



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

New Baccalaureate Degree Minor

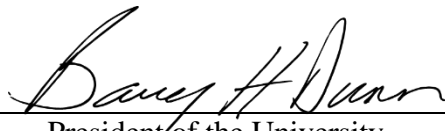
UNIVERSITY:	SDSU
TITLE OF PROPOSED MINOR:	Computer Engineering
DEGREE(S) IN WHICH MINOR MAY BE EARNED:	Computer Science, Electrical Engineering
EXISTING RELATED MAJORS OR MINORS:	Computer Science (B.S., minor), Electrical Engineering (B.S.)
INTENDED DATE OF IMPLEMENTATION:	2021-2022 Academic Year
PROPOSED CIP CODE:	14.0901
UNIVERSITY DEPARTMENT:	Electrical Engineering & Computer Science
BANNER DEPARTMENT CODE:	SEEC
UNIVERSITY DIVISION:	Jerome J. Lohr College of Engineering
BANNER DIVISION CODE:	3E

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

4/30/2021

Date

- 1. Do you have a major in this field?** 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.**

South Dakota State University (SDSU) requests authorization to offer a baccalaureate minor in Computer Engineering. The proposed minor supports the statutory mission of SDSU as provided in SDCL 13-58-1: *Designated as South Dakota's land grant university, South Dakota State University, formerly the state college of agriculture and mechanical arts, 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 agriculture, education,*

engineering, home economics, nursing, and pharmacy, and other courses or programs as the Board of Regents may determine. The Computer Engineering Minor is proposed by the Department of Electrical Engineering and Computer Science (EECS). Providing engineering training and support to the surrounding regions is central to the mission. Many regional employers have stated that the computer science and electrical engineering graduates would better fit their hiring needs if they had a computer engineering background. Various constituents of the EECS Department, including the two separate Industry Advisory Boards (Computer Science and Electrical Engineering), have conveyed their strong support for this minor as they believe the market and need for this training exists and is projected to grow. This plan proposes to allow interested students to gain these skills before graduation. Constituents outside the EECS Department, such as students affiliated with the College of Engineering's Robotics Club and the Department of Mechanical Engineering will also benefit directly from this proposed minor.

The proposed minor supports the university's strategic plan to achieve excellence through transformative education by developing and growing high-quality and distinct academic programs designed to meet the needs of diverse students and market demands. The proposed minor supports the BOR Strategic Plan goal of recruiting, retaining, and graduating students in STEM fields by providing the opportunity to earn a minor in an area of practice that is in demand both by students and industry.

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 proposed minor will provide training in the critical STEM area of computer engineering. Computer engineering is the engineering field that integrates topics in computer science and electrical engineering for the development of hardware and software specific to computers and embedded systems. Computer engineering deals with designing, developing, and operating computer systems. At its core, computer engineering concentrates on digital hardware devices and computers, and the software that controls them. Advanced courses focus on standard designs and techniques for specific application domains. In contrast to computer science and software engineering, computer engineering emphasizes solving problems in digital hardware and at the hardware-software interface. Applications include microcontroller and microprocessor-based systems, personal computers, high performance supercomputers, circuit design, and device engineering. The minor specifies a sequence of courses and academic experiences that provide a unique intersection of background and skills required to address computer engineering applications.

4. How will the proposed minor benefit students?

The proposed minor will provide a high-valued academic credential in computer engineering that is in significant demand by regional employers. This will give the students the requisite knowledge and skills to understand, analyze, and design systems comprised of both hardware and software.

5. Describe the workforce demand for graduates in related fields, including national demand and demand within South Dakota.

The U.S. Bureau of Labor Statistics (BLS) projects growths of 31%, 5%, 4%, and 2% for

information security analysts¹, computer network architects², network and computer systems administrators³, and computer hardware engineers⁴, respectively in 2019—2029, with more than 60,000 new hires projected. The 2019 median annual pay for these positions lies in the range of \$83,510 to \$117,220. The need for this expertise is further underscored by the low location quotients in the region (acc. to the BLS). In the strategic area of precision agriculture, computer engineers will play a vital role of designing, developing, and integrating hardware and software tools in the field.

6. Provide estimated enrollments and completions in the table below and explain the methodology used in developing the estimates.

These estimates were developed in consultation with regional employers who have stated their hiring needs during Electrical Engineering and Computer Science Industry Advisory Board meetings.

<i>Estimates</i>	Fiscal Years*			
	1 st	2 nd	3 rd	4 th
	FY 22	FY 23	FY 24	FY 25
Students enrolled in the minor (fall)	5	15	25	35
Completions by graduates	0	5	10	15

*Do not include current fiscal year.

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

All students will be required to take 13 credits of core courses that will develop mastery of basic computer engineering topics. Students will choose an additional 5 or more credits of coursework to cover broad areas of interest to computer engineers. All elective courses will give the student a better understanding of how software and hardware work together in computerized systems. This is a standard curricular approach to developing discipline/professional expertise via a minor in computer engineering.^{5,6}

¹ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Information Security Analysts, at <https://www.bls.gov/ooh/computer-and-information-technology/information-security-analysts.htm> (visited March 03, 2021).

² Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Computer Network Architects, at <https://www.bls.gov/ooh/computer-and-information-technology/computer-network-architects.htm> (visited March 09, 2021).

³ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Network and Computer Systems Administrators, at <https://www.bls.gov/ooh/computer-and-information-technology/network-and-computer-systems-administrators.htm> (visited March 09, 2021).

⁴ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Computer Hardware Engineers, at <https://www.bls.gov/ooh/architecture-and-engineering/computer-hardware-engineers.htm> (visited March 09, 2021).

⁵ Old Dominion University, Minor in Computer Engineering [Online] <https://www.odu.edu/academics/programs/minor/computer-engineering> (accessed: 3/19/21)

⁶ University of Maryland, Minor in Computer Engineering [Online] <https://ece.umd.edu/undergraduate/degrees/minor-computer-engineering> (accessed: 3/19/21)

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

A. Distribution of Credit Hours

Computer Engineering Minor	Credit Hours	Percent
Requirements in minor	13	68-72%
Electives in minor	5-6	28-31%
Total	18-19	100%

B. Required Courses in the Minor

Prefix	Number	Course Title	Prerequisites for Course	Credit Hours	New (yes, no)
CSC	300	Data Structures	CSC 250 Computer Science II	3 (3) *	No
CSC	456	Operating Systems	CSC 300 Data Structures & CSC 314 Assembly Language	3 (3)	No
EE	345	Computer Organization	EE 245-245L Digital Systems & Lab & CSC 150 Computer Science I	3 (7)	No
EE	347-347L	Microcontroller Systems Design & Lab	EE 345 Computer Organization	3, 1	No
Subtotal				13 (13) *	

*Credit hours in parentheses () indicate prerequisite courses not counted in the minor requirements. The net number of prerequisite credits not counted is thirteen. The prerequisites are fundamental courses for Computer Science and Electrical Engineering majors who might choose to earn the minor and therefore are not applicable to the minor itself.

The Computer Engineering Minor is designed as a stackable and value-added credential for students. Computer Science majors that declare the minor would not require extra coursework as they would substitute EE 245-245L Digital Systems & Lab and EE 345 Computer Organization for CSC 244-244L Digital Logic & Lab and CSC 317 Computer Organization and Architecture, respectively. The Electrical Engineering versions of the courses cover additional material and would meet the requirements for their Computer Science versions. Electrical Engineering majors that declare the minor would complete twelve credits beyond the major coursework (CSC 250, CSC 300, CSC 456, and CSC 314) to earn the 18-19 credit minor.

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

Select 5-6 credits from the following:

Prefix	Number	Course Title	Prerequisites for Course	Credit Hours	New (yes, no)
CSC	474	Computer Networks	CSC 300 Data Structures	3	No

CSC	487	Network Security	CSC 300 Data Structures	3	No
EE	492	Topics (Advanced Digital Design)	--	3	No
SE	440	Embedded Systems	SE 306 Software Project Management & EE 347 Microcontroller System Design	3 (3) *	No
CSC, EE, SE, ME, or HON	491	Approved Independent Study	--	1-3	No

9. What are the learning outcomes expected for all students who complete the minor? How will students achieve these outcomes?

Students will gain a necessary knowledge of computer engineering and the development of computer engineering solutions. Students will develop skills to implement in the fields of professional, scientific, government, or academic environments in computer engineering. The following are the specific student outcomes for the Computer Engineering minor:

- Design and analyze digital circuits and hardware such as those used in computer systems;
- Design and write low-level and high-level computer software germane to computer systems.

These student outcomes align with the department’s expectations for program educational objectives in computer science and electrical engineering.

The curriculum map below shows where students achieve these outcomes in the curriculum.

Computer Engineering Minor – Student Learning Outcomes

Individual Student Outcome	CSC 300	CSC 456	EE 345	EE 347-347L	Electives
Design and analyze digital circuits and hardware such as those used in computer systems.			X	X	X
Design and write low-level and high-level computer software germane to computer systems.	X	X		X	X

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.

Standard contemporary classroom and laboratory technologies will be used. Face-to-face lecture and hands-on laboratories will be the dominant instructional method.

11. Delivery Location⁷

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

⁷ The accreditation requirements of the Higher Learning Commission (HLC) require Board approval for a university to offer programs off-campus and through distance delivery.

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	2021-2022 Academic Year

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

	Yes/No	If Yes, identify delivery methods ⁸	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 online program)?⁹

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

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."

The University requests an exception to the Board policy that limits minors to a total of 18 credits, including prerequisites. The proposed Computer Engineering Minor is intended only for students earning bachelor's degrees in Electrical Engineering or Computer Science. Students will complete the prerequisites as part of the basic bachelor's degree requirements, regardless of the minor. The 18-19 credits included in the proposed minor prescribe a path to developing expertise in computer engineering through specific electives and focused experiential work.

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.

The minor will be offered using existing resources only. The Department of Electrical Engineering and Computer Science already has the resources, personnel, courses, lesson plans, and infrastructure required to implement the minor. No new investments are required at this time. The department has been building capacity for the minor for a long time now. Faculty members that hold advanced degree or terminal degree in their respective fields of computer

⁸ Delivery methods are defined in [AAC Guideline 5.5](#).

⁹ This question responds to HLC definitions for distance delivery.

science, electrical engineering, and software engineering will provide the high quality of instruction that is expected for any offering from SDSU. Instructional laboratories are fully staffed and adequately supplied to cater to the pedagogical requirements of delivering a successful minor in Computer Engineering.

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.*