



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

**New Certificate**

<b>UNIVERSITY:</b>	<b>SDSU</b>
<b>TITLE OF PROPOSED CERTIFICATE:</b>	<b>Bioprocessing Sciences</b>
<b>INTENDED DATE OF IMPLEMENTATION:</b>	<b>2019-2020 Academic Year</b>
<b>PROPOSED CIP CODE:</b>	<b>14.4501</b>
<b>UNIVERSITY DEPARTMENT:</b>	<b>College of Agriculture, Food and Environmental Sciences</b>
<b>UNIVERSITY DIVISION:</b>	<b>College of Agriculture, Food and Environmental Sciences</b>

**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.*

5/13/2019

\_\_\_\_\_  
 Institutional Approval Signature  
*President or Chief Academic Officer of the University*

\_\_\_\_\_  
 Date

**1. Is this a graduate-level certificate or undergraduate-level certificate?**

Undergraduate Certificate        Graduate Certificate   

**2. What is the nature/purpose of the proposed certificate?**

The Certificate in Bioprocessing Sciences will provide students with a value-added credential that supplements their major field of study by enhancing their professional skill set to serve the large bioprocessing industries in South Dakota and the region. Bioprocessing is a broad term encompassing the research, development, manufacturing, and commercialization of products prepared from or used by biological systems, including food, feed, fuels, and biopharmaceuticals, as well as remediation of environmental waste. The certificate will support SDSU's mission of providing engaging instruction that contributes to workforce development in South Dakota and the region.

The Bioprocessing Sciences Certificate supports the mission of SDSU as provided in SDCL 13-58-1: *The legislature established South Dakota State University as the Comprehensive Land-Grant University to meet the needs of the State and region by providing undergraduate and graduate programs of instruction in the liberal arts and sciences and professional education in agriculture, aviation, education, engineering, human sciences, nursing, pharmacy, and other courses or programs as the Board of Regents may determine.* Bioprocessing industries are expanding in South

Dakota, and a skilled labor force is required to support the development and manufacturing of bio-based products, such as biofuels, soy-based food products, and feed for farm-based aquaculture.

SDSU does not request new state resources for the proposed certificate.

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

Bioprocessing technologies are used in a variety of industries ranging from renewable fuels, food and drink products, pharma- and nutraceuticals, and environmental remediation of wastes. This certificate will combine courses from several disciplines to enhance the student's knowledge of these technologies and provide hands-on experiences with their applications, thus helping to prepare students for career opportunities in the bioprocessing industries. The SD Department of Labor has projected strong growth (12.1 to 14.8%) in industry employment for the period 2016 to 2026 in the areas of professional, scientific and technical services; chemical manufacturing; and waste management and remediation services.<sup>1</sup> Students majoring in disciplines related to agriculture, engineering, and other STEM areas are particularly encouraged to work towards a Certificate in Bioprocessing Sciences to enhance their preparation and employability for a career related to bioprocessing.

Bioprocessing is integral to several large industries in South Dakota and the region. South Dakota and the neighboring states of Minnesota, Iowa, and Nebraska account for four of the top six states in the U.S. for ethanol production capacity.<sup>2</sup> Additionally, bio-based processing significantly enhances the value of and demand for some of the most economically important commodities produced in South Dakota, including corn and soybeans.

Future employees and their employers in the bioprocessing industries will benefit from this certificate. Students will have an enhanced skill-set that combines basic knowledge of how bioprocessing technologies work and how to apply them in the commercial manufacturing of bio-based products. Students completing the certificate will have a clearer understanding of how their chosen major can fill workforce needs in the bioprocessing industries.

**4. Who is the intended audience for the certificate program?**

**A. Is the intent of certificate best described as a *stand-alone credential* option for students not seeking additional credentials (i.e., bachelor's or master's degree), a *value-added credential* that supplements a student's major field of study, or a *stackable credential* with credits that apply to a higher level credential (i.e., associate, bachelor's, or master's degree)? If all the credits in the certificate apply to program requirements in any associate, bachelor's, or graduate program, please list them.**

The certificate is intended to serve as a value-added credential that will supplement the bachelor's degree of several majors in agriculture, engineering, and natural sciences.

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<sup>1</sup> SD Dept. of Labor & Regulation (2018). *2017 Annual Workforce Report*. Available at [https://dlr.sd.gov/lmic/menu\\_publications.aspx](https://dlr.sd.gov/lmic/menu_publications.aspx)

<sup>2</sup> US Energy Information Administration. (June, 2017). *Today in Energy*. Available at: <https://www.eia.gov/todayinenergy/detail.php?id=31832>.

The intended audience includes students who wish to pursue careers related to one of the bioprocessing industries. Students majoring in several disciplines at SDSU already take some relevant coursework, but might be unaware of complementary courses offered in other disciplines and unaware of career opportunities related to bioprocessing. This certificate provides a pathway for students to supplement major coursework with courses from other disciplines into a formal credential that will prepare them to enter the bioprocessing workforce.

**B. What are the majors/degree programs from which students would likely enroll in the certificate program?**

Students majoring in Agricultural and Biosystems Engineering, Agricultural Systems Technology, Biotechnology, Dairy Manufacturing, Food Science, Mechanical Engineering, Microbiology, and Operations Management are the primary target audience. Students with one of these majors supplemented by the Bioprocessing Sciences Certificate will have a competitive advantage in the bioprocessing job marketplace.

**5. List the courses required for completion of the certificate in the table below (if any new courses are proposed for the certificate, please attach the new course requests to this form):<sup>3</sup>**

Prefix	Number	Course Title	Credit Hours	New (yes, no)
MICR OR MICR	231-231L  233-233L	General Microbiology and Lab (4)  Introductory Microbiology and Lab (4)	4	No
Select two or more of the following:				
ABE	343-343L	Engineering Properties of Biological Materials and Lab	3	No
ABE	444-444L	Unit Operations of Biological Materials Processing and Lab	4	No
AST	443-443L	Food Processing and Engineering Fundamentals	3	No
ME OR ME	311  314	Thermodynamics I (3)  Thermodynamics (3)	3	No
ME	416	Renewable Energy Systems	3	No
MICR	450	Applications of Microbiology and Biotechnology	3	No
OM	240	Decision Making Processes in Management	3	No
Select from the following to total 12 credits.				
ABE	411*	Design Project III	2	No
GE	425	Occupational Safety and Health Management	3	No
MICR	311-311L	Food Microbiology and Lab	4	No
MICR	332	Microbial Physiology	2	No
MICR	332L	Microbial Physiology Lab	2	No
MNET	231-231L	Manufacturing Processes I and Lab	3	No

<sup>3</sup> Regental system certificate programs typically are a subset of the curriculum offered in degree programs, include existing courses, and involve 9-12 credits for completion. Deviations from these guidelines require justification and approval.

Prefix	Number	Course Title	Credit Hours	New (yes, no)
NUTR	426-426L	Production of Wine, Beer and Spirits and Lab	3	No
OM	425	Production Operations and Management <sup>4</sup>	3	No
XXX	494*	Internship	1-2	No
XXX	498*	Undergraduate Research	1-2	No
*Must be relevant to bioprocessing and approved by program coordinator.				
Total Requirement			12	

**A. List any prerequisites for the courses above.**

The following courses include prerequisite requirements:

Course Title	Prerequisite
ME 311 Thermodynamics I	PHYS 211 [SGR #6] + EM 215
ME 314 Thermodynamics	PHYS 211 [SGR #6] + MATH 125 [SGR #5]
ME 416 Renewable Energy Systems	ME 311, ME 314, or PHYS 341
MICR 231-231L General Microbiology & Lab	CHEM 106 [SGR #6] or CHEM 112 [SGR #6]
MICR 233-233L Introductory Microbiology & Lab	BIOL 151 [SGR #6] + 6 credits of CHEM [SGR #6]
MICR 311-311L Food Microbiology & Lab	MICR 231 [SGR #6] or MICR 233
MICR 332 Microbial Physiology	MICR 231 [SGR #6] or MICR 233
MICR 450 Applications of Microbiology and Biotechnology	MICR 231 [SGR #6] or MICR 233
NUTR 426-426L Production of Wine, Beer and Spirits and Lab	Registration Restriction - Participants must be 21 years of age or older to enroll
OM 240 Decision Making Processes in Management	MATH 121 [SGR #5]
OM 425 Production & Operations Management	STAT 281 [SGR #5] or STAT 381

**B. Certificate programs are typically are a subset of the curriculum offered in degree programs, include existing courses, and involve 9-12 credits for completion (including prerequisites). If the certificate includes new courses or more than 12 credit hours (including prerequisites), provide justification below.**

The certificate consists of existing courses. Several of the courses have prerequisites; however, the prerequisites in question are typically taken during students' general education coursework and will have little effect on the students pursuing the certificate. In addition, the elective courses align closely to the program requirements for the primary audience. It is likely those electives would be completed by students in majors in which they would already be taking the prerequisites.

**6. Student Outcome and Demonstration of Individual Achievement.<sup>5</sup>**

<sup>4</sup> Minor course modification will revise OM 425 Production and Operations Management to remove MNET 367-367L Production Strategy & Lab as prerequisite effective fall 2019.

<sup>5</sup> Board Policy 2:23 requires certificate programs to "have specifically defined student learning outcomes."

**A. What specific knowledge and competencies, including technology competencies, will all students demonstrate before graduation? *The knowledge and competencies should be specific to the program and not routinely expected of all university graduates.***

Students completing this certificate program will be able to:

- Understand how cells or cellular components of biomaterials can be grown to produce commercial quantities of desired raw products (upstream bioprocessing).
- Understand and use biomass separation techniques to extract desired product from cell debris (downstream bioprocessing).
- Apply bioprocessing principles (e.g., fermentation, heat, mass, and energy transfer) to manufacturing of renewable energy and commercial bioproducts or to management of environmental waste.
- Apply principles of quality control, operations efficiency, project management, and safety to manufacturing of bio-based products.

**B. Complete Appendix A – Outcomes using the system form. *Outcomes discussed below should be the same as those in Appendix A.***

See Appendix A.

**7. Delivery Location.<sup>6</sup>**

**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 on-line program)?**

	Yes/No	Intended Start Date
On campus	Yes	2019-2020 Academic Year

	Yes/No	If Yes, list location(s)	Intended Start Date
Off campus	No		

	Yes/No	If Yes, identify delivery methods <sup>7</sup>	Intended Start Date
Distance Delivery (online/other distance delivery methods)	No		

**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 on-line program)?<sup>8</sup>**

<sup>6</sup> The accreditation requirements of the Higher Learning Commission (HLC) require Board approval for a university to offer programs off-campus and through distance delivery.

<sup>7</sup> Delivery methods are defined in [AAC Guideline 5.5](#).

<sup>8</sup> This question responds to HLC definitions for distance delivery.

	<b>Yes/No</b>	<i>If Yes, identify delivery methods</i>	<i>Intended Start Date</i>
<b>Distance Delivery (online/other distance delivery methods)</b>	No		

The courses in the Bioprocessing Sciences Certificate are not available online.

- 8. 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 certificate. Address off-campus or distance delivery separately.**

The courses for the certificate all currently exist at SDSU. New resources are not requested.

**Appendix A**  
**Certificate in Bioprocessing Sciences – Student Learning Outcomes**

	Required	Must complete two of these courses						
	MICR 231/L or MICR 233/L	ABE 343/L	ABE 444/L	AST 443/L	ME 311 or ME 314	ME 416	MICR 450	OM 240
<b>Student Outcomes</b>								
1. Understand how cells or cellular components of biomaterials can be grown to produce commercial quantities of desired raw products (upstream bioprocessing).	X						X	
2. Understand and use biomass separation techniques to extract desired product from cell debris (downstream bioprocessing).	X	X	X				X	
3. Apply bioprocessing principles (e.g., fermentation, heat, mass, and energy transfer) to manufacturing of renewable energy and commercial bioproducts or to management of environmental waste.		X	X	X	X	X	X	
4. Apply principles of quality control, operations efficiency, project management, and safety to manufacturing of bio-based products.	X			X				X

	Electives							
	ABE 411	GE 425	MICR 311/L	MICR 332/L	MNET 231/L	NUTR 426/L	OM 425	XXX 494 or 498
<b>Student Outcomes</b>								
1. Understand how cells or cellular components can be grown to produce commercial quantities of desired raw products (upstream bioprocessing).				X				
2. Apply biomass separation techniques to extract desired product from cell debris (downstream bioprocessing).	X			X		X		X
3. Apply bioprocessing principles (e.g., fermentation, heat, mass, and energy transfer) to manufacturing of renewable energy and commercial bioproducts or to management of environmental waste.	X		X		X	X		X
4. Apply principles of quality control, operations efficiency, project management, and safety to manufacturing of bio-based products.	X	X	X		X	X	X	X