**
- EXCH 389 Student Exchange - International **Credits: 0 to 16**
- EXCH 489 Student Exchange - International **Credits: 0 to 18**
- xxx 464 Capstone Design I (prefix varies with department) **Credits: (0-1) 1**
- xxx 465 Capstone Design II (prefix varies with department) **Credits: (0-2) 2**
- CEE 489 Capstone Design Project **Credits: (0-3) 3**
- CEE 498 Undergraduate Research/Scholarship **Credits: 1 to 6**
- CEE 491 Independent Study **Credits: 1 to 3**

- CBE 466 Capstone Design for Chemical Engineering **Credits: (0-2) 2**
- CBE 487 Global and Contemporary Issues in Chemical Engineering **Credits: 1-0) 1**
- ME 477 Mechanical Engineering Design I **Credits: (0-2) 2**
- ME 479 Mechanical Systems Design II **Credits: (0-2) 2**
- MEM 464 Mine Design and Feasibility Study **Credits: (0-4) 4**

Elective Courses for Cross-Cultural Teamwork and Project Management:

Students will be required to select six (6) credits from the list below to improve cross-cultural teamwork or project management. Two or more different prefixes are required.

- IENG 352 Creativity and Innovation **Credits: (1-0) 1**
- IENG 366 Engineering Management **Credits: (3-0) 3**
- MSL 201 Innovative Team Leadership **Credits: (1-0) 1**
- PSYC 319 Teams and Teaming **Credits: (1-0) 1**
- PSYC 331 Industrial and Organizational Psychology **Credits: (3-0) 3**
- CEE 474/574 Construction Engineering and Management **Credits: (3-0) 3**

Elective Courses for Cross-Cultural Understanding and Communication:

Students will be required to select nine (9) elective credit hours that expand the understanding of human nature, social systems, cross cultural communication in, or engineering practices in a global context*

- ANTH 210 Cultural Anthropology **Credits: (3-0) 3**
- EXCH 289 Student Exchange - International **Credits: 0 to 18**
- EXCH 389 Student Exchange - International **Credits: 0 to 16**
- EXCH 489 Student Exchange - International **Credits: 0 to 18**
- EXPL 285/385/485/585/685 Study Abroad Experiences **Credits: 1 to 3**
- GEOG 210 World Regional Geography **Credits: (3-0) 3**
- GEOG 400 Cultural Geography **Credits: (3-0) 3**
- GER 101 Introductory German I **Credits: (4-0) 4 ****
- GER 102 Introductory German II **Credits: (4-0) 4 ****
- POLS 250 Introduction to International Relations **Credits: (3-0) 3**
- POLS 350 International Relations **Credits: (3-0) 3**
- PSYC 461 Theories of Personality **Credits: (3-0) 3**
- SOC 100 Introduction to Sociology **Credits: (3-0) 3**
- SPAN 101 Introductory Spanish I **Credits: (4-0) 4 ****
- SPAN 102 Introductory Spanish II **Credits: (4-0) 4 ****

* Specialized courses being developed in conjunction with efforts to create study-abroad pathways within all undergraduate programs of study will be considered for inclusion as electives as they are developed (i.e., CBE 487, Global and Contemporary Issues in Chemical Engineering).

**Intermediate or advanced language courses or language courses taken while studying abroad may be substituted for introductory German or Spanish with approval of the program coordinator.

Materials Science - Metals Minor

Contact Information

Dr. Michael K. West

Department of Materials and Metallurgical Engineering

Mineral Industries 101

(605) 394-1283

E-mail: Michael.West@sdsmt.edu

This minor is designed for students in engineering and science disciplines that desire focused training in the field of materials science with special emphasis on metals. Students completing the minor in materials science-metals will demonstrate the following outcomes:

1. A proficiency in materials science concepts covering metals and alloys;
2. The ability to develop and improve new metals/alloys;
3. The ability to predict and evaluate the performance of metals and alloys.

Given the redundancy in the B.S. metallurgical engineering core curriculum, the minor in materials science-metals is not available to those students who receive a B.S. degree in metallurgical engineering. A minor in materials science-metals must be approved by the student's major department. The Office of the Registrar and Academic Services has forms that should be completed and signed by the department heads from both departments involved in this minor.

The requirements for a minor in materials science - Metals are

- MET 232 Properties of Materials **Credits: (3-0) 3**
- MET 330 Physics of Metals **Credits: (3-0) 3**
- MET 332 Thermomechanical Processing **Credits: (3-0) 3**

Three classes from

- MET 426/526 Steelmaking **Credits: (3-0) 3**
- MET 430/430L Welding Engineering and Design of Welded Structures/Lab **Credits: (2-1) 3**
- MET 432/532 Advanced Materials and Processes **Credits: (3-0) 3**
- MET 440/540 Mechanical Metallurgy **Credits: (3-0) 3**
- MET 445/545 Oxidation and Corrosion of Metals **Credits: (3-0) 3**
- MET 450/550 Forensic Engineering **Credits: (3-0) 3**

Total: 18 Credits

Curriculum Notes

MET 330, MET 332, MET 426/526, MET 430/430L, MET 432/532, MET 440/540, MET 445/545, and MET 450/550 are offered in alternate years, so plans for a materials science-metals minor should be made early.

Mathematics Minor

Contact Information

Dr. Kyle Riley

Department of Mathematics and Computer Science

McLaury 308

(605) 394-2471

E-mail: Kyle.Riley@sdsmt.edu

The core requirements for a minor in mathematics are MATH 123, MATH 125, MATH 225, and the completion of CSC 251 or MATH 221. In addition, students must also successfully complete MATH 423 or MATH 413 plus the completion of at least 6 credit hours from: MATH 315, MATH 381, MATH 382, or any MATH course 400-level and above, excluding Special Topics and Independent Studies courses. Thus, a total of at least 23 semester credit hours is needed for a Math minor. MATH 423 and MATH 413 are offered in alternate years so plans for a minor should be made early.

A minor in the Department of Mathematics and Computer Science must be approved by the student's major department. A form for declaring a minor is available at the Office of the Registrar and Academic Services. The form must be completed and signed by the department heads from both departments involved in this minor.

Military Science Minor

Contact Information

Lieutenant Colonel Lynna M. Speier

United States Army Professor of Military Science Department

Classroom Building, Rm 112

(605) 394-2769

E-mail: Lynna.Speier@sdsmt.edu

Minor in Military Science

Credits Required 18

The core curriculum for a Minor in Military Sciences requires students to complete 18 credits in leadership development and advanced military science. Participation in this minor is contingent upon completion of ROTC basic courses or equivalent training. Students from any discipline may pursue a minor in military science with approval from the Professor of Military Science

Students must receive a cumulative military science grade of 'B' or better within all courses required for the military science minor.

Required Courses: 18 Credits

- MSL 301 Adaptive Team Leadership **Credits: (2-0) 2**
- MSL 301L Adaptive Team Leadership Lab **Credits: (0-2) 2**
- MSL 302 Leadership in Changing Environments **Credits: (2-0) 2**
- MSL 302L Leadership in Changing Environments Lab **Credits: (0-2) 2**
- MSL 401 Developing Adaptive Leaders **Credits: (2-0) 2**
- MSL 401L Developing Adaptive Leaders Lab **Credits: (0-2) 2**
- MSL 402 Leadership in a Complex World **Credits: (2-0) 2**
- MSL 402L Leadership in a Complex World Lab **Credits: (0-2) 2**
- MSL 494 Leader Development and Assessment Course **Credits: 3 to 4**

Occupational Safety Minor

Contact Information

Dr. Carter Kerk

Industrial Engineering

IER 309

(605) 394-6067

E-mail: Carter.Kerk@sdsmt.edu

The minor in occupational safety is offered to students pursuing any B.S. degree program.

Application Procedures

Students should contact the program coordinator for the application procedure and appropriate forms.

Certification Check

Once an application is filed, it is included in the degree audit form. It is the responsibility of the student's advisor to certify certification completion along with the final degree audit.

The minimum math and science course requirements are

- CHEM 112 General Chemistry I **Credits: (3-0) 3**
- CHEM 112L General Chemistry I Lab **Credits: (0-1) 1**

- MATH 123 Calculus I **Credits: (4-0) 4**

- PHYS 111 Introduction to Physics I **Credits: (3-0) 3 OR**
- PHYS 211/211-A University Physics I/Recitation **Credits: (3-0) 3**

- MATH 281 Introduction to Statistics **Credits: (3-0) 3 OR**
- MATH 381 Introduction to Probability and Statistics **Credits: (3-0) 3 OR**
- MATH 441 Engineering Statistics Credits: 4

Required courses are

- IENG 321/321L Ergonomics/Human Factors Engineering/Lab **Credits: (2-1) 3**
- IENG 331 Safety Engineering **Credits: (3-0) 3**
- IENG 341

- PSYC 331 Industrial and Organizational Psychology **Credits: (3-0) 3 OR**
- POLS 407 Environmental Law & Policy **Credits: (3-0) 3**
- Senior Design or Senior Project in home department

A minimum of 6 credit hours:

- BIOL 121 Basic Anatomy **Credits: (3-0) 3**
- BIOL 121L Basic Anatomy Lab **Credits: (0-1) 1**
- BIOL 123 Basic Physiology **Credits: (3-0) 3**
- BIOL 123L Basic Physiology Lab **Credits: (0-1) 1**
- ENVE 7326
- CHEM 114 General Chemistry II **Credits: (3-0) 3**
- CHEM 114L General Chemistry II Lab **Credits: (0-1) 1**
- CHEM 480
- CP 297/397/497 Cooperative Education **Credits: 1 to 3**¹
- IENG 491 Independent Study **Credits: 1 to 3**¹
- ME 380
- PE 105 Wellness & Physical Fitness **Credits: (1-0) 1**

Curriculum Notes

Thus, a total of at least 21 credit hours is needed for an occupational safety minor. A minor in occupational safety must be approved by the student's major department and the minor coordinator on a form available at the Office of the Registrar and Academic Services. Additional information may be found at the department website: <http://ie.sdsmt.edu>.

¹ Projects must be pre-approved and have significant safety content.

Petroleum Systems Minor

Contact Information

Dr. Laurie Anderson

Department of Geology and Geological Engineering

Mineral Industries 303

(605) 394-2461

E-mail: Laurie.Anderson@sdsmt.edu

Petroleum Systems

The petroleum industry employs a wide variety of engineers and scientists and this interdisciplinary minor is available to any student on campus interested in expanding their portfolio of coursework to include additional content relevant to the energy sector.

Program Requirements

Science and engineering majors may pursue a Minor in Petroleum Systems by completing eighteen (18) credit hours of courses.

A minimum of six credits must be for courses outside of those that are required or elective in their major.

Required Courses (9 credits)

- GEOE 412/512 Science and Engineering Field Applications **Credits: 3 to 6** (Petroleum Field Camp section only- **Credits: 3**)
- GEOE 461/561 Petroleum Drilling and Production Engineering **Credits: (3-0) 3**
- **One of:**
- CBE 218 Chemical Engineering Fluid Mechanics **Credits: (3-0) 3**
- **or**
- ME 331 Thermo Fluid Dynamics **Credits: (3-0) 3**
- **or**
- EM 331 Fluid Mechanics **Credits: (3-0) 3**

Elective Courses (9 credits from this list)

- CBE 217 Chemical Engineering Material Balances **Credits: (3-0) 3**
- CBE 222 Chemical Engineering Process Thermodynamics **Credits: (3-0) 3**
- CBE 321 Chemical Engineering Equilibrium Thermodynamics **Credits: (3-0) 3**
- CBE 417 Chemical Engineering Equilibrium Separations **Credits: (2-0) 2**
- CBE 444/544 Reactor Design **Credits: (3-0) 3**
- CBE 445/545 Oxidation and Corrosion of Metals **Credits: (3-0) 3**
- CBE 482/582 Upstream Oil and Gas Processing **Credits: 1 or 3**
- CBE 483/583 Petroleum Refining **Credits: 2 or 3**

- CBE 485/585 Renewable and Sustainable Energy **Credits: (3-0) 3**
- CBE 485L/585L Renewable and Sustainable Energy Lab **Credits: (0-1) 1**
- CEE 326 Environmental Engineering I **Credits: (3-0) 3**
- CEE 428/528 Oil and Gas Development and the Environment **Credits: (3-0) 3**
- GEOE 324/324L Engineering Geophysics I/Lab **Credits: (2-1) 3**
- GEOE 462/462L/562/562L Well Log Analysis/Laboratory **Credits: (2-1) 3**
- GEOL 450 Fluid and Thermal Diffusion **Credits: (3-0) 3**
- GEOL 476/576 Petroleum Geology **Credits: (3-0) 3**
- ME 269/269L Energy Systems Product Development and Design/Lab **Credits: (2-2) 4**
- ME 402/502 Gas Dynamics **Credits: (3-0) 3**

Physics Minor

Contact Information

Dr. Andre G. Petukhov

Department of Physics

Electrical Engineering/Physics 223

(605) 394-2364

E-mail: Andre.Petukhov@sdsmt.edu

A minor in physics requires a minimum of 18 hours of courses in physics, which must include PHYS 213/213-A, and at least 15 hours of physics courses numbered higher than PHYS 213/213-A. All minors in physics must be approved by the department and must conform to the institutional policies and guidelines for minors.

Robotics Minor

Contact Information

Dr. Kyle Riley

Department of Mathematics and Computer Science

McLaury 308

(605) 394-2471

E-mail: Kyle.Riley@sdsmt.edu

The South Dakota School of Mines and Technology offers a minor in robotics, which is a great way to enhance any program of study to prepare graduates for a workplace that has become highly automated. A minor in robotics must be approved by the student's major department along with the approval of the Department Head for Mathematics and Computer Science.

The core coursework includes

- MATH 225 Calculus III **Credits: (4-0) 4**
- CSC 315 Data Structures & Algorithms **Credits: (4-0) 4**
- CSC 415/415L/515/515L Introduction to Robotics/Lab **Credits: (3-1) 4**
- **OR**
- CENG 415/415L/515/515L Introduction to Robotics/Lab **Credits: (3-1) 4**

Additional 6 credits from courses on an approved list

The minor is then complete with an additional 6 credits from courses on an approved list. The approved list of courses for the minor:

- CSC 414/514 Introduction to Computer Vision **Credits: (3-0) 3**

- CSC 416/516 Advanced Algorithms for Robotics **Credits: (3-0) 3**
- CSC 442/542 Digital Image Processing **Credits: (3-0) 3**
- CSC 447/547 Artificial Intelligence **Credits: (3-0) 3**
- IENG 475/475L Computer-Controlled Manufacturing Systems and Robotics **Credits: (2-1) 3**
- ME 351/351L Mechatronics and Measurement Systems/Lab **Credits: (3-1) 4**
- ME 352 Introduction to Dynamic Systems **Credits: (3-0) 3**
- CENG 452/452L Robotic Control Systems/Lab **Credits: (2.5-0.5) 3**

Sustainable Engineering Minor

Contact Information

Dr. Jennifer Benning, Program Coordinator
Department of Civil and Environmental
Engineering, Civil/Mechanical 237A
(605) 394-2425
E-mail: Jennifer.Benning@sdsmt.edu

Sustainable engineering describes a new approach for solving complex classes of social problems that result from the rising competition for increasingly limited supplies of resources, water and land. Sustainable engineering seeks to transform engineering practice to meet these challenges. Interdisciplinary in nature and application, sustainable engineering involves the application of life cycle assessment and other innovative techniques to determine the long term implications of a proposed design solution with the ultimate goal of minimizing overall environmental impacts from products, services, businesses, communities and nations, as well as create engineering solutions that are fair and just in a global societal context.

Students must complete the Notification of Intent to Seek a Minor form, with appropriate signatures and turn it into the registrar's office by the beginning of the first semester of the senior year.

Students from any major at the School of Mines may pursue a minor in sustainable engineering by completing 18 credit hours of coursework that includes two required courses.

Required courses

- CEE 325 Introduction to Sustainable Design **Credits: (3-0) 3**
- CEE 425/525 Sustainable Engineering **Credits: (3-0) 3**

Engineering Electives

Six (6) elective credit hours are selected from the following list of engineering courses with sustainability content. Three of the twelve required and elective engineering course credits are required to be outside the student's major.

- CEE 326 Environmental Engineering I **Credits: (3-0) 3**
- CEE 337 Engineering Hydrology **Credits: (3-0) 3**
- CBE 455/555 Pollution Phenomena and Process Design **Credits: (3-0) 3**
- IENG 352 Creativity and Innovation **Credits: (1-0) 1**
- IENG 431/531 Industrial Hygiene **Credits: (3-0) 3**
- IENG 451/451L Operational Strategies/Lab **Credits: (2-1) 3**
- IENG 475/475L Computer-Controlled Manufacturing Systems and Robotics **Credits: (2-1) 3**
- MET 220 Mineral Processing and Resource Recovery **Credits: (3-0) 3**
- MET 310 Aqueous Extraction, Concentration, and Recycling **Credits: (3-0) 3**

- MET 321/321L High Temperature Extraction, Concentration, and Recycling/Lab **Credits: (3-1) 4**
- MEM 120 Introduction to Mining, Sustainable Development, and Safety **Credits: (3-0) 3**
- MEM 405 Mine Permitting and Reclamation **Credits: (3-0) 3**
- CBE 485/585 Renewable and Sustainable Energy **Credits: (3-0) 3**
- CBE 485L/585L Renewable and Sustainable Energy Lab **Credits: (0-1) 1**
- ME 269/269L Energy Systems Product Development and Design/Lab **Credits: (2-2) 4**

Science or mathematics electives

Three (3) elective credit hours are selected from the following list of science or mathematics courses with sustainability content.

Note: GEOG 400 may be counted as a science **OR** social science elective, but not both.

- AES 403/503 Biogeochemistry **Credits: (3-0) 3**
- AES 405/505 Air Quality **Credits: (3-0) 3**
- AES 406/506 Global Environmental Change **Credits: (3-0) 3**
- BIOL 311 Principles of Ecology **Credits: (3-0) 3**
- BIOL 341 Microbial Processes in Engineering and Natural Sciences **Credits: (3-0) 3**
- GEOL 351 Earth Resources and the Environment **Credits: (3-0) 3**
- GEOG 400 Cultural Geography **Credits: (3-0) 3**
- MATH 451/551 Math Modeling **Credits: (3-0) 3**

Humanities/Social Science Electives

Finally, three (3) elective credit hours are selected from the following list of humanities/social science courses with sustainability content.

- ANTH 210 Cultural Anthropology **Credits: (3-0) 3**
- ENGL 300 The Literary Experience of Nature **Credits: (3-0) 3**
- HUM 200 Connections: Humanities & Technology **Credits: (3-0) 3**
- POLS 250 Introduction to International Relations **Credits: (3-0) 3**
- POLS 407 Environmental Law & Policy **Credits: (3-0) 3**
- GEOG 400 Cultural Geography **Credits: (3-0) 3**

These course requirements provide students with the broad, cross-disciplinary background that leads to the type of interdisciplinary, systems thinking that is essential for developing sustainable solutions.

Minors from Other South Dakota Regental Institutions

SDSM&T degree seeking students may complete requirements for any minor at any Regental university (Black Hills State University, Dakota State University, Northern State University, South Dakota State University or the University of South Dakota) that has been approved to grant that minor. This minor will be recorded on the transcript in conjunction with the degree/minor from the South Dakota School of Mines and Technology. (BOR Policy 2:2)

For information about the minors offered in the Regental system, the contact person for each university is listed below.

Black Hills State University - Contact Ramona Collins (605-642-6577) or Ramona.Collins@bhsu.edu

Dakota State University - Contact Sandy Anderson ((605-256-5144) or Sandy.Anderson@dsu.edu

Northern State University - Contact Cherie Sauer (605-626-7768) or sauerc@northern.edu

South Dakota School of Mines and Technology - Contact Philip Hunt (605-394-2400) or Philip.Hunt@sdsmt.edu

South Dakota State University - Contact Bailey Davis (605-688-4488) or Bailey.Davis@sdstate.edu

University of South Dakota - Contact Larry Hudson (605-677-5339) or Larry.Hudson@usd.edu

Certificates

Construction Engineering and Management Certificate

Contact Information

Mr. Keith Whitaker, PE

CEM Program Coordinator

Department of Civil and Environmental Engineering

(605) 394-1694

E-mail: Keith.Whitaker@sdsmt.edu

Dr. Scott Kenner, PE

Professor and Head

Department of Civil and Environmental Engineering

(605) 394-1697

E-mail: Scott.Kenner@sdsmt.edu

Construction Engineering and Management

The Construction Engineering and Management Certificate is designed to provide a program of advanced study for candidates anticipating a managerial career in the construction industry. In addition to course delivery in a hybrid distance mode, flexibility is built into the program to provide an optimum educational experience for working students.

Practicing professionals or students seeking to enhance their marketability for upper level management positions in various construction related industries may be initially interested in the 12-hour certificate in Construction Engineering and Management. Successful completion of four certificate courses with grades of "B" or better will qualify the student for further studies leading to the Master of Science (MS) degree in Construction Engineering and Management.

Background Requirements

The construction engineering and management coursework is geared towards the working construction professional. The successful applicant will have a background in business, science, engineering, technology or a related field with at least one semester of calculus and a course in probability and statistics.

An accelerated certificate program is available for qualified juniors enrolled in engineering B.S.C.E program at the South Dakota School of Mines and Technology. The accelerated certificate program allows B.S.C.E students to take up to nine (9) graduate level credits to simultaneously meet undergraduate and graduate certificate program requirements. The following restrictions apply to the accelerated certificate program:

1. The courses must be taken at the 500/600 level as an undergraduate.
2. Only courses taken at SDSM&T are eligible for dual credit. No transferred courses from other institutions will be allowed to count toward the accelerated master's certificate degree.

Approved Certificate Courses

Choose any four from the following:

(Note: 700 level courses are not available for undergraduate students)

- CEM 574 Construction Engineering and Management **Credits: (3-0) 3 Spring** (Undergraduate students only)
- CEM 608 Construction Contracts **Credits: (3-0) 3 Fall**
- CEM 610 Construction Project Management **Credits: (3-0) 3 Spring**
- CEM 612 Construction Estimating **Credits: (3-0) 3 Spring**
- CEM 614 Construction Project Scheduling **Credits: (3-0) 3 Spring**
- CEM 615 Engineering and Construction Ethics **Credits: (3-0) 3 Summer**
- CEM 616 Codes and Standards **Credits: (3-0) 3 Fall**
- CEM 619 Construction Company Management **Credits: (3-0) 3 Summer**
- CEM 620 Leading and Managing Design Organizations **Credits: (3-0) 3 Summer**
- CEM 665 Construction Equipment Management **Credits: (3-0) 3 Fall**
- CEM 706 Managing Sustainable Projects **Credits: (3-0) 3 Spring**
- CEM 710 Advanced Construction Management **Credits: (3-0) 3 Spring**
- CEM 715 Construction Operations **Credits: (3-0) 3 Fall**
- CEM 750 Environmental Permitting **Credits: (3-0) 3 Fall**

Engineering Management and Leadership Certificate

Contact Information

Dr. Jennifer Karlin

Industrial Engineering

IER 302

(605) 394-3467

E-mail: Jennifer.Karlin@sdsmt.edu

Program Information

Industry wants to hire engineers who are not only competent in their discipline, but also have a beginning understanding of engineering management and leadership. As defined by the American Society for Engineering Management, this discipline is "the art and science of planning, organizing, allocating resources, and directing and controlling activities which have a technological component." This certificate is an opportunity for engineering students to graduate ready to meet the challenges unique to leadership in the engineering environment.

Application Procedures

Students should contact the program coordinator for the application procedure and appropriate forms.

Certification Check

Once an application is filed, it is included in the degree audit form. It is the responsibility of the student's advisor to certify certification completion along with the final degree audit.

Certificate Requirements

- IENG 302 Engineering Economics **Credits: (3-0) 3**
- IENG 366 Engineering Management **Credits: (3-0) 3**

Elective Courses (6 credits required)

- IENG 215 Cost Estimating for Engineers I **Credits: (1-0) 1**
- IENG 216 Cost Estimating for Engineers II **Credits: (1-0) 1**
- IENG 217 Cost Estimating for Engineers III **Credits: (1-0) 1**
- IENG 352 Creativity and Innovation **Credits: (1-0) 1**
- IENG 353 Commercialization of New Technology **Credits: (1-0) 1**
- IENG 354 Marketing Technology Innovations **Credits: (1-0) 1**

- IENG 355 Financing Technology Innovations **Credits: (1-0) 1**
- IENG 356 Technology Start Ups **Credits: (1-0) 1**
- IENG 451/451L Operational Strategies/Lab **Credits: (2-1) 3**
- PSYC 331 Industrial and Organizational Psychology **Credits: (3-0) 3**
- MEM 466 Mine Management **Credits: (2-0) 2**

Occupational Safety Certificate

Contact Information

Dr. Carter Kerk

Industrial Engineering

IER 309

(605) 394-6067

E-mail: Carter.Kerk@sdsmt.edu

Program Summary

The graduate level Occupational Safety Certificate at SDSM&T is designed to respond to a business need across all sectors (including general industry, construction, mining, health care, service, etc.) that places occupational safety at the highest level of organizational priorities. This certificate is open to any graduate student at SDSM&T. (For undergraduate students, refer to the Occupational Safety Minor.)

Program Description

The Occupational Safety Certificate program is designed to enable students to enhance their graduate degree with a concentration of occupational safety related courses. While the certificate could enrich any graduate degree, it would be particularly well-suited for Biomedical Engineering, Chemical Engineering, Civil and Environmental Engineering, Construction Management, Engineering Management, and Mechanical Engineering. Courses are offered on-campus and it is possible to complete the certificate through distance offerings. The core course and core electives provide a foundation in the identification, evaluation, and control of hazards relating to safety, industrial hygiene, and ergonomics. These courses will provide students with knowledge of regulatory aspects (OSHA, MSHA, EU, etc.), standards (ISO, ANSI, OHSAS, NIOSH, etc.), program development and evaluation, as well as professional licensing, certification, and ethnics.

Application Procedures

Students should contact the program coordinator for the application procedure and appropriate forms.

Certification Check

Once an application is filed, it is included in the degree audit form. It is the responsibility of the student's advisor to certify certification completion along with the final degree audit.

Required Courses

- ENGM 650 Safety Management **Credits: (3-0) 3**

Core Electives

- BME 606 Occupational Biomechanics **Credits: (3-0) 3**
- ENGM 655 Ergonomics for Managers **Credits: (3-0) 3**
- IENG 431/531 Industrial Hygiene **Credits: (3-0) 3**

Other Electives

- AES 405/505 Air Quality **Credits: (3-0) 3**
- BME 602 Anatomy and Physiology for Engineers **Credits: (3-0) 3**
- CBE 455/555 Pollution Phenomena and Process Design **Credits: (3-0) 3**
- CP 697 Cooperative Education **Credits: 1 to 3 ^A**
- ENGM 791 Independent Study **Credits: 1 to 3 ^A**
- MEM 440/540 Advanced Mine Ventilation and Environmental Engineering **Credits: (3-0) 3**

Notes

Note A: With significant safety content and pre-approved by the certificate coordinator.

Nine (9) Total Credit Hours = 3 (required course) + 3 (one of the core electives) + 3 (combined additional core electives and other elective credits).

A Certificate of Occupational Safety must be approved by the student's graduate advisor and the certificate coordinator on a form available at the Office of the Registrar and Academic Services or from the certificate coordinator. Additional information may be found at the Industrial Engineering Department website ie.sdsmt.edu.

Six Sigma Greenbelt Certificate

Contact Information

Dr. Dean Jensen

Industrial Engineering

IER 308

(605) 394-1278

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Program Information

Lack of Six Sigma Greenbelt Certification is limiting the job opportunities for our otherwise highly qualified students. Six Sigma certification is strongly valued by many organizations in industry for its standardized problem solving process and adherence to statistically rigorous quality tools. The concepts that make up the Six Sigma philosophy and tools are already contained within the industrial engineering curriculum. The certification program would increase recognition from employers that students in South Dakota are acquiring these skills.

Application Procedures

Students should contact the program coordinator for the application procedure and appropriate forms.

Certification Check

Once an application is filed, it is included in the degree audit form. It is the responsibility of the student's advisor to certify certification completion along with the final degree audit.

Program Requirements

Probability and Statistics Requirement

- IENG 381 Introduction to Probability and Statistics **Credits: (3-0) 3**
OR
- MATH 281 Introduction to Statistics **Credits: (3-0) 3**

Quality Requirement

- IENG 486 Statistical Quality and Process Control **Credits: (3-0) 3**

OR

- ENGM 620 Quality Management **Credits: (3-0) 3**

OR

- ENGM 621 Statistical Process Control **Credits: (3-0) 3**

Six Sigma Philosophy Requirement

- IENG 452 Introduction to Six Sigma **Credits: (1-0) 1**

OR

- IENG 451/451L Operational Strategies/Lab **Credits: (2-1) 3**

Six Sigma Proficiency Requirement

- IENG 463 Six Sigma Greenbelt Project **Credits: (1-0) 1**
- IENG 461 Six Sigma Greenbelt Exam **Credits: (1-0) 1**

Technology Innovation Certificate

Contact Information

Dr. Stuart D. Kellogg

Industrial Engineering

IER 301

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Program Information

The Technology Innovation Certificate program is designed to provide the background and requisite instruction for students interested in introducing a new product or innovation to the marketplace. As such, this program is ideal for students interested in entrepreneurial endeavors or for employment with companies that promote a strong entrepreneurial culture.

The Technology Innovation Certificate is available for both undergraduate and graduate students. The program provides flexibility in course offerings by making use of a variety of courses already available either on this campus or elsewhere in the state system. In addition, every attempt has been made to modularize and invert courses required to meet core requirements. Specifically, all core requirements may be completed through 1 or 2 credit offerings. In some cases, core offerings feature classroom inversion which allows some content to be available through online offerings supplemented with hands and creative problems solving exercises in the classroom.

Philosophically, the program is based on the holistic learner development model which incorporates whole brain thinking, multi-disciplinary team problem solving exercises, and, where ever possible, real world applications in innovation or product development.

Application Procedures

Students should contact the program coordinator for the application procedure and appropriate forms.

Certification Check

Once an application is filed, it is included in the degree audit form. It is the responsibility of the student's advisor to certify certification completion along with the final degree audit.

Program Requirements

The courses that are to be used to meet the requirements for the Technology Innovation Certificate are:

Required Courses

Must complete all listed:

- IENG 352 Creativity and Innovation **Credits: (1-0) 1**
- IENG 353 Commercialization of New Technology **Credits: (1-0) 1**

- IENG 354 Marketing Technology Innovations **Credits: (1-0) 1**
- IENG 355 Financing Technology Innovations **Credits: (1-0) 1**
- IENG 356 Technology Start Ups **Credits: (1-0) 1**

Finance and Budgets Requirements

Must complete at least 2 credits from:

- IENG 215 Cost Estimating for Engineers I **Credits: (1-0) 1**
- IENG 216 Cost Estimating for Engineers II **Credits: (1-0) 1**
- ACCT 210 Principles of Accounting I **Credits (3-0) 3**
- BADM 406 Accounting for Entrepreneurs **Credits (3-0) 3**
- ENGM 661 Engineering Economics for Managers **Credits: 1 to 4**

Product Development Requirements

Must complete at least 2 credits from:

- EE 264L Electromechanical Systems Product Development and Design Lab **Credits: (0-2) 2**
- ME 264L Electromechanical Systems Product Development and Design Lab **Credits: (0-2) 2**
- ENGM 625 Innovation and Commercialization **Credits: (3-0) 3**

Elective Courses

Must complete at least 3 credits from:

- BADM 336 Entrepreneurship **Credits: (3-0) 3**
- BADM 438 Quality Management **Credits: (3-0) 3**
- BADM 489 Business Plan Writing and Competition **Credits: (1-0) 1**
- BADM 370 Marketing **Credits: (3-0) 3**
- IENG 366 Engineering Management **Credits: (3-0) 3**
- ENGM 640 Business Strategy **Credits: (3-0) 3**
- BADM 310 Business Finance **Credits: (3-0) 3**
- BADM 350 Legal Environment of Business **Credits: (3-0) 3**
- BADM 360 Organization and Management **Credits: (3-0) 3**

Geospatial Technology- Undergraduate Certificate

Contact Information

Dr. Laurie Anderson

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Geospatial Technology

Geospatial technology is a career field that measures, visualizes, and analyzes features on the earth's surface. It includes diverse applications such as mapping and cartography, aerial photography and satellite remote sensing, geographic information systems (GIS), global positional systems (GPS), geostatistics, LIDAR, photogrammetry, and geolocation. It forms an integral part of government services and industries, including natural resources management, environmental protection, architecture, urban planning, insurance, retail, marketing, agriculture, forestry, mining, petroleum, water resources, transportation, utilities, and more. It is an actively growing field with high demand for trained workers. It requires good computer skills.

Background Requirements

This certificate program is designed to enhance an individual's existing work or academic training by building specific geospatial competencies required in the workplace. The ideal career preparation is to combine this certificate with a degree or work experience in one of the fields listed above. It is strongly recommended that persons wishing to pursue this certificate already have or will soon have an associate's or bachelor's degree. Before enrolling in any classes for this certificate, the candidate must have good computer skills including the Windows operating system, word processing, spreadsheets, presentations, Internet, e-mail, and file management. Training in statistics is also recommended.

Program Requirements

The certificate consists of four required core courses. Students who have not yet achieved a bachelor's degree will take the undergraduate (400 level) courses; students holding a bachelor's degree may enroll in the graduate (500 level) courses. The two levels are offered simultaneously in the same classroom, but additional requirements and expectations pertain to students enrolled at the graduate level.

At least 9 credits of the certificate must be taken from the South Dakota School of Mines and Technology. A grade of "C" or better must be earned in every course, in order to earn the certificate.

- GEOL 416/416L/516/516L Introduction to GIS/Lab **Credits: (2-1) 3**
- GEOL 417/517 Geospatial Databases **Credits: (3-0) 3**
- GEOL 419/519 Advanced Geospatial Analysis **Credits: (3-0) 3**
- GEOL 420/520 Introduction to Remote Sensing **Credits: (3-0) 3**

Geospatial Technology- Graduate Certificate

Contact Information

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Geospatial Technology

Geospatial technology is a career field that measures, visualizes, and analyzes features on the earth's surface. It includes diverse applications such as mapping and cartography, aerial photography and satellite remote sensing, geographic information systems (GIS), global positional systems (GPS), geostatistics, LIDAR, photogrammetry, and geolocation. It forms an integral part of government services and industries, including natural resources management, environmental protection, architecture, urban planning, insurance, retail, marketing, agriculture, forestry, mining, petroleum, water resources, transportation, utilities, and more. It is an actively growing field with high demand for trained workers. It requires good computer skills.

Background Requirements

This certificate program is designed to enhance an individual's existing work or academic training by building specific geospatial competencies required in the workplace. The ideal career preparation is to combine this certificate with a degree or work experience in one of the fields listed above. It is strongly recommended that persons wishing to pursue this certificate already have or will soon have an associate's or bachelor's degree. Before enrolling in any classes for this certificate, the candidate must have good computer skills including the Windows operating system, word processing, spreadsheets, presentations, Internet, e-mail, and file management. Training in statistics is also recommended.

Program Requirements

The certificate consists of four required core courses. Students who have not yet achieved a bachelor's degree will take the undergraduate (400 level) courses; students holding a bachelor's degree may enroll in the graduate (500 level) courses. The two levels are offered simultaneously in the same classroom, but additional requirements and expectations pertain to students enrolled at the graduate level.

At least 9 credits of the certificate must be taken from the South Dakota School of Mines and Technology. A grade of "C" or better must be earned in every course in order to earn the certificate.

- GEOL 416/416L/516/516L Introduction to GIS/Lab **Credits: (2-1) 3**
- GEOL 417/517 Geospatial Databases **Credits: (3-0) 3**
- GEOL 419/519 Advanced Geospatial Analysis **Credits: (3-0) 3**
- GEOL 420/520 Introduction to Remote Sensing **Credits: (3-0) 3**

Global Engineering Certificate

Contact Information

Dr. Jennifer Benning

Associate Professor

Department of Civil and Environmental Engineering

Civil/Mechanical 241

(605) 394-2425

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Program Information

Many engineers encounter projects in unfamiliar cultures and work on multinational teams. The Certificate in Global Engineering provides cross cultural insight and experience that will increase the ability of engineers to work on projects and teams in other countries and cultures. Students learn advanced intercultural communication and teaming skills, and then complete a cross cultural design project while working on multinational teams, or by working on a project in Latin America, Asia or Africa or in a Native American community for example.

Students from any engineering discipline at the School of Mines may pursue the Certificate in Global Engineering by completing 9 credit hours of coursework as described below.

Certificate Requirements

Cross Cultural Engineering Design

Students must complete a 3 credit cross cultural engineering design activity (e.g., an approved design project, co-op, or engineering design course in a foreign culture or country.)

- CP 297/397/497 Cooperative Education **Credits: 1 to 3**
- EXPL 285/385/485/585/685 Study Abroad Experiences **Credits: 1 to 3**
- EXCH 289 Student Exchange - International **Credits: 0 to 18**
- EXCH 389 Student Exchange - International **Credits: 0 to 16**
- EXCH 489 Student Exchange - International **Credits: 0 to 18**
- CEE 498 Undergraduate Research/Scholarship **Credits: 1 to 6**
- CEE 491 Independent Study **Credits: 1 to 3**

Cross Cultural Communication

Students must complete 3 credits from the following list of courses to expand their understanding of human nature, social systems, or cross cultural communication in a global context.

- SOC 100 Introduction to Sociology **Credits: (3-0) 3**
- GEOG 400 Cultural Geography **Credits: (3-0) 3**
- POLS 250 Introduction to International Relations **Credits: (3-0) 3**
- POLS 350 International Relations **Credits: (3-0) 3**
- ANTH 210 Cultural Anthropology **Credits: (3-0) 3**

Cross Cultural Teamwork or Project Management

Students must complete 3 credits from the following courses to improve their understanding in cross cultural teamwork or project management.

- CEE 474/574 Construction Engineering and Management **Credits: (3-0) 3**
- MSL 201 Innovative Team Leadership **Credits: (1-0) 1**
- IENG 352 Creativity and Innovation **Credits: (1-0) 1**
- IENG 366 Engineering Management **Credits: (3-0) 3**
- PSYC 319 Teams and Teaming **Credits: (1-0) 1**
- PSYC 331 Industrial and Organizational Psychology **Credits: (3-0) 3**

Petroleum Systems Certificate

Contact Information

Dr. Laurie Anderson

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Mineral Industries 303
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Petroleum Systems

The world depends on energy resources to keep their people and economies thriving, and a skilled workforce is essential to meet those energy needs. The Petroleum Systems Certificate Program has a geoscience focus and is geared toward graduate students and professionals who are looking to expand their skill sets in petroleum and related fields, or who are looking to retool and retrain for a new career. Courses are tailored to meet the needs of industry and provide a focused curriculum of classes and cross training.

Background Requirements

The program is available to both graduate students at SD Mines and to outside professionals with relevant B.A./B.S. degrees in engineering and/or science. Some of the courses listed for the program have prerequisites, and students wishing to enroll must either have these prerequisites or obtain the permission of the instructor to take the course.

Program Requirements

The program requires completion of 12 credits of course work (at the graduate level, 500-level or above) from the approved list.

At least 9 credits of the certificate must be taken from the South Dakota School of Mines and Technology. A grade of "C" or better must be earned in every course in order to earn the certificate.

- GEOE 412/512 Science and Engineering Field Applications **Credits: 3 to 6**
- GEOE 461/561 Petroleum Drilling and Production Engineering **Credits: (3-0) 3**
- GEOE 462/462L/562/562L Well Log Analysis/Laboratory **Credits: (2-1) 3**
- GEOE 467/567 Introduction to Geomechanics **Credits: (3-0) 3**
- GEOL 422/422L/522/522L Tectonics and Sedimentary Basin Analysis/Lab **Credits: (2-1) 3**
- GEOL 476/576 Petroleum Geology **Credits: (3-0) 3**
- GEOL 632 Rocky Mountain Stratigraphy **Credits: (3-0) 3**
- GEOL 725 Geodynamics **Credits: (3-0) 3**