

SOUTH DAKOTA BOARD OF REGENTS

Academic and Student Affairs
Consent

REVISED
AGENDA ITEM: 4 – A (1)

DATE: August 10, 2017

SUBJECT: New Specialization: SDSM&T Mining Engineering Specialization in the Geology and Geological Engineering Ph.D. Program

South Dakota School of Mines and Technology (SDSM&T) requests authorization to offer a Mining Engineering Specialization with the Geology and Geological Engineering Doctor of Philosophy (Ph.D.) in program. Specializations within a degree program appear on a transcript and require Board approval.

The Departments of Mining Engineering and Management (MEM) and Geology and Geological Engineering (GGE) are collaborating to offer this specialization, but each will review and approve student applications, as well as maintain their own separate resource pools for student funding. The proposed specialization concentrates on research, mine planning and optimization, mine management, ventilation, deep water mining, and mineral economics. Many of the courses required in this program are offered on an annual or two-year rotation between the MEM and GGE departments. Three new courses and two course modifications have been submitted for approval through the Council on Graduate Education and University Curriculum Committee, with the intent to create two additional courses after this specialization is approved. A total of 72 credit hours will be required to complete this specialization.

DRAFT MOTION 20170810_4-A(1): I move to approve USD's Mining Engineering Specialization within the Geology and Geological Engineering Doctor of Philosophy (Ph.D.) program as described in Attachment I.



**SOUTH DAKOTA BOARD OF REGENTS
ACADEMIC AFFAIRS FORMS**

New Specialization

UNIVERSITY:	SDSM&T
TITLE OF PROPOSED SPECIALIZATION:	Mining Engineering Ph.D.
NAME OF DEGREE PROGRAM IN WHICH SPECIALIZATION IS OFFERED:	Geology and Geological Engineering Ph.D.
INTENDED DATE OF IMPLEMENTATION:	8/1/2017
PROPOSED CIP CODE:	
UNIVERSITY DEPARTMENT:	Geology and Geological Engineering
UNIVERSITY DIVISION:	

University Approval

To the Board of Regents and the Executive Director: I certify that I have read this proposal, that I believe it to be accurate, and that it has been evaluated and approved as provided by university policy.

Click here to enter a
date.

Institutional Approval Signature
President or Chief Academic Officer of the University

Date

1. Level of the Specialization (place an "X" in the appropriate box):

Baccalaureate Master's Doctoral

2. What is the nature/purpose of the proposed specialization?

The Department of Mining Engineering and Management (MEM) desires to add a Ph.D. program. This is in response to: (1) an increase in interest from both domestic and international prospective students, (2) an increase desire within the industry for employees with a Ph.D., and (3) improving opportunities for research funding from federal agencies such as the National Institute for Occupational Safety and Health (NIOSH), Department of Energy (DOE), and Department of Defense (DOD). In lieu of creating a new independent Ph.D. program, the MEM Department has worked cooperatively with the Department of Geology and Geological Engineering to plan for the development of a new specialization in **Mining Engineering** under the existing Geology and Geological Engineering (GGE) Ph.D. program. The two departments are already working collaboratively through their respective MS programs in areas such as research and courses. The new **Mining Engineering Specialization** will allow for greater interdisciplinary research and course development, especially for students that wish to work on broad and overlapping topics in geomechanics, hydrogeology, environment, energy, and

resource development. Interdisciplinary programs, especially at the Ph.D. level, are becoming more common across the country and allow the students in these programs to work seamlessly across programs with resources such as faculty, courses, laboratory equipment and space, graduate student space, and other graduate students. This can lead to significant efficiencies within a Ph.D. program, especially when funding resources become limited.

Within the Mining Engineering specialization, the following areas of concentration will be developed, which complement the existing areas of concentration in the current GGE Ph.D. program:

- Mine Planning and Optimization
- Mine Management
- Mine Ventilation
- Deep Water Mining
- Mineral Economics

The basic structure of the current GGE Ph.D. program, along with the degree requirements, will not change. For example, the number of total credits required for graduation will not vary amongst the various specializations. However, the Mining Engineering specialization will likely develop its own criteria for: (1) admittance of students into the program, (2) the qualifying and comprehensive exams, and (3) the minimum number of credits of coursework and research required (note that this criteria will not conflict, however, with the general guidelines set forth by the Office of Graduate Education at SD Mines). It is also intended that the two departments will maintain separate resource pools for student funding (i.e., teaching assistantships, research assistantships, laboratory operations and supplies, etc.). In addition, each department will be responsible for reviewing and approving (or declining) student graduate applications based on the aforementioned entrance requirements and funding. Incoming students to the Mining Engineering specialization will be expected to have substantial preparation in general science, math, and mining or mineral engineering; successful applicants will ideally have completed most of the subjects presented below. However, 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 toward the graduate degree requirements.

- Calculus I, II, III
- Differential Equations
- General Chemistry I and II
- General Physics I and II
- Statics and Dynamics
- Fluid Mechanics

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 with examples of specific topics listed below. A student may propose hybrid fields with other disciplines if approved by his/her graduate committee.

- Rock Mechanics / Geomechanics
- Mine Ventilation
- Mine Planning

- Geostatistics
- Rock Fragmentation
- Mineral Economics
- Engineering Geology

The MEM Department currently offers a number of graduate-level courses that can apply to the new interdisciplinary program. The following courses are currently offered on a two-year rotational basis:

MEM 510 – Advanced Mineral Economics for Managers
 MEM 520 – Advanced Tunneling and Underground Excavation
 MEM 525 – Advanced Rock Mechanics
 MEM 530 – Resource Industry Mergers and Acquisitions
 MEM 533 – Computer Applications in Geoscience Modeling/Lab
 MEM 535 – Resource Industry Finance and Accounting
 MEM 540 – Advanced Mine Ventilation
 MEM 545 – Advanced Geostatistics and Grade Estimations
 MEM 550 – Rock Slope Engineering
 MEM 580 – Advanced Explosives and Blasting
 MEM 610 – Topics in Mineral Economics, Sustainability and Mine Regulation
 MEM 630 – Mining Law and Environment

The following courses are currently offered each academic year and will be required for all students in the Ph.D. program:

MEM 700 – Developing and Planning Research (cross-listed with GEOE/GEOL 700)
 MEM 790 – Seminar
 GEOL 808 – Fundamental Problems in Engineering and Science (offered even fall semesters)

The MEM Department has proposed the following new courses and has submitted the appropriate paperwork through the Council on Graduate Education and University Curriculum Committee. It is anticipated that the course will be approved effective for the fall 2017 semester:

MEM 640 – Advanced Mine Management (previously offered as MEM 692)
 MEM 650 – Mine Systems Optimization (currently being offered as MEM 692 in spring 2017).
 MEM 660 – Mediation and Negotiation (currently being offered as MEM 692 in spring 2017).

The Department currently has two 400/500-level courses that will be modified to a 700-level course (through submission of the proper course modification paperwork to the Council on Graduate Education and University Curriculum Committee):

MEM 515 – Advanced Mining Geotechnical Engineering will become MEM 715
 MEM 555 – Rock Slope Engineering II will become MEM 755

If the Ph.D. specialization is approved, the MEM Department intends to create several new 700-level courses to support the program. Those courses include:

MEM 710 – Bulk Materials Handling

MEM 720 – Feasibility for Mine Design and Economics

Lastly, there are a number of courses currently being offered by the GGE Department that can be taken by Ph.D. students in the Mining Engineering specialization:

GEOE 615 – Advanced Field Methods in Groundwater
 GEOE 641 – Geochemistry
 GEOE 711 – Synthetic Aperture Radar Interferometry
 GEOE 762 – Analytical Methods in Groundwater
 GEOE 768 – Engineering Geology of Surficial Deposits
 GEOL 621 – Advanced Structural Geology
 GEOL 650 – Seminar in Ore Deposits
 GEOL 652 – Problems in Ore Deposits
 GEOL 725 – Geodynamics
 GEOL 728 – Linear Inverse Methods in Geology

Research funding has grown significantly within the MEM Department over the last three years. For FY14, research expenditures were approximately \$60,000 in the department while in FY16, expenditures grew to nearly \$350,000. Expenditures for FY17 are anticipated to be nearly \$500,000. Currently, two faculty within the MEM Department are major advisors for Ph.D. students; however, these students must obtain their degree through other departments such as Mechanical Engineering or the Materials Engineering and Science (MES) program. Therefore, having a Ph.D. program specialization for mining engineering is very important to both continue the funding growth and produce Ph.Ds. in the field.

It is anticipated that minimal resources will be initially required to support the new Ph.D. specialization in Mining Engineering. Current laboratory space is adequate for the immediate research being conducted by the faculty. Graduate student space could be increased, but the two departments (GGE and MEM) are already working together to share student space and maximize the efficiency of the spaces available. Additional funding for teaching assistantships will be the most significant need for the new Ph.D. specialization. Teaching assistantships often provide first semester funding for new students in the program. This permits the students to develop and conduct initial research on a project, along with identify their major professor, while providing much needed teaching support to the department for undergraduate labs and grading. A funding increase of \$25,000 can provide teaching assistantships for several Ph.D. students for the first semester (or even the first year).

The MEM Department currently has six full-time faculty and one part-time faculty. During the 2017-2018 academic year, the department intends to combine three of its 2-credit undergraduate courses and one of its 1-credit undergraduate courses. This will result in the elimination of two undergraduate courses and free up the teaching workload for two of the faculty. In addition, two of the newer tenure-track faculty have generally been teaching either 2 or 3 courses per academic year and will be asked to teach 4 courses per academic year (lecturer-track faculty in the department generally teach 5 to 6 courses per academic year). The MEM Department has mapped its course offerings for each semester and this matrix includes the new 700-level graduate courses discussed above (and also accounts for the combining of the undergraduate courses). The course offering matrix is attached herein. As the graduate program grows, it will be very likely that the addition of new faculty will be required. The benefit of adding a new

specialization within an existing Ph.D. program is that elective courses from both departments will be available to the graduate students, thereby providing greater efficiency in the teaching load. Collaboration in research is already occurring and will likely become stronger with the new specialization. As stated, as opportunities to obtain new research funding grows, along with the offering of new courses, the addition of new faculty will likely be necessary.

The addition of the mining engineering specialization to the GEOE/GEOL Ph.D. program has been discussed at length between the faculties of both departments. The faculty within the GGE Department and the MEM Department are supportive of the addition of the specialization as evidenced by the memo of support attached herein written by the Heads of both the GGE Department and the MEM Department.

3. Provide a justification for the specialization, including the potential benefits to students and potential workforce demand for those who graduate with the credential.¹

The MEM Department has received numerous inquiries from prospective students who wish to obtain a Ph.D. in Mining Engineering, and these students are ultimately pursuing their Ph.D. at other universities. Currently, fewer than 10 universities in the country offer a Ph.D. in Mining Engineering while, nationally, the emphasis on research within the mining field is growing. The increasing emphasis on Ph.D.-level research is reflected in the hiring and guidance of Federal entities such as NIOSH, which is seeking to hire Ph.D. researchers in the mining field and requiring grant applicants to have Ph.D.-level specialization in the field of mining engineering. The Mining Engineering and Management Department has been successful in obtaining such grants and in 2014 obtained \$1.25 million over 5 years in NIOSH funding. To maintain competitiveness for such funding, SDSM&T could meet the standard of having a Ph.D.-level research focus through the proposed Ph.D. specialization.

The ability to leverage expertise residing in multiple departments and programs with complimentary research focus areas (i.e., geology and geological engineering) in competing for grants will be a critical benefit of a Ph.D. specialization in mining engineering and one that will give SDSM&T a competitive advantage in grant writing. The institutional aims of having a program that meets student demand while maintaining and even improving our competitive advantage in seeking external research funding can be accomplished by adding a Ph.D. specialization in mining engineering; a full Ph.D. program in mining engineering is not necessary.

Students who currently must attend other institutions can be served at SDSM&T and will be sought as graduates for well remunerated professional positions, such as environmental health and safety director, chief engineer or research engineer for mining corporations or governmental agencies. The yearly salary range for such positions is reliably between \$100,000 and \$150,000. NIOSH and academe are facing the aging out of program directors and faculty members, which will open up many opportunities over the next decade. Graduates of the program will support the nation's bid to solve growing problems facing the mining industry today and advance SDSM&T's strategic goals of enrollment and research growth.

¹ For workforce related information, please provide data and examples; data sources may include but are not limited to the South Dakota Department of Labor, the US Bureau of Labor Statistics, Regental system dashboards, etc.

More research funding will equate to more students, along with an increase in the critical expertise required to move the nation forward in solving the growing problems facing the mining industry today.

4. List the proposed curriculum for the specialization (including the requirements for completing the major – *highlight courses in the specialization*):

Prefix	Number	Course Title <i>(add or delete rows as needed)</i>	Credit Hours	New (yes, no)
MEM	700	Developing and Planning Research	1	No
MEM	790	Seminar	2	No
GEOL	808	Fundamental Problems in Engineering and Science	3	No
MEM	XXX	MEM Electives*	12	Yes
	XXX	Other Electives*	18-34	No
MEM	898	Research	20-36	Yes
				Choose an item.
				Choose an item.

Total number of hours required for completion of specialization

72

Total number of hours required for completion of major

72

Total number of hours required for completion of degree

72

NOTE: Students may count 24 coursework and 6 research credits from a completed MS degree toward the 72 credit requirement.

*See below for a list of Required courses, MEM Elective courses, and Other Elective courses.

Required Courses

MEM 700 – Developing and Planning Research (1)

MEM 790 – Seminar (2)

GEOL 808 – Fundamental Problems in Engineering and Science (3)

Mining Engineering and Management (MEM) Elective Courses

MEM 510 – Advanced Mineral Economics for Managers (3)

MEM 520 – Advanced Tunneling and Underground Excavation (3)

MEM 525 – Advanced Rock Mechanics (3)

MEM 530 – Resource Industry Mergers and Acquisitions (3)

MEM 533 – Advanced Mine Planning and Design (3)

MEM 535 – Resource Industry Finance and Accounting (3)

MEM 540 – Advanced Mine Ventilation (3)

MEM 545 – Advanced Geostatistics and Grade Estimations (4)
 MEM 550 – Rock Slope Engineering (3)
 MEM 580 – Advanced Explosives and Blasting (3)
 MEM 610 – Topics in Mineral Economics, Sustainability and Mine Regulation (3)
 MEM 630 – Mining Law and Environment (3)
 MEM 640 – Advanced Mine Management (3)
 MEM 650 – Mine Systems Optimization (3)
 MEM 660 – Mediation and Negotiation (3)
 MEM 710 – Bulk Materials Handling (3)
 MEM 715 – Advanced Mining Geotechnical Engineering (3)
 MEM 720 – Feasibility for Mine Design and Economics (3)
 MEM 755 – Rock Slope Engineering II (3)

*These courses can also be taken as Other Electives once the 12 credits of MEM Electives are satisfied.

Other Elective Courses

GEOE 615 – Advanced Field Methods in Groundwater (3)
 GEOE 641 – Geochemistry (3)
 GEOE 711 – Synthetic Aperture Radar Interferometry (3)
 GEOE 762 – Analytical Methods in Groundwater (3)
 GEOE 768 – Engineering Geology of Surficial Deposits (3)
 GEOL 621 – Advanced Structural Geology (3)
 GEOL 650 – Seminar in Ore Deposits (1 to 3)
 GEOL 652 – Problems in Ore Deposits (3)
 GEOL 725 – Geodynamics (3)
 GEOL 728 – Linear Inverse Methods in Geology (3)

Research

MEM 898 – Research (variable credit)

5. Complete the following charts to indicate if the university intends to seek authorization to deliver the entire specialization at any off-campus location (e.g., UC Sioux Falls, Capital University Center, Black Hills State University-Rapid City, etc.) or intends to seek authorization to deliver the entire specialization through distance technology (e.g., as an on-line program)?²

	Yes/No	If Yes, list location(s), including the physical address	Intended Start Date
Off-campus	No		Click here to enter a date.

	Yes/No	If Yes, identify delivery methods	Intended Start Date
Distance Delivery	No		

6. **Additional Information:** *Additional information is optional. Use this space to provide pertinent information not requested above. Limit the number and length of additional attachments. Identify all attachments with capital letters. Letters of support are not necessary and are rarely included with Board materials. The University may include responses to questions from the Board or the Executive Director as appendices to the original proposal where applicable. Delete this item if not used.*

² The accreditation requirements of the Higher Learning Commission (HLC) require Board approval for a university to offer programs off-campus and through distance delivery.