

Biomedical Engineering (BS)

Students studying biomedical engineering at NC State and UNC-Chapel Hill are challenged with a curriculum at the interface of engineering and medicine. During the first year, students are introduced to the fundamentals of engineering. These courses include calculus, physics, chemistry and biology. All of which provide the foundation for future engineering courses. Once accepted into the program, students take engineering courses in mechanics, circuits and materials followed by specialized courses in biomedical engineering. The design process is woven throughout the curriculum. Students take courses that familiarize them with manufacturing processes while preparing them for the capstone senior design course that use a Design Control Process based on the FDA's Quality System Regulations. Computers are used throughout the program. Graduates will be prepared for professional employment in research, design, engineering and the life sciences. First year students interested in this curriculum should enroll in the Engineering First Year program and select BME as their intention.

In the BME department, students are given access to state-of-the-art equipment and facilities at both UNC-Chapel Hill and NC State University. This unique relationship offers students a wealth of opportunities for research, group collaboration, coursework, and exposure to experts in medicine and engineering. While all of the classes undergraduate students need to complete their degree are available on their home campus, students may choose to take courses on either campus. Students never have to travel to the partner campus; the joint program simply offers additional opportunities.

Plan Requirements

First Year

Fall Semester		Hours
CH 101	Chemistry - A Molecular Science ¹	3
CH 102	General Chemistry Laboratory ¹	1
E 101	Introduction to Engineering & Problem Solving ²	1
E 115	Introduction to Computing Environments	1
MA 141	Calculus I ¹	4
ENG 101	Academic Writing and Research	4
Hours		14

Spring Semester

BIO 183	Introductory Biology: Cellular and Molecular Biology	4
MA 241	Calculus II	4
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory ¹	4
Select one of the following Economic Courses:		3
ARE 201	Introduction to Agricultural & Resource Economics	
ARE 201A	Introduction to Agricultural & Resource Economics	
EC 201	Principles of Microeconomics	
EC 205	Fundamentals of Economics	

E 102	Engineering in the 21st Century	2
Hours		17

Second Year

Fall Semester

BME 201	Computer Methods in Biomedical Engineering	3
BME 209	Introduction to the Materials Science of Biomaterials	4
BME 298	Biomedical Engineering Design and Manufacturing I	2
MA 242	Calculus III	4
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory	4
Hours		17

Spring Semester

BME 205	Introduction to Biomedical Mechanics	4
BME 207	Biomedical Electronics	4
CH 221 & CH 222	Organic Chemistry I and Organic Chemistry I Lab	4
MA 341 or MA 331	Applied Differential Equations I or Differential Equations for the Life Sciences	3
Hours		15

Third Year

Fall Semester

BME 301	Human Physiology : Electrical Analysis	4
STEM Elective ³		3
CH 201	Chemistry - A Quantitative Science	3
CH 202	Quantitative Chemistry Laboratory	1
PHI 325	Bio-Medical Ethics	3
BME 3x5 Gateway Elective		3
Hours		17

Spring Semester

BME 302	Human Physiology: Mechanical Analysis	4
BME 398	Biomedical Engineering Design and Manufacturing II	2
BME 3x5 Gateway Elective		3
BME 3x5 Gateway Elective		3
Hours		12

Fourth Year

Fall Semester

BME 451	BME Senior Design: Product Development	3
BME Specialty Elective (p. 2) ⁴		3
BME Specialty Elective (p. 2) ⁴		3
Hours		9

Spring Semester

BME 452	BME Senior Design: Product Implementation and Strategy	3
BME Specialty Elective (p. 2) ⁴		3
BME Specialty Elective (p. 2) ⁴		3
Hours		9
Total Hours		110

¹ A grade of C or higher is required.

² A grade of C- or higher is required.

³ Students should consult their academic advisors to determine how to complete this requirement.

⁴ Take 4 specialty electives from no more than two groups

Code	Title	Hours
GEP Courses		
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		6
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		2
GEP Elective (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
GEP Global Knowledge (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/) (verify requirement)		
GEP Foundations of American Democracy (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-fad/) (verify requirement)		
World Language Proficiency (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/world-language-proficiency/) (verify requirement)		
Total Hours		14

BME 3x5 Gateway Electives

Code	Title	Hours
BME 315	Biotransport	3
BME 325	Biochemistry for Biomedical Engineers	3
BME 335	Biomaterials	3
BME 345	Biomedical Solid Mechanics	3
BME 355	Biocontrols	3
BME 365	Linear Systems in Biomedical Engineering	3
BME 375	Biomedical Microcontroller Applications	3
BME 385	Bioinstrumentation	3

BME Specialty Electives

Code	Title	Hours
Group 061		
Pharmacoengineering		
BME 516		3
BME 570	ImmunoEngineering	3
BME 498	Undergraduate Research in Biomedical Engineering	
BMME 511	Genetic Engineering	
BMME 523	Biomolecular Engineering	
BMME 524	Biomolecular Sensing Technologies	
BMME 527	Engineering Principles in Targeted Photomedicine	
Group 062		
Regenerative Medicine		
BIT 466 & BME 483	Animal Cell Culture Techniques and Tissue Engineering Technologies	2

or BIT/PO 566 and BME/BEC 583

BME 448	Functional Tissue Engineering	3
or BME 548	Functional Tissue Engineering	
BME 462		
BME 484	Fundamentals of Tissue Engineering	3
or BME 584	Fundamentals of Tissue Engineering	
BME 498	Undergraduate Research in Biomedical Engineering	3
MAE 201	Thermal-Fluid Sciences	3
or MSE 301	Introduction to Thermodynamics of Materials	
or BMME 441	Thermal Physics	
MAE 308	Fluid Mechanics	3
or CE 282	Hydraulics	
or BMME 455	Biofluid Mechanics	
TE 463	Polymer Engineering	3
BME 498	Undergraduate Research in Biomedical Engineering	3
BMME 420	Intro to Synthetic Biology	
BMME 435	Biological Physics	
BMME 470	Analysis of Tissue Engr. Tech.	
BMME 511	Genetic Engineering	

Group 063

Rehabilitation Engineering

BME 418	Wearable Biosensors and Microsystems	3
or BME 518	Wearable Biosensors and Microsystems	
BME 425	Bioelectricity	3
or BME 525	Bioelectricity	
BME 438	Bone Mechanobiology	3
or BME 538	Bone Mechanobiology	
BME 444	Orthopaedic Biomechanics	3
or BME 544	Orthopaedic Biomechanics	
BME/TE 467	Mechanics of Tissues & Implants Requirements	3
BME 456	Rehabilitation Robotics	3
or BME 556	Rehabilitation Robotics	
BME 498	Undergraduate Research in Biomedical Engineering	
BMME 405	Biomechanics of Movement	
BMME 445	Systems Neuroscience	
BMME 447	Neural Basis of Rehabilitation Engineering	

Group 064

Biosignals and Imaging

BME 412	Biomedical Signal Processing	3
or BME 512	Biomedical Signal Processing	
BME 418	Wearable Biosensors and Microsystems	
or BME 518	Wearable Biosensors and Microsystems	
BME 425	Bioelectricity	
or BME 525	Bioelectricity	
BME 463	Biomedical Optics and Lasers	3
or BME 563	Biomedical Optics and Lasers	
BME 464	Microscopy	3
or BME 564	Microscopy	
BME 498	Undergraduate Research in Biomedical Engineering	

ECE 505	Neural Interface Engineering	
ECE 455	Industrial Robot Systems	3
ECE 456	Mechatronics	3
or ECE 556	Mechatronics	
ECE 461	Embedded System Analysis and Optimization	3
or ECE 561	Embedded System Analysis and Optimization	
MA 501	Advanced Mathematics for Engineers and Scientists I	3
or MATH 528	Mech. Method for Physical Sciences and Engineers	
BMME 461	Intro to Medical Imaging	
BMME 575	Machine Learning	
BMME/COMP 576	Mathematics for Imaging Computing	
Group 065		
Medical Microdevices		
BME 412	Biomedical Signal Processing	3
or BME 512	Biomedical Signal Processing	
BME 418	Wearable Biosensors and Microsystems	
or BME 518	Wearable Biosensors and Microsystems	
BME 498	Undergraduate Research in Biomedical Engineering	
BME/ECE 522	Medical Instrumentation	3
E 304	Introduction to Nano Science and Technology	3
ECE 436	Digital Control Systems	3
ECE 505	Neural Interface Engineering	3
MAE 201	Thermal-Fluid Sciences	3
or MSE 301	Introduction to Thermodynamics of Materials	
or BMME 455	Biofluid Mechanics	
MAE 308	Fluid Mechanics	3
or CE 282	Hydraulics	
or BMME 441	Thermal Physics	

Semester Sequence

This is a sample.

Critical Path Courses – Identify using the code (CP) which courses are considered critical path courses which represent specific major requirements that are predictive of student success in a given program/plan. Place the (CP) next to the credit hours for the course.

First Year

Fall Semester		Hours
CH 101	Chemistry - A Molecular Science ¹	3
CH 102	General Chemistry Laboratory ¹	1
E 101	Introduction to Engineering & Problem Solving (CP) ¹	1
E 115	Introduction to Computing Environments (CP) ¹	1
ENG 101	Academic Writing and Research (CP) ²	4
MA 141	Calculus I (CP) ¹	4
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
Hours		15

Spring Semester

MA 241	Calculus II (CP) ¹	4
PY 205	Physics for Engineers and Scientists I (CP) ¹	3
PY 206	Physics for Engineers and Scientists I Laboratory (CP) ¹	1
BIO 183	Introductory Biology: Cellular and Molecular Biology	4
E 102	Engineering in the 21st Century	2
Select one of the following:		3
EC 205	Fundamentals of Economics	
EC 201	Principles of Microeconomics	
ARE 201	Introduction to Agricultural & Resource Economics	
Hours		17

Second Year

Fall Semester

BME/BMME 201	Computer Methods in Biomedical Engineering (CP)	3
BME/BMME 209 or BME 205	Introduction to the Materials Science of Biomaterials (CP) or Introduction to Biomedical Mechanics	4
BME/BMME 298	Biomedical Engineering Design and Manufacturing I (CP)	2
MA 242	Calculus III	4
PY 208	Physics for Engineers and Scientists II (CP)	3
PY 209	Physics for Engineers and Scientists II Laboratory (CP)	1
Hours		17

Spring Semester

BME/BMME 205 or BME 209	Introduction to Biomedical Mechanics (CP) or Introduction to the Materials Science of Biomaterials	4
BME/BMME 207	Biomedical Electronics (CP)	4
CH 221	Organic Chemistry I	3
CH 222	Organic Chemistry I Lab	1
MA 341 or MA 331	Applied Differential Equations I or Differential Equations for the Life Sciences	3
Hours		15

Third Year

Fall Semester

BME/BMME 301	Human Physiology : Electrical Analysis	4
CH 201	Chemistry - A Quantitative Science	3
CH 202	Quantitative Chemistry Laboratory	1
BME 3x5 Gateway Elective (p. 2)		3
STEM Elective		3
PHI 325	Bio-Medical Ethics	3
Hours		17

Spring Semester

BME/BMME 302	Human Physiology: Mechanical Analysis	4
BME 3x5 Gateway Elective (p. 2)		3
BME 3x5 Gateway Elective (p. 2)		3

BME/BMME 398	Biomedical Engineering Design and Manufacturing II	2
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
Hours		15
Fourth Year		
Fall Semester		
BME 451 or BMME 697	BME Senior Design: Product Development or	3
BME Specialty Elective (p. 2)		3
BME Specialty Elective (p. 2)		3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
Hours		15
Spring Semester		
BME 452 or BMME 698	BME Senior Design: Product Implementation and Strategy or	3
BME Specialty Elective (p. 2)		3
BME Specialty Elective (p. 2)		3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
Hours		13
Total Hours		124

¹ A grade of C or higher is required.

² A grade of C- or higher is required.

Career Opportunities

Biomedical engineers are employed by hospitals, pharmaceutical companies, medical device and testing companies, government agencies, universities, and medical schools. With so many areas of specialization within the field, graduates are encouraged to further their education by attending graduate or professional school after graduation. Graduates from this program have attended graduate programs in biomedical engineering, physical therapy, mechanical engineering, industrial engineering, microbiology, virology, public health, and sports physiology, among others, at many different institutions. Graduates who have taken additional courses to satisfy entrance requirements have also been accepted by medical, dental and pharmacy schools.

Career Titles

- Anesthesiologist (MD)
- Bioengineers and Biomedical Engineers
- Biofuels/Biodiesel Technology and Product Development Manager
- Biomedical Engineer
- Cardiologist (MD)
- Chemical Engineer
- Dentist (DDS)
- Dermatologist (MD)

- Engineering Professor
- Family Practitioner (MD)
- General Internists (MD)
- Gynecologist (MD)
- Mechanical Engineer
- Medical Technologist
- Nanosystems Engineers
- Non-Destructive Testing Specialists
- Obstetrician (MD)
- Occupational Physician (MD)
- Ophthalmologist (MD)
- Orthodontist (MD)
- Pathologist (MD)
- Pediatrician (MD)
- Psychiatrist (MD)
- Radiologist (MD)
- Sales Engineers
- Surgeons (MD)

Learn More About Careers

NCcareers.org (<https://nccareers.org/>)

Explore North Carolina's central online resource for students, parents, educators, job seekers and career counselors looking for high quality job and career information.

Occupational Outlook Handbook (<https://www.bls.gov/ooh/>)

Browse the Occupational Outlook Handbook published by the Bureau of Labor Statistics to view state and area employment and wage statistics. You can also identify and compare similar occupations based on your interests.

Career One Stop Videos (<https://www.careeronestop.org/>)

View videos that provide career details and information on wages, employment trends, skills needed, and more for any occupation. Sponsored by the U.S. Department of Labor.

Focus 2 Career Assessment (<https://careers.dasa.ncsu.edu/explore-careers/career-assessments/>) (NC State student email address required)

This career, major and education planning system is available to current NC State students to learn about how your values, interests, competencies, and personality fit into the NC State majors and your future career. An NC State email address is required to create an account. Make an appointment with your career counselor (<https://careers.dasa.ncsu.edu/about/hours-appointments/>) to discuss the results.

Focus 2 Apply Assessment (<https://www.focus2career.com/Portal/Register.cfm?SID=1929>) (Available to prospective students)

A career assessment tool designed to support prospective students in exploring and choosing the right major and career path based on your unique personality, interests, skills and values. Get started with Focus 2 Apply and see how it can guide your journey at NC State.

Biomedical Engineering Society (<https://www.bmes.org/>)

National Society of Professional Engineers (<https://www.nspe.org/>)