

SOUTH DAKOTA BOARD OF REGENTS

Academic and Student Affairs
Consent

AGENDA ITEM: 6 – C (2)

DATE: August 2-4, 2022

SUBJECT

New Program Request – SDSMT – Minor in Ceramic Engineering

CONTROLLING STATUTE, RULE, OR POLICY

[BOR Policy 2:23](#) – Program and Curriculum Approval

BACKGROUND / DISCUSSION

South Dakota School of Mines & Technology (SDSMT) requests authorization to offer a minor in Ceramic Engineering. The proposed minor will provide students with an interest in ceramic and glass materials an opportunity to understand and explore this discipline. Upon completion, the students would be prepared for a job in the ceramics/glass industry, or for a graduate program in materials science or a related field.

IMPACT AND RECOMMENDATION

SDSMT plans to offer the minor in Ceramic Engineering on campus. SDSMT does not request new state resources, and two new courses will be required. SDSMT estimates 8 students enrolled and 4 graduates by the fourth year of the program.

Board office staff recommends approval.

ATTACHMENTS

Attachment I – New Program Request Form: SDSMT – Minor in Ceramic Engineering

DRAFT MOTION 20220802_6-C(2):

I move to authorize SDSMT to offer a minor in Ceramic Engineering, as presented.



SOUTH DAKOTA BOARD OF REGENTS ACADEMIC AFFAIRS FORMS

New Baccalaureate Degree Minor

Use this form to propose a new baccalaureate degree minor (the minor may include existing and/or new courses. An academic minor within a degree program enables a student to make an inquiry into a discipline or field of study beyond the major or to investigate a particular content theme. Minors provide a broad introduction to a subject and therefore develop only limited competency. Minors consist of a specific set of objectives achieved through a series of courses. Course offerings occur in a specific department or may draw from several departments (as in the case of a topical or thematic focus). In some cases, all coursework within a minor proscribed; in others cases, a few courses may form the basis for a wide range of choices. Regental undergraduate minors typically consist of 18 credit hours. Proposals to establish new minors as well as proposals to modify existing minors must recognize and address this limit. The Board of Regents, Executive Director, and/or their designees may request additional information about the proposal. After the university President approves the proposal, submit a signed copy to the Executive Director through the system Chief Academic Officer. Only post the New Baccalaureate Degree Minor Form to the university website for review by other universities after approval by the Executive Director and Chief Academic Officer.

UNIVERSITY:	SDSM&T
TITLE OF PROPOSED MINOR:	Ceramic Engineering
DEGREE(S) IN WHICH MINOR MAY BE EARNED:	All science and engineering BS degrees
EXISTING RELATED MAJORS OR MINORS:	Metallurgical Engineering
INTENDED DATE OF IMPLEMENTATION:	Fall 2022
PROPOSED CIP CODE:	14.0601
UNIVERSITY DEPARTMENT:	Materials and Metallurgical Eng.
BANNER DEPARTMENT CODE:	MMET
UNIVERSITY DIVISION:	Engineering
BANNER DIVISION CODE:	4E

☒ **Please check this box to confirm that:**

- The individual preparing this request has read [AAC Guideline 2.8](#), which pertains to new baccalaureate degree minor requests, and that this request meets the requirements outlined in the guidelines.
- This request will not be posted to the university website for review of the Academic Affairs Committee until it is approved by the Executive Director and Chief Academic Officer.

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.

President of the University

Click here to enter a
date.

Date

Note: In the responses below, references to external sources, including data sources, should be documented with a footnote (including web addresses where applicable).

1. Do you have a major in this field (*place an "X" in the appropriate box*)? ☐ Yes ☒ No
2. If you do not have a major in this field, explain how the proposed minor relates to your university mission and strategic plan, and to the current Board of Regents Strategic Plan 2014-2020.

Links to the applicable State statute, Board Policy, and the Board of Regents Strategic Plan are listed below for each campus.

BHSU:	SDCL § 13-59	BOR Policy 1:10:4
DSU:	SDCL § 13-59	BOR Policy 1:10:5
NSU:	SDCL § 13-59	BOR Policy 1:10:6
SDSMT:	SDCL § 13-60	BOR Policy 1:10:3
SDSU:	SDCL § 13-58	BOR Policy 1:10:2
USD:	SDCL § 13-57	BOR Policy 1:10:1
Board of Regents Strategic Plan 2014-2020		

Although the B.S. degree program does not exist many of the ceramics-related courses proposed for this minor are already being offered at an undergraduate level. There will be three additional classes needed. Two of the courses (**MET 300 Applied Glass & Ceramic Engineering** and the accompanying **MET 300L Applied Glass & Ceramic Engineering Laboratory**) will be created regardless of the approval of the minor, as an awarded NSF IUSE (Improving Undergraduate STEM Education) program proposed the creation of a new course. The other new course, **MET 400/500 Fundamentals of Glass & Ceramics Engineering**, is being created to add as an upper-level elective for undergraduates and as a 500-level course for graduate students.

3. What is the nature/purpose of the proposed minor? Please include a brief (1-2 sentence) description of the academic field in this program.

The purpose of the proposed minor is to provide students with an interest in ceramic and glass materials an opportunity to understand and explore this discipline. Ceramics/glasses is a broad field that encompasses materials that are relevant to many science and engineering domains, and hence is germane to virtually any STEM program.

4. How will the proposed minor benefit students?

This program will offer an opportunity for STEM students who have interests in ceramics the opportunity to earn a Minor in this field of study. Upon completion of the Minor, the students would be prepared for a job in ceramics/glass industry and also be prepared for graduate education (e.g., materials science).

5. Describe the workforce demand for graduates in related fields, including national demand and demand within South Dakota. 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. Please cite any sources in a footnote.

Ceramic engineering demand largely follows that for materials science graduates and other specialized materials graduates such as metallurgical engineering. According to the latest

information from the US Bureau of Labor Statistics overall employment materials scientists is projected to grow 5 percent from 2019 to 2029, faster than the average for all occupations.

Ceramic Materials provide the opportunity for a wide range of potential jobs (aerospace engineers to civil engineers to chemical engineers and more); all of these fields use or interact with materials in some form. Thus, the occupation of “Materials Engineer” is commonly used for the U.S. Bureau of Labor Statistics. With a Bachelor’s Degree as the minimum entry-level education, the range of careers (a majority of which were listed above) report a 2020 median pay ranging from \$80,680 to \$118,000.¹

Relevant SD industries that have a need for ceramic engineers include cement/refractory (GCC Dakota), porcelain producers (Pacer Corp.) as well as the biomedical device industry.

The work force for graduates in related fields would include scientists and engineers from a variety of disciplines including, but not limited to Environmental Engineers, Health and Safety Engineers, Geoscientists, Medical Scientists, Environmental Scientists, Civil Engineers, Materials Engineers, Geological Engineers, Chemists and Chemical Engineers. Ceramic materials and development of smart materials is a research area of growing interests in many areas from concerns of recycling and deforestation to conservation of mineral resources to materials development for a wide range of applications (human body to aerospace).

According to the U.S. Bureau of Labor Statistics, for the following related careers the job outlook is as follows:

About 1,800 openings for materials engineers are projected each year, on average, over the decade. (<https://www.bls.gov/ooh/architecture-and-engineering/materials-engineers.htm>)

About 1,800 openings for chemical engineers are projected each year, on average, over the decade. (<https://www.bls.gov/ooh/architecture-and-engineering/chemical-engineers.htm>)

About 3,100 openings for geoscientists are projected each year, on average, over the decade. (<https://www.bls.gov/ooh/life-physical-and-social-science/geoscientists.htm>)

About 9,100 openings for chemists and materials scientists are projected each year, on average, over the decade. (<https://www.bls.gov/ooh/life-physical-and-social-science/chemists-and-materials-scientists.htm>)

About 4,000 openings for aerospace engineers are projected each year, on average, over the decade. (<https://www.bls.gov/ooh/architecture-and-engineering/aerospace-engineers.htm>)

6. Provide estimated enrollments and completions in the table below and explain the methodology used in developing the estimates (*replace “XX” in the table with the appropriate year*).

	Fiscal Years*			
	1 st	2 nd	3 rd	4 th
<i>Estimates</i>	FY 22	FY 23	FY 24	FY 25
Students enrolled in the minor (fall)	2	4	7	8
Completions by graduates	0	1	2	4

*Do not include current fiscal year.

- [1] “Chemists and materials scientists: Occupational outlook handbook,” *U.S. Bureau of Labor Statistics*, 08-Sep-2021. [Online]. Available: <https://www.bls.gov/ooh/life-physical-and-social-science/chemists-and-materials-scientists.htm#tab-8>. [Accessed: 27-Jan-2022].

7. What is the rationale for the curriculum? Demonstrate/provide evidence that the curriculum is consistent with current national standards.

The Minor required courses are set to establish a fundamental understanding of inorganic materials (GEOL 212/212L, CHEM 352), where and how basic materials required for ceramics/glasses are formed (GEOL 201), and the material properties that result from their chemistry and processing history (MET 232/233). The courses provide the opportunity for further investigation, expansion, and potential application for ceramic/glass materials in a variety of fields spanning geological engineering to biomedical engineering. The ABET Criteria for Accrediting Ceramic Engineering Programs (2022-2023) was used as a guide when developing this curriculum.

8. Complete the tables below. Explain any exceptions to Board policy requested.

Minors by design are limited in the number of credit hours required for completion. Minors typically consist of eighteen (18) credit hours, including prerequisite courses. In addition, minors typically involve existing courses. If the curriculum consists of more than eighteen (18) credit hours (including prerequisites) or new courses, please provide explanation and justification below.

A. Distribution of Credit Hours

Ceramic Engineering	Credit Hours	Percent
Requirements in minor	18	100%
Electives in minor	0	0%
Total	18	100%

B. Required Courses in the Minor

Prefix	Number	Course Title (add or delete rows as needed)	Prerequisites for Course <i>Include credits for prerequisites in subtotal below.</i>	Credit Hours	New (yes, no)
MET	232	Properties of Materials OR	MATH 123 (4 cr), CHEM 112 (3 cr)	3	No
BME/MET	233	Properties of Biomaterials	MATH 123 (4 cr), CHEM 112 (3 cr)	3	No
GEOL	201	Physical Geology OR	None	3	No
GEOE	221/L	Geology for Engineers	None	3	No
GEOL	212/212L	Mineralogy and Crystallography	CHEM 112 (3cr) and GEOL 201 (3 cr) / GEOL 201L (1 cr) OR GEOE 221/L	3	No
CHEM	352	Systematic Inorganic Chemistry	CHEM 114 (3 cr)	3	No

MET	300/300L	Applied Glass and Ceramic Engineering*	CHEM 112 (3cr) and MET 232 (3 cr) OR BME/MET 233 (3 cr)	3	Yes
MET	400/500	Fundamentals of Glass and Ceramic Engineering*	CHEM 112 (3 cr) and MET 232 (3 cr) OR BME/MET 233 (3 cr)	3	Yes
Subtotal				18-28**	

Note this course can also count as an undergraduate MET Directed Elective.

****The proposed minor in Ceramics will require 18-28 (depending on major) credit hours of coursework. For students pursuing a Bachelor of Science in Metallurgical Engineering, Geology, and Geological Engineering at South Dakota Mines, this will be an “in-program” minor for students in these majors, and MATH 123, CHEM 112, and CHEM 114 are required by these majors.**

9. Elective Courses in the Minor: List courses available as electives in the program. Indicate any proposed new courses added specifically for the minor.

None.

A. What are the learning outcomes expected for all students who complete the minor? How will students achieve these outcomes? Complete the table below to list specific learning outcomes—knowledge and competencies—for courses in the proposed program in each row. Label each column heading with a course prefix and number. Indicate required courses with an asterisk (*). Indicate with an X in the corresponding table cell for any student outcomes that will be met by the courses included. All students should acquire the program knowledge and competencies regardless of the electives selected. Modify the table as necessary to provide the requested information for the proposed program.

Individual Student Outcome (Same as in the text of the proposal)	Program Courses that Address the Outcomes							
	MET 300/300L*	MET 400*	MET 232*	MET 233*	CHEM 352*	GEOL 201*	GEOL 221/221L*	GEOL 212/212L*
Employ selection and design of ceramic/glass engineering processes	X	X	X	X				

Apply experimental, statistical, and computational methods to glass/ceramic engineering problems	X	X	X	X				
Understand fundamental science associated with ceramics/glasses	X	X	X	x	X	X	X	X

Modify the table as necessary to include all student outcomes. Outcomes in this table are to be the same ones identified in the text.

10. What instructional approaches and technologies will instructors use to teach courses in the minor? *This refers to the instructional technologies and approaches used to teach courses and NOT the technology applications and approaches expected of students.*

Wherever possible interactive instruction and experiential learning will be applied within the courses in the proposed Minor.

11. Delivery Location

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

A. Complete the following charts to indicate if the university seeks authorization to deliver the entire program on campus, at any off campus location (e.g., USD Community Center for Sioux Falls, Black Hills State University-Rapid City, Capital City Campus, etc.) or deliver the entire program through distance technology (e.g., as an online program)?

	Yes/No	Intended Start Date
On campus	Yes	Fall 2022

	Yes/No	If Yes, list location(s)	Intended Start Date
Off campus	No		Choose an item. Choose an item.

	Yes/No	If Yes, identify delivery methods <i>Delivery methods are defined in AAC Guideline 5.5.</i>	Intended Start Date
Distance Delivery (online/other distance delivery methods)	No		Choose an item. Choose an item.
Does another BOR institution already have authorization to	No	If yes, identify institutions:	

offer the program online?		
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B. Complete the following chart to indicate if the university seeks authorization to deliver more than 50% but less than 100% of the minor through distance learning (e.g., as an online program)? This question responds to HLC definitions for distance delivery.

	Yes/No	If Yes, identify delivery methods	Intended Start Date
Distance Delivery (online/other distance delivery methods)	No		Choose an item. Choose an item.

12. Does the University request any exceptions to any Board policy for this minor? Explain any requests for exceptions to Board Policy. If not requesting any exceptions, enter "None."

We request a waiver to BOR AAC Guideline 2.8, which states that, "Minors typically consist of eighteen (18) credit hours, including prerequisite courses." The proposed minor in Ceramics will require 18-28 (depending on major) credit hours of coursework for students pursuing a Bachelor of Science in Metallurgical Engineering, Geology, and Geological Engineering at South Dakota Mines. This will be an "in-program" minor for students in these majors.

However, those students pursuing other engineering majors may pursue this minor and will have additional credit hour requirements due to the pre-requisites for the named courses in the minor. This is unavoidable because certain disciplines may not have the pre-requisite background for a diverse, but complex technological field.

Substituting BME/MET 233 as a course in lieu of MET 232 as a required course will be allowed. Historically, Dr. Katrina Donovan has delivered both courses. The two courses are very similar, however, BME/MET 233 has emphasis on biomaterials (bone, teeth, prosthetics, etc.) whereas MET 232 covers a broader range of materials with an emphasis on metallic material properties which is also important material background for ceramics.

13. Cost, Budget, and Resources: Explain the amount and source(s) of any one-time and continuing investments in personnel, professional development, release time, time redirected from other assignments, instructional technology & software, other operations and maintenance, facilities, etc., needed to implement the proposed minor. Address off-campus or distance delivery separately.

There will be no changes in cost, budget, or resources as faculty are set to deliver these courses regardless of minor put forth in this form.

14. New Course Approval: New courses required to implement the new minor may receive approval in conjunction with program approval or receive approval separately. Please check the appropriate statement (place an "X" in the appropriate box).

☒ YES,

the university is seeking approval of new courses related to the proposed program in conjunction with program approval. All New Course Request forms are included as Appendix C and match those described in section 7.

☐ NO,

the university is not seeking approval of all new courses related to the proposed program in conjunction with program approval; the institution will submit new course approval requests separately or at a later date in accordance with Academic Affairs Guidelines.

15. 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.*