



SOUTH DAKOTA BOARD OF REGENTS
ACADEMIC AFFAIRS FORMS
New Undergraduate Degree Program

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| UNIVERSITY: | University of South Dakota and South Dakota School of Mines & Technology |
| MAJOR: | Biomedical Engineering |
| EXISTING OR NEW MAJOR(S): | New |
| DEGREE: | Bachelor of Science |
| EXISTING OR NEW DEGREE(S): | Existing |
| INTENDED DATE OF IMPLEMENTATION: | Fall 2019 |
| PROPOSED CIP CODE: | 14.0501 |
| SPECIALIZATIONS:¹ | None |
| IS A SPECIALIZATION REQUIRED (Y/N): | No |
| DATE OF INTENT TO PLAN APPROVAL: | 3/31/2018 |
| UNIVERSITY DEPARTMENT: | Biomedical Engineering-USD Nanoscience and Nanoengineering-SDSMT |
| UNIVERSITY DIVISION: | College of Arts and Sciences (USD) TBD (SDSMT) |

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 | Date |
| President of the University | Date |

1. What is the nature/purpose of the proposed program?

For more than a decade, the University of South Dakota (USD) and South Dakota School of Mines & Technology (SDSM&T) have jointly offered successful graduate degrees in Biomedical Engineering. USD and SDSM&T will offer a Joint Bachelor of Science degree in Biomedical Engineering (BME). The Joint Degree capitalizes on an inter-institutional model by bridging the medical and engineering disciplines to produce well prepared BME graduates to advance human health and wellbeing. In order to serve students and maximize resources, USD and SDSM&T have worked jointly to cover the administration and assessment of the shared curriculum of the BME program across the two universities. USD and SDSM&T Faculty/Staff have had several face to face meetings as well as online collaborative meetings centered on curriculum and course development. Collaborative teaching, team teaching, and online modalities will be utilized to maximize resources and faculty expertise. The BME leadership of both universities will participate in the assessment and continued improvements of the shared BME curriculum.

¹ If the proposed new program includes specific specializations within it, complete and submit a New Specialization Form for each proposed specialization and attach it to this form. Since specializations appear on transcripts, they require Board of Regents approval.

The purpose of the proposed program are listed in the objectives below:

Graduates will:

- a. Learn with hands-on laboratory experience, experimental design and data analysis tools, and effective team-work strategies.
- b. Acquire the problem-solving skills required to start a business in the growing regional biomedical market.
- c. Acquire the expertise needed to drive the success of regional biotechnology, biomaterial development, or biomedical research companies.
- d. Demonstrate critical-thinking, creativity, effective communication, and leadership skills.
- e. Acquire the foundational skills in engineering and medicine needed to advance research and innovation development domestically and globally.

2. How does the proposed program relate to the university's mission and strategic plan, and to the current Board of Regents Strategic Plan 2014-2020?²

The statutory mission of the University of South Dakota is provided in SDCL 13-57-1³:

Designated as South Dakota's liberal arts university, the University of South Dakota, established and located at Vermillion, in Clay County, shall be under the control of the Board of Regents and shall provide undergraduate and graduate programs of instruction in the liberal arts and sciences and professional education in business, education, fine arts, law and medicine, and other courses or programs as the Board of Regents may determine.

The statutory mission of the South Dakota School of Mines & Technology is provided in SDCL 13-60-1:

The South Dakota School of Mines and Technology, formerly the State School of Mines, located at Rapid City, in Pennington County, shall be under the control of the Board of Regents and shall provide undergraduate and graduate programs of instruction in engineering and the natural science and other courses or programs as the Board of Regents may determine.

Biomedical Engineering exists at the intersection of biomedical science, engineering science, and human health care. Accordingly, a program that is jointly offered by The University of South Dakota and the South Dakota School of Mines & Technology will support the missions of each university.

The SD Board of Regents strategic plan puts forth four major goals to attain by 2020; the proposed B.S. in Biomedical Engineering will help address three of these goals:

1. *Student Success – Grow degree production to 7,450 per year by 2020:*
As highlighted earlier in this Intent to Plan, there is tremendous and growing demand for biomedical engineers in the workforce both nationally and regionally. This growth makes biomedical engineering an attractive option for students.
2. *Academic Quality and Performance – Document that academic programs are of the highest quality:*

² South Dakota statutes regarding university mission are located in SDCL 13-57 through 13-60; Board of Regents policies regarding university mission are located in Board Policies 1:10:1 through 1:10:6. The Strategic Plan 2014-2020 is available from https://www.sdbor.edu/the-board/agendaitems/Documents/2014/October/16_BOR1014.pdf.

³ http://legis.sd.gov/Statutes/Codified_Laws/DisplayStatute.aspx?Type=Statute&Statute=13-57-1

Both USD and SDSMT will seek accreditation of their programs from the Accreditation Board for Engineering and Technology, Inc. (ABET), which periodically reviews all accredited programs to be certain they are compliant with rigorous and industry-relevant standards.

3. *Research and Economic Development – Increase annual system research and contract expenditures to \$150M by 2020 to advance knowledge, enhance technology transfer, commercialization, and catalyze economic development:*

In the Unified Bioscience Strategy, Dr. Christoph Bausch identified biomaterials and biomedical Devices as target areas for economic growth in South Dakota. Both of these areas fall within the domain of biomedical engineering. Further, the existing graduate-level biomedical engineering program (which is also jointly offered between USD and SDSMT) has been actively participating in technology transfer, commercialization, and economic development. Antimicrobial Materials, Inc. and Tailored Medical Devices, Inc.; companies founded by BME graduate students, are currently licensing university technologies (AMI directly, and TMDI through a sub-license from Sanford Health). Furthermore, the SD Chamber of Commerce and Industry has awarded four Governor’s Giant Vision Business Plan awards to companies that are led by BME graduates or students (BME graduates or students are underlined):

2016 BlueDop Medical (Patrick Kelly and Tyler Remund)

2014 AgriVax (Sue Lancaster)

2014 Antimicrobial Materials Inc. (Greg Bertsch)

2013 Tranzderm Solutions (Sue Lancaster)

3. Describe the workforce demand for graduates of the program, including national demand and demand within South Dakota.

The Bureau of Labor Statistics reports that growth in the national job outlook for biomedical engineers for 2016-2026 will be as fast as average and that the median annual salary in 2016 was \$85,620.⁴ In 2016 the Coalition of State Bioscience Institutes (CSBI) reported on workforce trends.⁵ Their report separates the United States into seven geographic regions, with South Dakota assigned to Region 4. In 2015, Region 4 had 18,803 job postings.

Locally, SAB Biotherapeutics, Sanford Health, and Alumend (all based in Sioux Falls) have pharmaceutical products and medical devices that are in FDA-approved trials and Immutrix (based in Rapid City) is quickly approaching that stage in development. Also, the Governor’s Office of Economic Development is actively recruiting companies in the medical product space, including naming “bioscience” as one of the “key industries” for the state.⁶ These observations, coupled with the active research in biomaterials and biomedical devices occurring at SDSMT and USD, led Dr. Christoph Bausch in his report on a South Dakota Unified Bioscience Strategy, to conclude that the biomaterial and medical device spaces should be a cornerstone of the SD bioscience economic development strategy.⁷

⁴ Bureau of Labor Statistics Occupational Outlook Handbook for Biomedical Engineers, <https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm>

⁵ The Coalition of State Bioscience Institutes (CSBI): 2016 Life Science Workforce Trends Report http://docs.wixstatic.com/ugd/dd6885_941eb22598f7465a84b4db3386dc29c6.pdf

⁶ South Dakota Governor’s Office of Economic Development, Key Industries, “Bioscience in South Dakota,” available from <http://www.sdreadytowork.com/Key-Industries/Bioscience.aspx>.

⁷ South Dakota Unified Bioscience Strategy, Confidential. Report is on File at USD BME.

There is a strong national and regional need for biomedical engineers. The medical device and pharmaceutical product industry in South Dakota is young and rapidly growing. The BME Graduate Program has produced graduate and student led companies that are partaking in the biotech growth as shown in their participation and Governor’s Giant Vision Business Plan awards from the SD Chamber of Commerce and Industry. To support that growth, the industry will need a skilled biomedical engineering workforce that can be uniquely provided by the Board of Regents through USD and SDSMT. Below are examples of biotech in the region:

| Firm Name | City/State | Firm Name | City/State |
|--|----------------------|---------------------|-------------------|
| POET | Sioux Falls/SD | Immutrix | Rapid City/SD |
| John Morrell Food Group (Smithfield Foods) | Sioux Falls/SD | SAB Biotherapeutics | Sioux Falls/SD |
| Avera | Sioux Falls/SD | Sanford | Sioux Falls/SD |
| Sanford Research | Sioux Falls/SD | OmegaQuant | Sioux Falls/SD |
| Monsanto | South Dakota | Nanoblood | Sioux Falls, SD |
| Alumend | Sioux Falls/SD | Aquatech Bioenergy | Sioux Falls/SD |
| Antimicrobial Materials | Sioux Falls/SD | Prolong | Sioux Falls/SD |
| VanGuard Sciences | North Sioux City, SD | Mitogenetics | Sioux Falls/SD |
| Novita Nutrition | Brookings, SD | GSR | Brookings/SD |

4. How will the proposed program benefit students?

The B.S. in Biomedical Engineering is an interdisciplinary degree that offers a span of job opportunities both in South Dakota and nationally. The diverse education in BME, which combines life science and engineering courses, will prepare the students to work in many professional fields (medical device, health care, animal health, agriculture, biotechnology, pharmaceutical industries, etc.). BME students have access to the vast resources of the USD main campus, USD GEAR Center, and SDSMT, which provides extensive and diverse opportunities for collaboration with faculty, clinicians, and students.

The programs will go up for Accreditation Board for Engineering and Technology, Inc. (ABET) accreditation. The students will also be a stakeholder in the biomedical engineering program and will be included in ongoing review of program educational objectives for continued success and continued improvement in the BME program.

Students will be prepared to go directly into well-paying industries where biomedical products are designed and manufactured. Biomedical Engineering graduates bring a unique knowledge of life sciences, engineering design, and analysis skills to an employer. The undergraduate Biomedical Engineering degree can also help advance students to further their education into professional studies.

5. Program Proposal Rationale:

A. If a new degree is proposed, what is the rationale?⁸

No new degree is proposed. The major will be offered within the existing Bachelor of Science.

B. What is the rationale for the curriculum?

USD and SDSMT Biomedical Engineer Program Mission: To develop students who are prepared to solve critical problems in human health. We educate students at the intersection of life science and engineering while building a firm foundation in ethics, innovation, and communication. Students will develop skills to design and implement solutions to impact lives.

The BME faculty have designed the curriculum to fulfill our department's mission and achieve our objectives. The curriculum was designed to provide the student with a broad-based and application-inspired curriculum with interdisciplinary components. The curriculum includes biomedical engineering core courses, mathematics, calculus-based physics, humanities, and social sciences. The curriculum culminates in a capstone design experience where interdisciplinary teams apply knowledge to solve real-world engineering problems. A BME curriculum provides a foundation in medical devices, biomedical implants, biomaterials, and biomedical instrumentation to compete in an increasingly technical medical field, and also prepares students for graduate school, medical school, or professional school.

Please see the curriculum attachment for both SDSMT and USD to show what courses will be offered at the universities (see Appendix D). Differences in the curriculum are primarily due to courses offerings in different departments at each respective institution.

In regards to the SDSU minor in biomedical engineering, there are generic overlaps in that both curriculums require taking senior design with a biomedical engineering emphasis. The other courses in the SDSU minor in biomedical engineering are courses related to anatomy and physiology. The BME bachelor's degree will have an engineering focus in Quantitative Systems Physiology I and II. Please see the attachment from SDSU's website on their stance on a degree in Biomedical Engineering (see Appendix E).

c. Demonstrate/provide evidence that the curriculum is consistent with current national standards.

The curriculum was designed to meet ABET General Criterion 5: Curriculum accreditation standards.

Per ABET:

“PROGRAM CRITERIA FOR BIOENGINEERING, BIOMEDICAL AND SIMILARLY NAMED ENGINEERING PROGRAMS

1. Curriculum: The structure of the curriculum must provide both breadth and depth across the range of engineering and science topics consistent with the program educational objectives and student outcomes. The curriculum must prepare graduates with experience in:

⁸ This question refers to the type of degree, not the program. For example, if your university has authorization to offer the Bachelor of Science and the program requested is a Bachelor of Science, then the request is not for a new degree.

- (a) Applying principles of engineering, biology, human physiology, chemistry, calculus-based physics, mathematics (through differential equations) and statistics;
- (b) Solving bio/biomedical engineering problems, including those associated with the interaction between living and non-living systems;
- (c) Analyzing, modeling, designing, and realizing bio/biomedical engineering devices, systems, components, or processes; and
- (d) Making measurements on and interpreting data from living systems.”⁹

D. Summary of the degree program

| Biomedical Engineering @ USD | Credit Hours | Credit Hours | Percent |
|---|---------------------|---------------------|----------------|
| System General Education Requirements* | 34* | | |
| Subtotal, Degree Requirements | | 34* | 26.2% |
| Required Support Courses (not included above) | 19 | | |
| Major Requirements | 59 | | |
| Major Electives | 18 | | |
| Subtotal, Program Requirements | | 96 | 73.8% |
| Free Electives | | 0 | 0% |
| Degree Total ¹⁰ | | 130 | 100% |

*For USD, the general education requirements for SGR#5 is met with MATH 123, Calculus I, which is 5 Credits at USD. For SGR #6, the courses that will fill this requirement are ISCI 151/L (3/1 credits) and ISCI 153/L (3/1 credits), both of which require the lab as a co-requisite. This is the reason the System General Education Requirements for USD is 34 credit hours.

| Biomedical Engineering @ SDSM&T | Credit Hours | Credit Hours | Percent |
|---|---------------------|---------------------|----------------|
| System General Education Requirements* | 32* | | |
| Subtotal, Degree Requirements | | 32 | 24.6% |
| Required Support Courses (not included above) | 37 | | |
| Major Requirements | 43 | | |
| Major Electives | 18 | | |
| Subtotal, Program Requirements | | 98 | 75.4% |
| Free Electives | | 0 | 0% |
| Degree Total ¹¹ | | 130 | 100% |

*For SDSM&T, the general education requirements are 32 since Goal 5 is 4 CR (MATH 123 at SDSM&T) and Goal 6 is 7 CR to include a lab (BIOL 151/L (4CR) and PHYS 211 (3CR)).

⁹ABET Engineering Accreditation Commission Criteria for Accrediting Engineering Programs

http://www.abet.org/wp-content/uploads/2017/12/E001-18-19-EAC-Criteria-11-29-17-FINAL_updated1218.pdf

¹⁰ Board Policy 2:29 requires each baccalaureate level degree program to require 120 credit hours and each associate degree program to require 60 credit hours. Exceptions to this policy require documentation that programs must comply with specific standards established by external accreditation, licensure, or regulatory bodies or for other compelling reasons and must receive approval by the Executive Director in consultation the President of the Board of Regents.

¹¹ Board Policy 2:29 requires each baccalaureate level degree program to require 120 credit hours and each associate degree program to require 60 credit hours. Exceptions to this policy require documentation that programs must comply with specific standards established by external accreditation, licensure, or regulatory bodies or for other compelling reasons and must receive approval by the Executive Director in consultation the President of the Board of Regents.

Required Support Courses Outside the Major @ USD*(Not general education or institutional graduation requirements)*

| Prefix | Number | Course Title | Credit Hours | New (yes, no) |
|---------------|---------------|---|---------------------|----------------------|
| ISCI | 225/L | Integrated Science III and Lab | 4 | No |
| MATH | 125 | Calculus II | 5 | No |
| MATH | 225 | Calculus III | 4 | No |
| MATH | 321 | Differential Equations | 3 | No |
| MATH | 381 or 481 | Introduction to Probability and Statistics OR Probability and Statistics | 3 | No |
| Subtotal | | | 19 | |

Required Support Courses Outside the Major @ SDSMT*(Not general education or institutional graduation requirements)*

| Prefix | Number | Course Title | Credit Hours | New (yes, no) |
|---------------|---------------|---|---------------------|----------------------|
| BIOL | 221/L | Human Anatomy | 4 | No |
| BIOL | 326 | Biomedical Physiology | 3 | No |
| CHEM | 112/L | General Chemistry I/Lab | 4 | No |
| CHEM | 114/L | General Chemistry II/Lab | 4 | No |
| CHEM | 326/L | Organic Chemistry I/Lab | 5 | No |
| CHEM | 328 | Organic Chemistry II | 3 | No |
| MATH | 125 | Calculus II | 5/4 | No |
| MATH | 225 | Calculus III | 4 | No |
| MATH | 321 | Differential Equations | 3 | No |
| MATH | 381 or 481 | Introduction to Probability and Statistics OR Probability and Statistics | 3 | No |
| Subtotal | | | 37 | |

Major Requirements (USD)

| Prefix | Number | Course Title | Credit Hours | New (yes, no) |
|-----------|------------|---|--------------|---------------|
| BME | 101/L | Introduction to Biomedical Engineering | 1/1 | No |
| CSC | 170/170L | Programming for Engineering and Science | 3/0 | No |
| PHYS | 211/L | Physics I | 3/1 | No |
| BME/EM | 214 | Statics | 3 | No |
| BME/MET | 232 | Property of Materials | 3 | No |
| CHEM | 326/L | Organic Chemistry I and Lab | 3/2 | No |
| CHEM | 328 or 330 | Organic Chemistry II and Lab or Structure Function Biomolecules | 3/2 | No |
| BME/IENG | 301 | Engineering Economics | 2 | No |
| BME | 300 | Quantitative Systems Physiology I | 3 | Yes |
| BME | 302 | Quantitative Systems Physiology II | 3 | Yes |
| BME/ ISCI | 335/L | Biomedical Technologies | 3/1 | No |
| BME | 303 | Introduction to Biomechanics | 3 | Yes |
| BME | 304 | Biomedical Engineering Fluid Mechanics | 3 | Yes |
| BME | 305 | Biomedical Engineering Transport Phenomena | 3 | Yes |
| BME | 306 | Biomedical Engineering Thermodynamics | 3 | Yes |
| BME | 401 | Biomaterials | 3 | Yes |
| BME | 463L | Biomedical Engineering Lab | 0/1 | Yes |
| BME | 464 | Senior Design I | 3 | Yes |
| BME | 465 | Senior Design II | 3 | Yes |
| Subtotal | | | 59 | |

Major Requirements (SDSM&T)

| Prefix | Number | Course Title | Credit Hours | New (yes, no) |
|----------|----------|--|--------------|---------------|
| BME | 101/L | Introduction to Biomedical Engineering | 1/1 | No |
| CSC | 170/170L | Programming for Engineering and Science | 3/0 | No |
| EM | 214 | Statics | 3 | No |
| MET | 232 | Property of Materials | 3 | No |
| EE | 301/301L | Intro Circuits, Machines and Systems/Lab | 3/1 | No |
| IENG | 301 | Engineering Economics | 2 | No |
| BME/ISCI | 335/L | Biomedical Technologies | 3/1 | No |
| BME | 303 | Introduction to Biomechanics | 3 | Yes |
| BME | 304 | Biomedical Engineering Fluid Mechanics | 3 | Yes |
| BME | 305 | Biomedical Engineering Transport Phenomena | 3 | Yes |
| BME | 306 | Biomedical Engineering Thermodynamics | 3 | Yes |
| BME | 401 | Biomaterials | 3 | Yes |
| BME | 463L | Biomedical Engineering Lab | 0/1 | Yes |
| BME | 464 | Senior Design I | 3 | Yes |
| BME | 465 | Senior Design II | 3 | Yes |
| Subtotal | | | 43 | |

Major Electives: List courses available as electives in the program. Indicate any proposed new courses added specifically for the major.

| Prefix | Number | Course Title () | Credit Hours | New (yes, no) |
|--------------------------|----------|--|--------------|---------------|
| BME | 307/L | Experimental Design | 2/1 | Yes |
| BME | 308 | Biomedical Engineering for Global Health | 3 | Yes |
| BME | 402 | Computational Biomedical Engineering | 3/1 | Yes |
| BME | 404 | Biomedical Signal and Imaging | 3/1 | Yes |
| BME | 405/L | Cell and Tissue Engineering | 3/1 | Yes |
| BME | 425 | Medical Product Development | 3 | No |
| BME | 450 | Regulatory Pathways in Medical Product Development | 3 | No |
| BME | 586 | Immuno-Engineering (CBE 486) | 2 or 3 | No |
| BME | 408 | Biomedical Engineering | 3 | No |
| BME | 528/L | Applied Finite Element Analysis/Lab (ME 428/L) | 2/1 | No |
| BME | 606 | Occupational Biomechanics (IENG 406) | 3 | No |
| EE (USD BME elective) | 301/301L | Intro Circuits, Machines and Systems/Lab | 3/1 | No |
| Subtotal | | | 18 | |

6. Student Outcomes and Demonstration of Individual Achievement

A. What specific knowledge and competencies, including technology competencies, will all students demonstrate before graduation? Complete Appendix A – Outcomes using the system form.

Appendix A defines the specific knowledge and competencies, including technology competencies that all students will demonstrate before graduation. Below is a list that graduates of this program will be able to demonstrate:

| ABET # | Outcome |
|--------|--|
| 1 | an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics |
| 2 | an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors |
| 3 | an ability to communicate effectively with a range of audiences |
| 4 | an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts |
| 5 | an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives |
| 6 | an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions |
| 7 | an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. |

B. Are national instruments (i.e., examinations) available to measure individual student achievement in this field? If so, list them.

The NCEES Fundamentals of Engineering (FE) exam is a national examination is a student's first step in the process to becoming a professional licensed engineer (P.E.). The FE Exam will measure an individual's achievement in the BME field.

C. How will individual students demonstrate mastery? Describe the specific examinations and/or processes used, including any external measures.¹² What are the consequences for students who do not demonstrate mastery?

Individual students will demonstrate mastery with a final year end capstone design project as well as partake in the FE OTHER DISCIPLINE Exam.

1. **Senior Design:** Senior Design is a major design experience serving as the capstone course in Biomedical Engineering. Students work in teams to engineer practical solutions to problems. Starting from a problem statement, the students work in teams to investigate the reasons for the problem, and what others have done to solve it. They create and analyze new and better solutions to the problem (from concept level to detailed level). They build and test a prototype of their solution. Design students will apply knowledge and skills acquired in earlier coursework toward a novel engineering project developed by the student with assistance from their research adviser. At the end of Senior Design, students will present project background and discuss potential technical approaches and deliverables. Students who do not demonstrate mastery will not pass the course.
2. **FE Exam:** The NCEES Fundamentals of Engineering (FE) exam is a national examination as a student's first step in the process to becoming a professional licensed engineer (P.E.). It is designed for recent graduates and students who are close to finishing an undergraduate engineering degree from an EAC/ABET-accredited program. The FE exam is a computer-based exam administered year-round. It is a pass/fail exam taken by approximately 55,000 people each year, most of whom are college seniors or recent graduates. Students graduating with a Biomedical Engineering degree will be prepared to take the FE OTHER DISCIPLINES Exam. The FE exam will be used as an outcomes assessment tool for the program. For assessment purposes, however, the pass-fail rate is of secondary importance, and the focus is instead on examinees' performance in a given subject. To effectively use the FE exam as an assessment tool, faculty will know the specifications for the exam as well as the level of understanding that the items are meant to measure. The goal is to ensure that the exam aligns with topics that are important to and current with what is being practiced in the Biomedical Engineering discipline. Effective assessment should result in continuous program improvement. Faculty will evaluate the results of student performance in individual subject areas. Doing so will identify areas in which students are performing below the goals established by the faculty and perhaps significantly below national averages. Some jobs will require an applicant to have passed the FE exam. Consequences for students who do not demonstrate mastery on the FE Exam may not get a job that they desire.

¹² What national examination, externally evaluated portfolio or student activity, etc., will verify that individuals have attained a high level of competence and identify those who need additional work?

7. What instructional approaches and technologies will instructors use to teach courses in the program?

Instructional approaches will involve solving problems using basic science, engineering principles and math. Laboratory and design experiences and case studies will be closely integrated with lecture material and previous coursework. Teamwork, problem-solving, application, written and oral presentations are central components throughout the curriculum. At the end of the curriculum, students will create and apply knowledge in their capstone design project.

8. Did the University engage any developmental consultants to assist with the development of the curriculum?¹³ Did the University consult any professional or accrediting associations during the development of the curriculum? What were the contributions of the consultants and associations to the development of curriculum?

No developmental consultants assisted with the development of the curriculum. The curriculum was developed by the Biomedical Engineering Faculty at USD and a Faculty Committee from the different departments at SDSMT. The ABET accreditation resources available on the ABET website were used to aid in the development of the curriculum to ensure we meet specific requirements for accreditation.

9. Are students enrolling in the program expected to be new to the university or redirected from other existing programs at the university? Complete the table below and explain the methodology used in developing the estimates.

We plan to offer this degree in Sioux Falls, Vermillion (USD Main Campus), and Rapid City (SDSMT), therefore, we anticipate that many of the students will be new to the universities. Of course, it is likely that some will re-direct from other programs as well.

| <i>Estimates (USD)</i> | Fiscal Years* | | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|
| | 1st | 2nd | 3rd | 4th |
| | FY 20 | FY 21 | FY 22 | FY 23 |
| Students new to the university | 10 | 20 | 25 | 35 |
| Students from other university programs | 0 | 5 | 0 | 0 |
| Continuing students | 3 | 10 | 30 | 50 |
| =Total students in the program (fall) | 13 | 35 | 55 | 85 |
| Program credit hours (major courses)** | 234 | 630 | 990 | 1530 |
| Graduates | | 3 | 4 | 6 |

These estimates are based on enrollment and retention rates within the University, conversations with several biomedical device and drug companies that are based in Sioux Falls, and looking at other BME programs at universities with similar populations.

¹³ Developmental consultants are experts in the discipline hired by the university to assist with the development of a new program (content, courses, experiences, etc.). Universities are encouraged to discuss the selection of developmental consultants with Board staff.

| | Fiscal Years* | | | |
|---|-----------------|-----------------|-----------------|-----------------|
| | 1 st | 2 nd | 3 rd | 4 th |
| <i>Estimates (SDSM&T)</i> | FY 20 | FY 21 | FY 22 | FY 23 |
| Students new to the university | 20 | 20 | 20 | 20 |
| Students from other university programs | 30 | 0 | 0 | 0 |
| Continuing students | 0 | 50 | 70 | 80 |
| =Total students in the program (fall) | 50 | 70 | 90 | 100 |
| Program credit hours (major courses)** | 900 | 1260 | 1620 | 1800 |
| Graduates | | | 10 | 20 |

*Do not include current fiscal year.

**This is the total number of credit hours generated by students in the program in the required or elective program courses. Use the same numbers in Appendix B – Budget.

10. Is program accreditation available? If so, identify the accrediting organization and explain whether accreditation is required or optional, the resources required, and the University’s plans concerning the accreditation of this program.

Program accreditation is available through ABET. The Biomedical Engineering Program’s goal is to be accredited through the ABET Engineering Accreditation Commission (EAC). As a new program, the ABET accreditation would ensure confidence that the Biomedical Engineering Program meets quality standards and that graduates are prepared to enter a global workforce. Additional resources (that have not been included in the curriculum/budget) required for ABET accreditation are related to institutional support and leadership, which must be adequate to ensure the quality and continuity of the program.

Please see the attached Form 4-3 Request to Seek Accreditation (See Appendix F, also posted for AAC/BOR review).

11. Does the University request any exceptions to any Board policy for this program? Explain any requests for exceptions to Board Policy. If not requesting any exceptions, enter “None.”

USD and SDSMT request an exemption to the 120 credit hour maximums for a baccalaureate degree program as described in BOR Policy 2:29. Policy 2:29 notes that exceptions may be granted by the Executive Director in consultation with the Board president for programs that must “comply with specific standards established by external accreditation, licensure or regulatory bodies or for other compelling reasons.” USD and SDSMT request an exemption for the program to require 130 credit hours in order to meet ABET accreditation criteria.

12. Delivery Location¹⁴

- 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., UC Sioux Falls, Capital University Center, Black Hills State University-Rapid City, etc.) or deliver the entire program through distance technology (e.g., as an online program)?

| | Yes/No | Intended Start Date |
|---|--------|---------------------|
| On campus (Both SDSMT and Main USD Campus) | Yes | Fall 2019 |

| | Yes/No | If Yes, list location(s) | Intended Start Date |
|------------|--------|---|---------------------|
| Off campus | Yes | GEAR Center Sioux Falls, University Center Sioux Falls | Fall 2019 |

| | Yes/No | If Yes, identify delivery methods ¹⁵ | Intended Start Date |
|--|--------|---|---------------------|
| Distance Delivery (online/other distance delivery methods) | Yes | DDN, Travel to Main Campus Vermillion | Fall 2019 |

- B. Complete the following chart to indicate if the university seeks authorization to deliver more than 50% but less than 100% of the certificate through distance learning (e.g., as an online program)?¹⁶

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

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 major. Address off-campus or distance delivery separately.

Expenses (USD) Please see USD Budget Attached (See Appendix B-USD):

For this program, there will be no need to add faculty or staff at this time. Current faculty and staff have time allotted for teaching, and have the necessary qualifications to develop and teach course material. Budget being requested would allow for continuing education of faculty and staff. In addition, budget will be needed to facilitate travel between Rapid City, Sioux Falls and Vermillion. As the program grows, additional cost will be expected which would include, faculty, staff, facilities and capital expenditures.

¹⁴ The accreditation requirements of the Higher Learning Commission (HLC) require Board approval for a university to offer programs off-campus and through distance delivery.

¹⁵ Delivery methods are defined in [AAC Guideline 5.5](#).

¹⁶ This question responds to HLC definitions for distance delivery.

Expenses (SDSM&T) Please see SDSM&T Budget Attached (See Appendix B-SDSMT):

For this program, there will initially be no need to add faculty or staff. Current faculty and staff will have time re-allotted for teaching, and have the necessary qualifications to develop and teach course material. Budget being requested would allow for addition of faculty and staff. Initial investment in equipment for offering BME 463L has been included in the budget. In addition, budget will be needed to facilitate travel between Rapid City, Sioux Falls and Vermillion. As the program grows, additional cost will be expected which would include, faculty, staff, facilities and capital expenditures.

Revenue: In addition to revenue generated through student enrollment, there will be fundraising efforts through endowments, industry partners, and alumni.

14. Is the university requesting or intending to request permission for a new fee or to attach an existing fee to the program?

- Yes No

15. New Course Approval: New courses required to implement the new undergraduate degree program may receive approval in conjunction with program approval or receive approval separately. Please check the appropriate statement:

- 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 5D.
- 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.

16. Additional Information:

The Bachelor of Science Degree in Biomedical Engineering offered jointly by the University of South Dakota and South Dakota School of Mines and Technology will seek ABET accreditation. This ABET accreditation is to provide assurance the BME program offered meets the quality standards of the profession for which the program prepares graduates.

The Bachelor of Science Degree in Biomedical Engineering is a single program embedded within two universities. The University of South Dakota has a Biomedical Engineering Department housed in the College of Arts and Sciences. In order to serve students and maximize resources, a Memorandum of Understanding between USD and SDSMT will be put in place to cover aspects such as the administration of BME leadership to facilitate successful and efficient operation across the two universities.

Appendix A

Individual Student Outcomes and Program Courses

| Individual Student Outcome | BME 101/GE 130 * | CSC 170/L * | PHYS 211/L * | ISCI 215/L * | ISCI 245/L | IENG 301* | CHEM 326/L * | CHEM 328/L or 330* | ISCI/BME 335* | BME 300* | BME 302* | BME 303* | BME 304* | BME 305* | BME 306* | BME 307 | BME 308 | BME 401* | BME 463* | BME 464* | BME 465* | BME 403 | BME 404 | BME 405 | BME 408 | BME 425 | BME 450 | BME 586 | CPHD 601 | MET/CBE 445 | MES/NANO 475 | NANO 445 | | |
|---|------------------|-------------|--------------|--------------|------------|-----------|--------------|--------------------|---------------|----------|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|----------|-------------|--------------|----------|--|--|
| an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (ABET 1) | | | X | | | | X | X | | X | X | X | X | X | X | | | X | | X | X | X | X | X | | | | X | | X | X | | | |
| an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (ABET 2) | X | X | | X | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | |
| an ability to communicate effectively with a range of audiences (ABET 3) | X | | | X | | X | | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts (ABET 4) | | | | X | X | X | | | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives (ABET 5) | X | | X | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Appendix B-USD

University of South Dakota, [Bachelor of Science] in [Biomedical Engineering]

1. Assumptions

| | | 1st FY20 | 2nd FY21 | 3rd FY22 | 4th FY23 |
|--|----------|-------------|-------------|-------------|-------------|
| <i>Headcount & hours from proposal</i> | | | | | |
| Fall headcount (see table in proposal) | | 13 | 35 | 55 | 85 |
| Program FY cr hrs, On-Campus | | 0 | 630 | 990 | 1,530 |
| Program FY cr hrs, Off-Campus | | 234 | 0 | 0 | 0 |
| | | | | | |
| Faculty, Regular FTE | See p. 3 | 2.00 | 2.00 | 2.00 | 3.00 |
| Faculty Salary & Benefits, average | See p. 3 | \$102,782 | \$102,782 | \$102,782 | \$102,782 |
| | | | | | |
| Faculty, Adjunct - number of courses | See p. 3 | 0 | 0 | 0 | 0 |
| Faculty, Adjunct - per course | See p. 3 | \$1,000 | \$1,000 | \$1,000 | \$1,000 |
| | | | | | |
| Other FTE (see next page) | See p. 3 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other Salary & Benefits, average | See p. 3 | \$8,470 | \$8,470 | \$8,470 | \$8,470 |

2. Budget

| | | | | | |
|---|--------------|------------------|------------------|------------------|------------------|
| <i>Salary & Benefits</i> | | | | | |
| Faculty, Regular | | \$205,564 | \$205,564 | \$205,564 | \$308,346 |
| Faculty, Adjunct (rate x number of courses) | | \$0 | \$0 | \$0 | \$0 |
| Other FTE | | \$0 | \$0 | \$0 | \$0 |
| | S&B Subtotal | \$205,564 | \$205,564 | \$205,564 | \$308,346 |
| <i>Operating Expenses</i> | | | | | |
| Travel | | \$0 | \$0 | \$0 | \$0 |
| Contractual Services | | \$0 | \$0 | \$0 | \$0 |
| Supplies & materials | | \$1,000 | \$2,000 | \$3,500 | \$6,000 |
| Capital equipment | | \$0 | \$7,000 | \$15,000 | \$15,000 |
| | OE Subtotal | \$1,000 | \$9,000 | \$18,500 | \$21,000 |
| | Total | \$206,564 | \$214,564 | \$224,064 | \$329,346 |

3. Program Resources

| | | | | | |
|---|-----------|----------|-----------|-----------|-----------|
| Off-campus support tuition/hr, HEFF net | UG | \$296.48 | \$296.48 | \$296.48 | \$296.48 |
| Off-campus tuition revenue | hrs x amt | \$69,375 | \$0 | \$0 | \$0 |
| | | | | | |
| On-campus support tuition/hr, HEFF net | UG | \$212.13 | \$212.13 | \$212.13 | \$212.13 |
| On-campus tuition revenue | hrs x amt | \$0 | \$133,645 | \$210,013 | \$324,566 |
| | | | | | |
| Program fee, per cr hr (if any) | \$0.00 | \$0 | \$0 | \$0 | \$0 |
| Delivery fee, per cr hr (if any) | \$0.00 | \$0 | \$0 | \$0 | \$0 |
| University redirections | | \$0 | \$0 | \$0 | \$0 |
| Community/Employers | | \$0 | \$0 | \$0 | \$0 |
| Grants/Donations/Other | | \$0 | \$0 | \$0 | \$0 |

| | | | |
|----------------------|----------|---------|--------------------------------------|
| Graduate | \$444.25 | \$51.09 | \$393.16 to point to your net |
| Externally Supported | \$40.00 | | |

State-support: Change cell on page 1 to use the UG or GR net amount for your university.

| On-Campus Tuition, HEFF & Net | FY18 Rate | HEFF | Net |
|--|------------------|-------------|---|
| UG Resident - DSU, NSU, SDSU, USD | \$239.70 | \$27.57 | \$212.13 Change cell on page 1 |
| UG Resident - BHSU | \$250.45 | \$28.80 | \$221.65 to point to your net |
| UG Resident - SDSMT | \$246.00 | \$28.29 | \$217.71 |
| GR Resident - DSU, NSU, SDSU, USD | \$314.70 | \$36.19 | \$278.51 Change cell on page 1 |
| GR Resident - BHSU | \$323.35 | \$37.19 | \$286.16 to point to your net |
| GR Resident - SDSMT | \$320.05 | \$36.81 | \$283.24 |
| UG Nonresident - DSU, NSU | \$337.35 | \$38.80 | \$298.55 Change cell on page 1 |
| UG Nonresident - BHSU | \$350.45 | \$40.30 | \$310.15 to point to your net |
| UG Nonresident - SDSU, USD | \$347.95 | \$40.01 | \$307.94 |
| UG Nonresident - SDSMT | \$385.30 | \$44.31 | \$340.99 |
| GR Nonresident - DSU, NSU | \$585.50 | \$67.33 | \$518.17 Change cell on page 1 |
| GR Nonresident - BHSU | \$603.35 | \$69.39 | \$533.96 to point to your net |
| GR Nonresident - SDSU, USD | \$605.05 | \$69.58 | \$535.47 |
| GR Nonresident - SDSMT | \$642.35 | \$73.87 | \$568.48 |
| UG Sioux Falls Associate Degree | \$271.35 | \$31.21 | \$240.14 Change cell on page 1 to point to your net |

Variable Benefits Rates

| University | FY18 | |
|------------|--------|--|
| BHSU | 14.64% | Change the benefits rate cell in the table on page 2 to point to the rate for your university. |
| DSU | 14.36% | |
| NSU | 14.31% | |
| SDSM&T | 14.20% | |
| SDSU | 14.38% | |
| USD | 14.34% | |

Appendix B-SDSMT

South Dakota School of Mines and Technology, [Bachelor of Science] in [Biomedical Engineering]

1. Assumptions

| | | 1st FY20 | 2nd FY21 | 3rd FY22 | 4th FY23 |
|--|----------|-------------|-------------|-------------|-------------|
| <i>Headcount & hours from proposal</i> | | | | | |
| Fall headcount (see table in proposal) | | 50 | 70 | 90 | 100 |
| Program FY cr hrs, On-Campus | | 900 | 1,260 | 1,620 | 1,800 |
| Program FY cr hrs, Off-Campus | | 0 | 0 | 0 | 0 |
| | | | | | |
| Faculty, Regular FTE | See p. 3 | 1.50 | 2.00 | 3.00 | 3.00 |
| Faculty Salary & Benefits, average | See p. 3 | \$102,420 | \$102,420 | \$102,420 | \$102,420 |
| | | | | | |
| Faculty, Adjunct - number of courses | See p. 3 | 0 | 0 | 0 | 0 |
| Faculty, Adjunct - per course | See p. 3 | \$1,000 | \$1,000 | \$1,000 | \$1,000 |
| | | | | | |
| Other FTE (see next page) | See p. 3 | 0.50 | 0.50 | 0.50 | 0.50 |
| Other Salary & Benefits, average | See p. 3 | \$54,150 | \$54,150 | \$54,150 | \$54,150 |

2. Budget

| | | | | | |
|---|--------------|------------------|------------------|------------------|------------------|
| <i>Salary & Benefits</i> | | | | | |
| Faculty, Regular | | \$153,630 | \$204,840 | \$307,260 | \$307,260 |
| Faculty, Adjunct (rate x number of courses) | | \$0 | \$0 | \$0 | \$0 |
| Other FTE | | \$27,075 | \$27,075 | \$27,075 | \$27,075 |
| | S&B Subtotal | \$180,705 | \$231,915 | \$334,335 | \$334,335 |
| <i>Operating Expenses</i> | | | | | |
| Travel | | \$1,000 | \$1,000 | \$1,000 | \$1,000 |
| Contractual Services | | \$0 | \$0 | \$0 | \$0 |
| Supplies & materials | | \$1,000 | \$2,000 | \$3,500 | \$3,500 |
| Capital equipment | | \$200,000 | \$15,000 | \$15,000 | \$15,000 |
| | OE Subtotal | \$202,000 | \$18,000 | \$19,500 | \$19,500 |
| | Total | \$382,705 | \$249,915 | \$353,835 | \$353,835 |

3. Program Resources

| | | | | | |
|---|-----------|-----------|-----------|-----------|-----------|
| Off-campus support tuition/hr, HEFF net | UG | \$393.16 | \$393.16 | \$393.16 | \$393.16 |
| Off-campus tuition revenue | hrs x amt | \$0 | \$0 | \$0 | \$0 |
| | | | | | |
| On-campus support tuition/hr, HEFF net | UG | \$278.51 | \$278.51 | \$278.51 | \$278.51 |
| On-campus tuition revenue | hrs x amt | \$250,659 | \$350,922 | \$451,185 | \$501,317 |
| | | | | | |
| Program fee, per cr hr (if any) | \$0.00 | \$0 | \$0 | \$0 | \$0 |
| Delivery fee, per cr hr (if any) | \$0.00 | \$0 | \$0 | \$0 | \$0 |
| University redirections | | \$0 | \$0 | \$0 | \$0 |
| Community/Employers | | \$0 | \$0 | \$0 | \$0 |

State-support: Change cell on page 1 to use the UG or GR net amount.

| Off-Campus Tuition, HEFF & Net | FY18 | | | |
|---|-------------|-------------|-----------------|---|
| | Rate | HEFF | Net | |
| Undergraduate | \$335.00 | \$38.53 | \$296.48 | <i>Change cell on page 1 to point to your net</i> |
| Graduate | \$444.25 | \$51.09 | \$393.16 | |
| Externally Supported | \$40.00 | | | |

State-support: Change cell on page 1 to use the UG or GR net amount for your university.

| On-Campus Tuition, HEFF & Net | FY18 | | | |
|--|-------------|-------------|-----------------|---|
| | Rate | HEFF | Net | |
| UG Resident - DSU, NSU, SDSU, USD | \$239.70 | \$27.57 | \$212.13 | <i>Change cell on page 1 to point to your net</i> |
| UG Resident - BHSU | \$250.45 | \$28.80 | \$221.65 | |
| UG Resident - SDSMT | \$246.00 | \$28.29 | \$217.71 | |
| GR Resident - DSU, NSU, SDSU, USD | \$314.70 | \$36.19 | \$278.51 | <i>Change cell on page 1 to point to your net</i> |
| GR Resident - BHSU | \$323.35 | \$37.19 | \$286.16 | |
| GR Resident - SDSMT | \$320.05 | \$36.81 | \$283.24 | |
| UG Nonresident - DSU, NSU | \$337.35 | \$38.80 | \$298.55 | <i>Change cell on page 1 to point to your net</i> |
| UG Nonresident - BHSU | \$350.45 | \$40.30 | \$310.15 | |
| UG Nonresident - SDSU, USD | \$347.95 | \$40.01 | \$307.94 | |
| UG Nonresident - SDSMT | \$385.30 | \$44.31 | \$340.99 | |
| GR Nonresident - DSU, NSU | \$585.50 | \$67.33 | \$518.17 | <i>Change cell on page 1 to point to your net</i> |
| GR Nonresident - BHSU | \$603.35 | \$69.39 | \$533.96 | |
| GR Nonresident - SDSU, USD | \$605.05 | \$69.58 | \$535.47 | |
| GR Nonresident - SDSMT | \$642.35 | \$73.87 | \$568.48 | |
| UG Sioux Falls Associate Degree | \$271.35 | \$31.21 | \$240.14 | <i>Change cell on page 1 to point to your net</i> |

Variable Benefits Rates

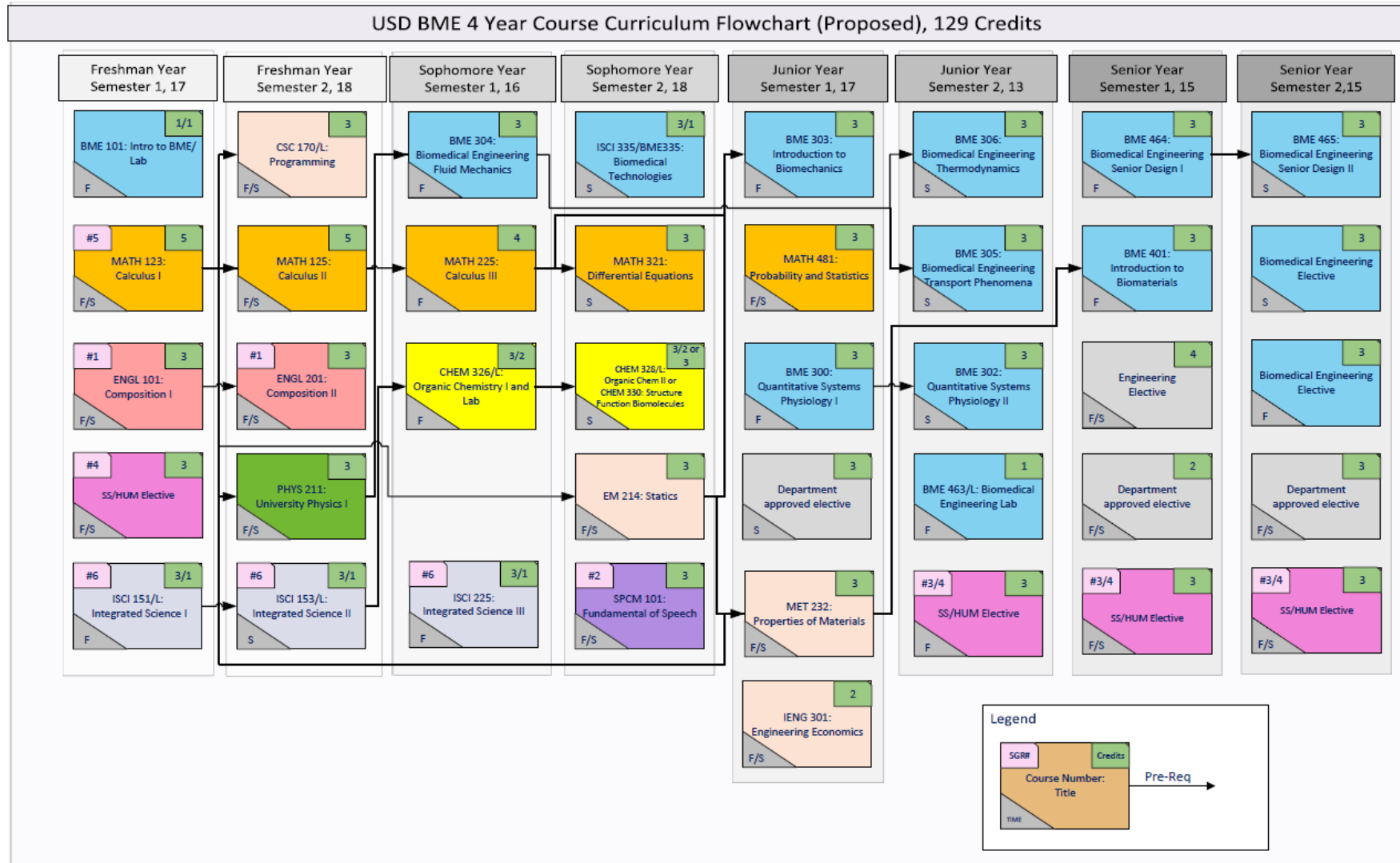
| University | FY18 | |
|------------|--------|---|
| BHSU | 14.64% | <i>Change the benefits rate cell in the table on page 2 to point to the rate for your university.</i> |
| DSU | 14.36% | |
| NSU | 14.31% | |
| SDSM&T | 14.20% | |
| SDSU | 14.38% | |
| USD | 14.34% | |

Appendix C

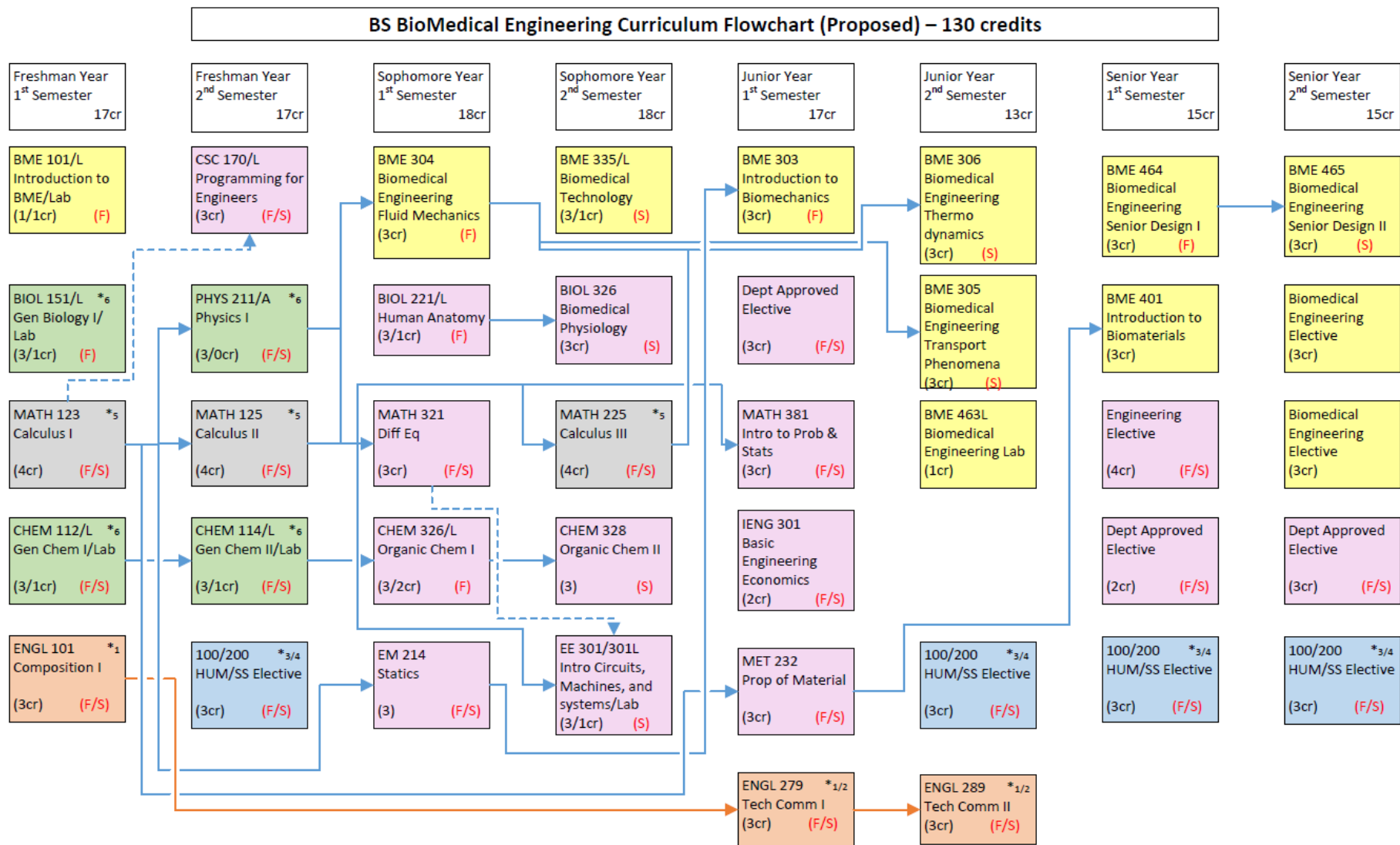
| <i>New Unique Course</i> | |
|---|--|
| <i>Prefix & Number</i> | <i>Course Title</i> |
| BME 300 | Quantitative Systems Physiology I |
| BME 302 | Quantitative Systems Physiology II |
| BME 303 | Introduction to Biomechanics |
| BME 304 | Biomedical Engineering Fluid Mechanics |
| BME 305 | Biomedical Engineering Transport Phenomena |
| BME 306 | Biomedical Engineering Thermodynamics |
| BME 307/L | Experimental Design/Lab |
| BME 308 | Biomedical Engineering for Global Health |
| BME 401/BME 501 | Introduction to Biomaterials |
| BME 402/L | Computational Biomedical Engineering/Lab |
| BME 403 | Cell Biomechanics |
| BME 404/L | Biomedical Signal and Imaging/Lab |
| BME 405/L | Cell and Tissue Engineering/Lab |
| BME 463 | Biomedical Engineering Laboratory |
| BME 464 | Biomedical Engineering Senior Design I |
| BME 465 | Biomedical Engineering Senior Design II |
| <i>Revised Course Requests</i> | |
| <i>Prefix & Number</i> | <i>Course Title</i> |
| ISCI 335/335L | Biomedical Technologies/Lab [<i>Prereqs; cross-list/equate; delivery method</i>] |
| MET 232 | Properties of Materials [<i>Prereqs; cross-list/equate; delivery method</i>] |
| <i>Authority to Offer Common Course Requests</i> | |
| <i>Prefix & Number</i> | <i>Course Title</i> |
| BME 101/101L | Intro Biomedical Engineering [<i>Authority for SDSMT</i>] |
| EM 214 | Statics [<i>Built as BME 214</i>] |
| IENG 301 | Basic Engineering Economics [<i>Built as BME 301</i>] |
| ISCI 335/335L | Biomedical Technologies/Lab [<i>Authority for SDSMT and USD as BME 335/335L as well</i>] |
| MET 232 | Properties of Materials [<i>Built as BME 232</i>] |

Appendix D

USD:



SDSMT:





JEROME J. LOHR COLLEGE OF ENGINEERING

Biomedical Engineering Minor

Contact: ☎ 605-688-4161 ✉ Email



Biomedical engineering is a fast growing and wide ranging field that produces important innovations to improve our quality of life. SDSU has been preparing students for careers in biomedical engineering for more than 30 years. Contact Dean Lewis Brown to find out how you can tailor your engineering degree at SDSU for a career in biomedical engineering.

What is Biomedical Engineering?

It's where mechanics meets medicine. Biomedical engineers apply the concepts of engineering and the physical sciences to medicine and biology with the objective of enhancing human experience by improving the quality and effectiveness of patient care. It's also a very entrepreneurial field with new jobs constantly emerging. According to the Bureau of Labor and Statistics, employment for biomedical engineers is expected to rise by 62 percent from 2010 to 2020.

What do Biomedical Engineers do?

Biomedical engineering is a vast field ranging from surgical robots, artificial organs and prosthetics to diagnostic tools and therapies. Many of our engineering graduates have taken steps to prepare themselves for a career in biomedical engineering while at SDSU and are now employed in a broad range of careers including:

- Medical device research & development
- Medical instrumentation design
- Biomedical communications and digital signal processing
- Medical and/or biomedical research

Biomedical Engineering Minor vs. Major

Since biomedical engineering is an application of traditional engineering to the life sciences, and not a distinct discipline of its own, it is important for a student with an interest in biomedical engineering to complete a degree in the traditional engineering discipline of his/her interest. Most biomedical engineers have backgrounds/degrees in:

1. Electrical or computer engineering
2. Mechanical engineering
3. Engineering physics
4. Materials science engineering

While it is possible to obtain an undergraduate degree in biomedical engineering at some institutions, a student receives a stronger engineering background by completing a traditional engineering degree (such as in electrical engineering, mechanical engineering, etc.) that is enhanced with extra life science and biomedical engineering studies. SDSU offers this option with our minor in biomedical engineering program. Those students who want to be best prepared for a career in

[ABET Enrollment and Graduation Data](#)

[About the College](#) ▶

[Our People](#)

[Departments & Fields of Study](#) ▼

[Biomedical Engineering Minor](#)

[Explore Majors and Careers](#)

[STEM Youth Camps and Activities](#) ▶

[K-12 Parents, Students, & Teachers](#)

[Opportunities for Native Americans](#) ▶

[Opportunities for Women](#)

[Internship & Career Opportunities](#)

[Career Fair](#) ▶

[Engineering Research](#) ▶

[Distinguished Engineers](#)

[Engineering Extension](#)

[SD Local Transportation Assistance Program](#)

[American Society for Engineering Education](#)

[Giving to the College](#)

[For Prospective Students](#)

biomedical engineering, either as an engineer or scientist, should complete both the traditional degree and the minor in biomedical engineering.

Resources

- [Recent BME student projects](#)
- [Viable project ideas](#)
- [BME Advising document](#)
- [BME Minor brochure](#)
- [Catalog description](#)

BME in the news

[SDSU engineering students earn fellowship at Mayo Clinic.](#)

Resources

- [BME Advising Sheets \(EE majors, ME majors\)](#)
- [Catalog description](#)



South Dakota State University
1015 Campanile Ave. Brookings, S.D. 57007
1-605-688-4121
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Appendix F



SOUTH DAKOTA BOARD OF REGENTS ACADEMIC AFFAIRS FORMS Request to Seek Accreditation

| | |
|-------------------------------|--|
| UNIVERSITY: | USD and SDSM&T |
| PROGRAM: | Biomedical Engineering |
| CIP CODE: | 14.0501 |
| UNIVERSITY DEPARTMENT: | Biomedical Engineering (USD) Nanoscience & Nanoengineering (SDSM&T) |
| UNIVERSITY DIVISION: | College of Arts and Sciences (USD) TBD (SDSM&T) |

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.

_____ Date

President of the University

_____ Date

President of the University

1. Level of program seeking accreditation (place an "X" in the appropriate box):

- Certificate
 Associate
 Bachelor's
 Doctoral
 Master's

2. Accrediting Agency:

Accreditation Board for Engineering and Technology, Inc. (ABET)

3. What are the advantages of accreditation?

The advantages of accreditation fall in three categories: Students, Program and Institution, Industry

1. Students:

- A. Verifies that the educational experience meets global standard
- B. Enhances student employment opportunities—many corporations require graduation from accredited programs
- C. Supports student entry in to a technical profession through licensure, registration, and certification. Most professions require graduation from an ABET-accredited program.
- D. Establishes student's eligibility for many federal student loans, grants, and/or scholarships.

2. Programs and Institutions:

- A. ABET accreditation tells prospective students, peers, and the professions that the program:
 - i. Receives recognition of its quality.
 - ii. Promotes “best practices” in education.
 - iii. Directly involves faculty and staff in self-assessment and continuous quality improvement processes.
 - iv. Is based on “learning outcomes,” rather than “teaching inputs.”
- 3. Industry, government and the world:
 - A. Ensures that graduates have met the educational requirements necessary to enter the profession.
 - B. Proof that a collegiate program has met standards essential to produce graduates ready to enter the biomedical engineering field
 - C. Graduates from an ABET-accredited program have a solid educational foundation and are capable of leading the way in innovation, emerging technologies, and in anticipating the welfare and safety needs of the public

4. What are the anticipated costs involved in accreditation, including:

A. Costs involved in undergoing self-study and preparing the application for accreditation:

The self-study and preparation of the application for ABET accreditation are carried out by the faculty of Biomedical Engineering Department. There are no additional costs for the program.

B. Out-of-pocket costs related to dues or site visits:

Readiness Reviews

| | |
|-------------------------------|---------|
| Fee for each program reviewed | \$1,000 |
|-------------------------------|---------|

What is the Readiness Review?

On-Site Reviews

| | |
|--------------------------------|---------|
| Base fee for an on-site review | \$3,225 |
|--------------------------------|---------|

| | |
|--------------------------------------|---------|
| Fee for each program evaluator (PEV) | \$3,225 |
|--------------------------------------|---------|

Additional Fees

| | |
|--------------------------------------|-------|
| One evaluator reviewing two programs | \$345 |
|--------------------------------------|-------|

| | |
|----------------------------------|-------|
| Extra day, per program evaluator | \$345 |
|----------------------------------|-------|

| | |
|--|-------|
| Visit to off-campus location, per location | \$345 |
|--|-------|

Total Estimated for out-of-pocket costs related to dues or site visits: \$8,500.00

C. Base budget implications including incremental costs and minimum base resources required (dollars and FTE):

Annual Maintenance

This fee covers the upkeep of accreditation data files, review of institutional materials, and the publication and distribution of annual lists of accredited programs.

Base fee per campus per commission \$685

Fee for accredited program at each campus \$685

Annual support fee: Once accredited the annual maintenance fee is \$1,370.00

Curriculum: The curriculum for this degree is designed to meet ABET requirements. Continuous improvement will occur in accordance with the ABET process.

Faculty: Program management and ABET accreditation preparation roles will be determined in the Memorandum of Understanding between the Universities.

5. What is the source of the revenue needed?

USD: College of Arts and Sciences

SDSMT: Interdisciplinary Programs

6. What is the estimated date for submission of accreditation application?

In order to submit an accreditation application, a student must graduate from the program. The Biomedical Engineering anticipates submitting the application for accreditation by June of 2023, with a site visit taking place in 2024.