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Bachelor of Science in Biomedical Engineering

The Bachelor of Science Degree in Biomedical Engineering obtained through the engineering partnership program is conferred by the University of Colorado Boulder. Lower-division coursework is completed through Western Colorado University before applying for admission to the University of Colorado Boulder. The entire program is completed on the campus of Western Colorado University. A student may apply for admission to the Western-University of Colorado Boulder Partnership Program when they have satisfied all criteria of one of the following scenarios:

Scenario One

- Complete a college-level, two-course sequence in calculus with a grade of "B-" or higher
- Complete one college-level physical science course (calculus-based physics and/or college-level chemistry) with a grade of "B-" or higher
- Maintain a college-level cumulative GPA of 3.0 or higher

Scenario Two

- Complete the first- and second-year course sequence listed on the current Program Sheet/Degree Plan for the Engineering Partnership Program
- Maintain a college-level cumulative GPA of 3.0 or higher

Student Learning Outcomes. Graduates of this program will have...

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 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

Program Educational Objectives.

The Biomedical Engineering program is designed to prepare students for successful careers with a positive societal impact in industry, academia, government and consulting. Our alumni are expected to:

- apply their engineering and computer science knowledge, critical thinking, creativity and problem-solving skills with integrity and inclusivity in a professional practice or in non-engineering or technical fields, such as law, medicine or business.
- continue their intellectual development through graduate education, professional development courses, self-directed investigation, and/or on-the-job training and experience.
- embrace leadership and collaborative roles in their careers.

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The Bachelor of Science Degree in Biomedical Engineering requires:

- The official transfer of all coursework listed on the plan of study to the University of Colorado Boulder
- At least 45 credits earned from the University of Colorado Boulder (residency requirement)
- A minimum of 128 cumulative credits earned to the degree program
- Student knowledge and adherence to course prerequisites as listed in the course catalog
- A cumulative and major GPA of at least 2.00 (from entirely CU Boulder coursework as a student's Western GPA will not continue in the CU Boulder portion of the program)
- Satisfactory completion of all HEAR requirement deficiencies related to high school coursework

AP & IB Credit

Partnership students are to adhere to CU Boulder standards for AP and IB Scores (not Western standards). These scores are often higher than the score required for credit from Western (particularly those listed below).

- An AP score of 4 or higher is required on **Biology** to receive credit for General Biology I with lab (4 credits) at CU Boulder (CU EBIO 1210 + 1230, Western BIOL 150)
- An AP score of 4 or higher is required on **Calculus AB** to receive credit for Calculus I (5 credits) at CU Boulder (CU MATH 1300, Western MATH 151)
- An AP score of 4 or higher is required on **Calculus BC** to receive credit for Calculus I (5 credits) and Calculus II (5 credits) at CU Boulder (CU MATH 1300 and 2300, Western MATH 151 and 251)
    - Additionally, a **Calculus BC** score of 3 or higher with an AB sub score of 4 or higher is required to receive credit for Calculus I (5 credits) at CU Boulder (CU MATH 1300, Western MATH 151)
- An AP score of 5 is required on **Chemistry** to receive credit for General Chemistry I with lab (5 credits) at CU Boulder (CU CHEM 1113 and 1114, Western CHEM 111 + 112 or CHEM 121)
- An AP score of 5 is required on either **Computer Science A** or **Computer Science Principles** to receive credit for Computer Science 1 (4 credits) at CU Boulder (CU CSCI 1300, Western CS 191)
- An AP score of 5 is required on **Physics C: Mechanics** to receive credit for General Physics I (4 credits) at CU Boulder (CU PHYS 1110, Western PHYS 190 + 185).
- An AP score of 5 is required on **Physics C: Electricity & Magnetism** to receive credit for General Physics II (4 credits) at CU Boulder (CU PHYS 1120, Western PHYS 191 + 186).

Grade Requirements

The minimum passing grade for a course that is considered a prerequisite for another course is C-, allowing a student to progress through the curriculum and apply these courses towards degree requirements. This includes all Western, CU Boulder, and transfer courses. **The minimum passing grade for standalone classes is a D–.** Per CEAS Academic Expectations and Policies, if the minimum required grade in a prerequisite course is not achieved, the student is required to repeat the course until the minimum acceptable grade has been earned (maximum of 3 graded attempts total to master the subject content at the required level). If a student takes the advanced (post-requisite) course, it does not remove the obligation to meet the prerequisite course minimum grade requirement, even if the grade earned in the advanced course is acceptable. To remain in good academic standing, students must maintain a **cumulative CU Boulder GPA of 2.00.** In addition, students need to have a cumulative and **major GPA of at least 2.00** to graduate from the CU Boulder College of Engineering and Applied Science.

WESTERN COLORADO UNIVERSITY

University of Colorado Boulder

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REQUIRED COURSES

Western coursework is in red font, while CU Boulder coursework is in black font.

College Writing Requirement: 3 credit hours

ENG 302	Technical Writing	3

Humanities and Social Sciences: 15 credit hours, 6 of which must be upper-division

Upper-division Humanities & Social Science:

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_____

Remaining (Lower-division) Humanities & Social Sciences:

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Computing Courses: 3 credit hours

ENGR 130 or	Intro to Engineering Computing	
CS 191	Computer Science II	3

Mathematics and Basic Science Courses: 35 credit hours

MATH 151	Calculus I	4
MATH 251	Calculus II	4
MATH 252	Calculus III	4
MATH 358	Differential Equations w/ Linear Algebra	4
BIOL 150	Biological Principles with Lab	4
CHEM 111	General Chemistry I	3
CHEM 112	General Chemistry I Lab	1
CHEM 113	General Chemistry II	3
PHYS 190	General Physics I	3
PHYS 185	Laboratory Physics I	1
PHYS 191	General Physics II	3
PHYS 186	Laboratory Physics II	1

Mechanics Courses: 9 credit hours

PHYS 250	Statics	3
ENGR 251	Dynamics	3
ENGR 363	Mechanics of Solids	3

Other Engineering Courses: 7 credits

MCEN 3030	Computational Methods	3
MCEN 3047	Data Analysis & Experimental Methods	4

Biomedical Courses: 28 credit hours

WWGE 100	Headwaters: BME-focused	2
ENGR 161	Computer-Aided Design	3
ENGR 162	Fabrication	1
ENGR 201	Biomaterials	3
ENGR 210	Biomedical Principles & Methods	3
BMEN 3010	Biotransport	3
BMEN 3030	Bioinstrumentation	4
BMEN 4010	BME Capstone Design I	3
BMEN 4020	BME Capstone Design II	3
BMEN 4117	Anatomy & Physiology for BME	3

Electrical Courses: 3 credit hours

MCEN 3017	Circuits & Electronics	3

Engineering Technical Electives: 9 credit hours of engineering coursework not already in degree (6 credits must be 3000-level or higher).

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_____

General Technical Electives: 9 credit hours of selected engineering, science, math, computer science, engineering management or other courses 3000-level or higher not already in the degree.

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Free Electives: Credit hours variable

Complete enough electives to bring the total credit hours toward the degree to 128. Normally this is 7 credit hours but could vary (for example due to transfer credits). Please consult with your Academic Advisor with questions.

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NOTE: 1 credit of either H&SS or free elective must be a CU Boulder course to meet the residency requirement.

TOTAL CREDITS **128**

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ADDITIONAL DEGREE INFORMATION

Acceptable Course Substitutions:
CHEM 121 (General Chemistry for Engineers, 3 credits) for CHEM 111 + 112 (General Chemistry I with lab, 4 credits). Note: In this situation students may need to make up additional credit to fulfill degree requirements (total of 128 credits). CS 191 (Computer Science II, 3 credits) for ENGR 130 (Introduction to Engineering Computing, 3 credits).
To investigate additional course substitutions from Western or another institution, check www.transferology.com to verify how applicable courses will transfer to CU Boulder and discuss options with an Academic Advisor.

Headwaters 100
To fulfill the CU Boulder BMEN 1000 (Exploring Biomedical Engineering, 1 credit) requirement, Western partnership students must take a biomedical engineering-focused Headwaters (WWGE 100) section, including *Exploring Biomedical Engineering* and *Engineering, Physics and Society*. Other Headwaters sections do not count towards this requirement. Transfer students, or students who take a non-biomedical engineering-focused Headwaters section, may substitute ENGR 265 (Engineering as a Profession, 1 credit) for this requirement.

Approved Humanities & Social Sciences
At least 15 credit hours in humanities and social sciences are required in order to graduate. A list of acceptable humanities and social sciences with Western can be found on the "Humanities and Social Science Requirements" PDF.

Engineering Technical Electives
CU Boulder courses more technical in nature are considered *Engineering Technical Electives.* At least six credits must be 3000-level or higher. Options in Gunnison will be advertised each semester. Students are eligible for any Engineering Technical Electives via offerings in Boulder or remote based on the Engineering Technical Electives List. All engineering technical electives can also be used for general technical electives.

General Technical Electives
CU Boulder courses 3000- level or higher in a variety of subjects are considered *General Technical Electives,* including coursework in Gunnison (which will be advertised each semester) and remote offerings as indicated on the General Technical Electives list. In addition, a student may earn up to 12 credits through BMEN Independent Study (six max) and/or Internship for Credit (six max), which may be approved as general technical electives or engineering technical electives, depending on the nature of the work involved." Please note that in order to be approved for technical elective credit, you must provide sufficient information about the engineering/technical nature of your position and duties.

Senior Capstone
A two-semester senior capstone (beginning in fall and ending in spring) is required for 6 credit hours. This sequence must be taken contiguously and may not be taken before senior year.

Free Electives
College-level coursework accepted by CU Boulder not used otherwise to satisfy degree requirements will apply as free electives towards the total 128 credits required for degree completion. Biomedical engineering does allow courses counting as free electives to be taken on a pass/fail basis (however the college limits use to 6 per semester and 16

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cumulative and students must first submit a petition prior to choosing this option). Use www.transferology.com to verify that courses will transfer to CU Boulder as appropriate equivalencies.

Petition Process
Students seeking an exception to a policy or practice (including transfer coursework policies) should first talk to their Academic Advisor and then submit a petition.

Coursework Not Accepted for Transfer Credit
All courses will undergo a transfer evaluation and the credit be transferred to CU Boulder as applicable. The following coursework will not be accepted for transfer credit and will not count toward a degree at CU Boulder, as described in the Campus Transfer Credit Policy:

- any courses in which the grade earned is below a C- (1.70)
- courses identified by CU Boulder as remedial, such as remedial English, mathematics, science and developmental reading
- vocational-technical courses that are offered at two-year and proprietary institutions (exceptions may be granted only by the CU Boulder dean responsible for the student's curriculum)
- courses in religion that constitute specialized religious training or that are doctrinal in nature
- credits earned for work experience or through a cooperative education program
- outdoor leadership education coursework
- credits earned in physical education activity courses
- courses or programs identified as college orientation

Credit hours required for graduation that were earned more than ten years prior to transferring into an undergraduate program at CU Boulder may not apply to the completion of a student's graduation requirements.

Students are responsible for making up any difference in credit hours between the transfer credit received and the CU Boulder course. This can happen when students transfer in coursework from an institution on a quarter-system, for example. Furthermore, students must have their Academic Advisor approve how the credit shortfall is made up (based on ABET and other departmental requirements). Students need to have a minimum of 128 unique non-duplicative, degree applicable credit hours, along with meeting the specified course and other requirements for a specific bachelor's degree program per CEAS Transfer Credit Policy.

Academic Standing
To remain in good academic standing with the College of Engineering and Applied Science, a student must maintain satisfactory academic performance as measured by GPA and progress toward completion of a Bachelor of Science degree. Failure to meet these requirements (including the 2.00 GPA) results in the student being placed on Academic Alert, Academic Recovery, and/or Academic Suspension. Students in this situation should consult their Academic Advisor and review the Academic Standing Policies.

Academic Calendar
Western partnership students adhere to the same calendar as Western students (for holiday breaks, etc.). However, add, drop and withdrawal dates for coursework may differ and can be found on the CU Boulder Registrar's Website.

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Internship for Credit

Students may receive up to three credits of free or technical electives (COEN 3930) for an internship or co-op experience, and two different experiences may be used to provide six credits maximum. Students must secure the position prior to completing the application (with sufficient information about the engineering/technical nature of your position and duties, especially if aiming to fulfill technical elective credit), and have (as well as maintain) a 2.00 GPA. All internships for credit must be full-time (40 hours per week) and a minimum of 300 contact hours are required to receive the three elective credits. Students can apply online and questions can be directed to their Academic Advisor or Sharon Anderson (CEAS Director of Active Learning).

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RECOMMENDED SEQUENCE OF COURSEWORK

Students are responsible for knowing and adhering to course prerequisites as listed in the course catalog. Certain courses may only be offered during the fall or spring semester. Western coursework is in red font, while CU Boulder coursework is in black font.

First Year

	FALL SEMESTER			SPRING SEMESTER	
MATH 151	Calculus I	4	MATH 251	Calculus II	4
PHYS 190	General Physics I	3	PHYS 191	General Physics II	3
PHYS 185	Laboratory Physics I	1	PHYS 186	Laboratory Physics II	1
CHEM 111	General Chemistry I	3	ENG 102	Writing and Rhetoric I (free elective)	3
CHEM 112	General Chemistry I Lab	1	CHEM 113	General Chemistry II	3
WWGE 100	BME-focused Headwaters	2	ENGR 130	Intro to Engineering Computing	3
	TOTAL Semester hours	14		TOTAL Semester hours	17

Sophomore Year

	FALL SEMESTER			SPRING SEMESTER	
MATH 252	Calculus III	4	MATH 358	Diff Equations w/ Linear Algebra	4
PHYS 250	Statics	3	ENGR 251	Dynamics	3
ENGR 201	Biomaterials	3	ENGR 210	Biological Principles and Methods	3
ENGR 161	Computer-Aided Design	3	ENGR 363	Mechanics of Solids	3
ENGR 162	Fabrication	1	ENG 302	Technical Writing	3
BIOL 150	Biological Principles with Lab	4			
	TOTAL Semester hours	18		TOTAL Semester hours	16

Junior Year

	FALL SEMESTER			SPRING SEMESTER	
BMEN 3010	Biotransport	3	BMEN 3030	Bioinstrumentation	4
MCEN 3017	Circuits & Electronics for MEs	3	MCEN 3047	Data Analysis & Experimental Methods	4
BMEN 4117	Anatomy & Physiology for BME	3		Engineering Technical Elective	3
MCEN 3030	Computational Methods	3		General Technical Elective	3
	H&SS Elective (Lower-Division) *	3		H&SS Elective (Lower-Division) *	3
	TOTAL Semester hours	15		TOTAL Semester hours	17

Senior Year

	FALL SEMESTER			SPRING SEMESTER	
BMEN 4010	Biomedical Engineering Design I	3	BMEN 4020	Biomedical Engineering Design II	3
	Engineering Technical Elective	3		Engineering Technical Elective	3
	General Technical Elective	3		General Technical Elective	3
	H&SS Elective (Lower-Division) *	3		H&SS Elective (Upper-Division) *	3
	H&SS Elective (Upper-Division) *	3		Free Elective*	4
	TOTAL Semester hours	15		TOTAL Semester hours	16

***NOTE:** 1 credit of either H&SS or free elective must be a CU Boulder course to meet the residency requirement.

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