Materials Science and Engineering (BS): Biomaterials Concentration

The Biomaterials concentration within the Materials Science and Engineering (MSE) degree offers students a focused and interdisciplinary education at the intersection of materials science, biology, and engineering. This concentration is designed to equip students with the knowledge and skills necessary to address challenges in the development and application of materials for medical, biological, and healthcare-related fields.

Admission

Students complete the standard set of engineering first-year courses, which include courses in the humanities, chemistry, mathematics, physics, and computing. Students may apply to join the Department of Materials Science and Engineering as degree-seeking students via the CODA process (https://www.engr.ncsu.edu/academics/undergrad/coda/). Students can declare a biomaterials concentration during the CODA process or any subsequent semester once they join the MSE program.

Curriculum

At NC State, Materials Science and Engineering students are trained to understand the complexities of all classes of material. Our curriculum begins with core courses in thermodynamics, kinetics, and structure, building a strong foundation before advancing to mechanical, thermal, electrical, magnetic, and optical properties.

Hands-on learning is a cornerstone of the program, with two laboratory courses that immerse students in analytical techniques to characterize materials at all scales and measure their properties. Our program covers cutting-edge technologies like nanomaterials, biomaterials, advanced functional materials, materials forensics, computational modeling, and Aldriven materials optimization.

As part of this concentration, students begin with foundational coursework in biology by taking either BIO 181 or BIO 183. The core of the concentration is MSE 485: Biomaterials, a specialized course that delves into the design, development, and application of materials used in medical devices, tissue engineering, drug delivery systems, and other biological applications. Students explore the properties of biocompatible materials, the principles of material selection for medical uses, and the methods for fabricating and testing biomaterials in clinical and laboratory settings. To further customize their education, students select three electives from a wide range of courses in materials processing, engineering, biology, and other related disciplines. This flexibility allows students to tailor their studies to align with their specific interests and career goals. For example, students interested in medical device development may choose courses in biomechanics or polymer science, while those focused on tissue engineering or biotechnology might select courses in cell biology or bioinformatics.

In our two-semester capstone senior design project, students apply their knowledge to solve practical materials challenges with industry partners.

Working in teams, you'll tackle hands-on problems and bridge classroom learning with real-world impact.

The Materials Science and Engineering program is accredited by the Engineering Accreditation Commission of ABET (https://www.abet.org).

Accelerated Bachelor's/Master's Program

The Accelerated Bachelor's/Master's (ABM) program (https:// www.mse.ncsu.edu/undergraduate/abm/) allows students to earn a bachelor's and a master's degree in five years. Four graduate courses (12 credit hours) can be taken while still an undergraduate student and can be double-counted towards both the bachelor's and master's degrees.

Contact Information

3002 Engineering Building 1 (EB1) 911 Partners Way, Raleigh NC 27695-7907 919.515.2377 Website

Plan Requirements

Code	Title	Hours
Math		
MA 141	Calculus I ^{1,2}	4
MA 241	Calculus II ^{1,2}	4
MA 242	Calculus III ³	4
MA 341	Applied Differential Equations I	3
ST 370	Probability and Statistics for Engineers	3
Sciences		
CH 101 & CH 102	Chemistry - A Molecular Science and General Chemistry Laboratory ^{1,2}	4
CH 201 & CH 202	Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory	4
CH 220	Introductory Organic Chemistry	3
or CH 221	Organic Chemistry I	
CH 222	Organic Chemistry I Lab	1
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory ^{1,2}	4
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory	4
Economics		
EC 205	Fundamentals of Economics	3
or EC 201	Principles of Microeconomics	
or ARE 201	Introduction to Agricultural & Resource Economi	CS
Ethics Elective ((verify requirement) (p. 2)	
Required Cours	es	
MSE 201	Structure and Properties of Engineering Materia	ls 3
MSE 255	Experimental Methods for Structural Analysis of Materials	2
MSE 260	Mathematical Methods for Materials Engineers	3
MSE 270	Materials Science and Engineering Seminar	1
MSE 300	Structure of Materials at the Nanoscale	3

1

MSE 301	Introduction to Thermodynamics of Materials	3
MSE 320	Introduction to Defects in Solids	3
MSE 335	Experimental Methods for Analysis of Material Properties	2
MSE 355	Electrical, Magnetic and Optical Properties of Materials	3
MSE 360	Kinetic Processes in Materials	3
MSE 370	Microstructure of Inorganic Materials	3
MSE 380	Microstructure of Organic Materials	3
MSE 420	Mechanical Properties of Materials	3
MSE 423	Introduction to Materials Engineering Design	1
MSE 470	Materials Science and Engineering Senior Design Project	3
MSE 480	Materials Forensics and Degradation	3
Biomaterials Cor	ncentration Courses	
BIO 183	Introductory Biology: Cellular and Molecular Biology	4
MSE 485	Biomaterials	3
Biomaterials Elect	ives (5 credit hour minimum) (p.)	5
MSE Processing I	Elective (p. 2)	3
Technical Writing	g	
ENG 331	Communication for Engineering and Technology	3
or ENG 333	Communication for Science and Research	
Orientation Cour	ses	
E 101	Introduction to Engineering & Problem Solving ^{1,3}	1
E 102	Engineering in the 21st Century ³	2
E 115	Introduction to Computing Environments ¹	1
GEP Courses		
ENG 101	Academic Writing and Research ^{1,3}	4
GEP Humanities (category-requirem	http://catalog.ncsu.edu/undergraduate/gep- nents/gep-humanities/)	6
GEP Social Scien category-requirem	ces (http://catalog.ncsu.edu/undergraduate/gep- nents/gep-social-sciences/)	3
GEP Health and E undergraduate/ge studies/)	Exercise Studies (http://catalog.ncsu.edu/ p-category-requirements/gep-health-exercise-	2
GEP Elective (http requirements/)	p://catalog.ncsu.edu/undergraduate/gep-category-	3
GEP Interdisciplin undergraduate/ge perspectives/)	ary Perspectives (http://catalog.ncsu.edu/ p-category-requirements/gep-interdisciplinary-	3
GEP Global Know category-requirem	<pre>rledge (http://catalog.ncsu.edu/undergraduate/gep- nents/gep-global-knowledge/) (verify requirement)</pre>	
GEP Foundations undergraduate/ge requirement)	of American Democracy (http://catalog.ncsu.edu/ p-category-requirements/gep-fad/) (verify	
World Language F gep-category-requ requirement)	Proficiency (http://catalog.ncsu.edu/undergraduate/ uirements/world-language-proficiency/) (verify	
Total Hours		126

Total Hours

- ¹ College of Engineering CODA class ² Grade of C or higher required
- ³ Grade of C- or higher required

Biomaterials Electives

Code	Title	Hours
BCH 351	General Biochemistry	3
BCH 451	Principles of Biochemistry	4
BEC 462/562/ CHE 462/562	Fundamentals of Bio-Nanotechnology	3
BEC 488/588/ CHE 488/588	Animal Cell Culture Engineering	2
BIO 414	Cell Biology	3
BIT 410	Manipulation of Recombinant DNA	4
BIT 466/566/ PO 466/566	Animal Cell Culture Techniques	2
BME 466/566/ TE 466/566	Polymeric Biomaterials Engineering	3
BME/TE 467	Mechanics of Tissues & Implants Requirements	3
BME 483/583/ BEC 483/583	Tissue Engineering Technologies	2
CH 223 & CH 224	Organic Chemistry II and Organic Chemistry II Lab	4
MSE 490	Special Topics in Materials Science and Engineering (must be biomaterials related)	1-4
MSE 495	Materials Engineering Projects (department approval required)	3
MT 323	Introduction to Theory and Practice of Medical Fiber and Yarn Formation	3
MT 366	Biotextile Product Development	3
MT 432	Evaluation of Biotextiles	3
MT/PCC 471	Chemistry of Biopolymers	3
PSE 332	Wood and Pulping Chemistry	3
PSE/CH 335	Principles of Green Chemistry	4
PSE 425	Bioenergy & Biomaterials Engineering	3
Other biomaterials your MSE academ	electives (with departmental approval). Contact nic advisor for options.	

500-level courses (with departmental approval). Available to students who are admitted to an engineering ABM program OR have a minimum 3.5 overall GPA.

MSE Processing Electives

Code	Title	Hours
MSE 440/540	Processing of Metallic Materials	3
MSE 445/545	Ceramic Processing	3
MSE 455/555	Polymer Technology and Engineering	3
MSE 456/556	Composite Materials	3
MSE 460/560	Microelectronic Materials	3

Ethics Electives

Code	Title	Hours
EED 414/514	Ethics for Engineering Education	3
IDS 201	Environmental Ethics	3
PHI 214	Issues in Business Ethics	3
PHI 221	Contemporary Moral Issues	3
PHI 227	Data Ethics	3
PHI/STS 325	Bio-Medical Ethics	3
PHI 375	Ethics	3

STS 302	Contemporary Science, Technology and Human Values	3
STS 304	Ethical Dimensions of Progress	3

Semester Sequence

This is a sample.

First Year		
Fall Semester		Hours
CH 101 & CH 102	Chemistry - A Molecular Science and General Chemistry Laboratory ^{1,2}	4
ENG 101	Academic Writing and Research ^{1, 3}	4
E 102	Engineering in the 21st Century ³	2
MA 141	Calculus I ^{1,2}	4
EC 205	Fundamentals of Economics	- -
or EC 201 or ARE 201	or Principles of Microeconomics or Introduction to Agricultural & Resource Economics	0
	Hours	17
Spring Semester		
CH 201 & CH 202	Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory	4
E 101	Introduction to Engineering & Problem Solving ^{1,3}	1
E 115	Introduction to Computing Environments ¹	1
MA 241	Calculus II ^{1,2}	4
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory ^{1,2}	4
GEP Health and Exer undergraduate/gep-c studies/)	rcise Studies (http://catalog.ncsu.edu/ ategory-requirements/gep-health-exercise-	1
	Hours	15
Second Year		
	Structure and Droparties of Engineering	2
MSE 201	Materials ²	3
BIO 183	Introductory Biology: Cellular and Molecular Biology	4
MA 242	Calculus III ³	4
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory	4
GEP Health and Exer undergraduate/gep-c studies/)	rcise Studies (http://catalog.ncsu.edu/ ategory-requirements/gep-health-exercise-	1
	Hours	16
Spring Semester		
MSE 255	Experimental Methods for Structural Analysis of Materials	2
MSE 260	Mathematical Methods for Materials Engineers	3
MSE 270	Materials Science and Engineering Seminar	1
CH 220 or CH 221	Introductory Organic Chemistry or Organic Chemistry I	3

CH 222	Organic Chemistry I Lab	1
MA 341	Applied Differential Equations I	3
GEP Requirement (h	ttp://catalog.ncsu.edu/undergraduate/gep-	3
category-requirement	ts/)	
	Hours	16
Third Year		
Fall Semester		
MSE 300	Structure of Materials at the Nanoscale	3
MSE 301	Introduction to Thermodynamics of Materials	3
MSE 320	Introduction to Defects in Solids	3
MSE 335	Experimental Methods for Analysis of Material Properties	2
GEP Requirement (h category-requirement	ttp://catalog.ncsu.edu/undergraduate/gep- is/)	3
GEP Requirement (h category-requirement	ttp://catalog.ncsu.edu/undergraduate/gep- is/)	3
	Hours	17
Spring Semester		
MSE 355	Electrical, Magnetic and Optical Properties of Materials	3
MSE 360	Kinetic Processes in Materials	3
MSE 370	Microstructure of Inorganic Materials	3
MSE 380	Microstructure of Organic Materials	3
MSE 485	Biomaterials	3
MOL 400	Diomaterials	5
	Hours	15
Fourth Year	Hours	15
Fourth Year Fall Semester	Hours	15
Fourth Year Fall Semester MSE 420	Hours Mechanical Properties of Materials	15 3
Fourth Year Fall Semester MSE 420 MSE 423	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design	3 15 3 1
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology	3 15 3 1 3
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research	3 15 3 1 3
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elect	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research ctive (p. 2)	3 15 3 1 3
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elect Biomaterials Concent	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research ctive (p. 2) tration Elective (p. 2)	3 15 3 1 3 3 2-4
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elect Biomaterials Concent GEP Requirement (https://www.concent.concent/	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research ctive (p. 2) tration Elective (p. 2) ttp://catalog.ncsu.edu/undergraduate/gep-	3 15 3 1 3 3 2-4 3
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elect Biomaterials Concent GEP Requirement (hr category-requirement	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research ctive (p. 2) tration Elective (p. 2) ttp://catalog.ncsu.edu/undergraduate/gep- ts/)	3 15 3 1 3 3 2-4 3
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elect Biomaterials Concent GEP Requirement (hr category-requirement	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research tive (p. 2) tration Elective (p. 2) tration Elective (p. 2) Hours Hours	3 15 3 1 3 3 2-4 3 15
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elec Biomaterials Concent GEP Requirement (h category-requirement	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research etive (p. 2) tration Elective (p. 2) tration Elective (p. 2) ttp://catalog.ncsu.edu/undergraduate/gep- ts/) Hours	3 15 3 1 3 2-4 3 2-4 3 15
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elect Biomaterials Concern GEP Requirement (hr category-requirement Spring Semester MSE 470	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research ctive (p. 2) tration Elective (p. 2) tration Elective (p. 2) tration Elective (p. 2) Hours Materials Science and Engineering Senior Design Project	3 15 3 1 3 2-4 3 15 3
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elec Biomaterials Concern GEP Requirement (h category-requirement Spring Semester MSE 470 MSE 480	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research ctive (p. 2) tration Elective (p. 2) tration Elective (p. 2) thours Materials Science and Engineering Senior Design Project Materials Forensics and Degradation	3 15 3 1 3 2-4 3 15 3 3 3
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elec Biomaterials Concent GEP Requirement (h category-requirement Spring Semester MSE 470 MSE 480 ST 370	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research ctive (p. 2) tration Elective (p. 2) ttp://catalog.ncsu.edu/undergraduate/gep-ts/) Hours Materials Science and Engineering Senior Design Project Materials Forensics and Degradation Probability and Statistics for Engineers	3 15 3 1 3 2-4 3 2-4 3 3 3 3 3 3 3
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elec Biomaterials Concent GEP Requirement (h category-requirement) Spring Semester MSE 470 MSE 480 ST 370 Biomaterials Concent	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research ctive (p. 2) tration Elective (p. 2) ttp://catalog.ncsu.edu/undergraduate/gep- ts/) Hours Materials Science and Engineering Senior Design Project Materials Forensics and Degradation Probability and Statistics for Engineers tration Elective (p. 2)	3 15 3 1 3 2-4 3 2-4 3 3 3 3 2-4
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elect Biomaterials Concent GEP Requirement (hr category-requirement) Spring Semester MSE 470 MSE 480 ST 370 Biomaterials Concent Ethics Elective ((p. 2 catalog.ncsu.edu/unc	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research ctive (p. 2) tration Elective (p. 2) ttp://catalog.ncsu.edu/undergraduate/gep- ts/) Hours Materials Science and Engineering Senior Design Project Materials Forensics and Degradation Probability and Statistics for Engineers tration Elective (p. 2))GEP Requirement (http:// lergraduate/gep-category-requirements/))	3 15 3 1 3 3 2-4 3 15 3 3 3 2-4 3
Fourth Year Fall Semester MSE 420 MSE 423 ENG 331 or ENG 333 MSE Processing Elect Biomaterials Concent GEP Requirement (hr category-requirement MSE 470 MSE 480 ST 370 Biomaterials Concent Ethics Elective ((p. 2 catalog.ncsu.edu/unc	Hours Mechanical Properties of Materials Introduction to Materials Engineering Design Communication for Engineering and Technology or Communication for Science and Research ctive (p. 2) tration Elective (p. 2) ttp://catalog.ncsu.edu/undergraduate/gep- ts/) Hours Materials Science and Engineering Senior Design Project Materials Forensics and Degradation Probability and Statistics for Engineers tration Elective (p. 2) (GEP Requirement (http:// lergraduate/gep-category-requirements/)) Hours	3 15 3 1 3 3 2-4 3 15 3 3 3 2-4 3 3 2-4 3 15

College of Engineering CODA class
 Grade of C or higher required

³ Grade of C- or higher required

Career Opportunities

Earning a Bachelor of Science in MSE: Biomaterials Concentration offers graduates a wealth of exciting career opportunities across diverse industries. The interdisciplinary nature of an MSE education prepares individuals to work in roles that involve designing, developing, and optimizing materials that drive innovation and address societal needs. Here's what you can expect:

Starting Salary: Graduates in MSE typically earn an average starting salary of \$70,000 to \$90,000 per year.

What can I do with a Biomaterials Concentration?

The Biomaterials concentration is structured to provide a strong foundation for a variety of career paths. Graduates are prepared to enter industries such as medical devices, pharmaceuticals, or biotechnology, where they can contribute to the development of innovative materials and technologies that improve patient care and quality of life. Alternatively, students may choose to pursue advanced studies in graduate or professional programs, including materials science, bioengineering, or medicine, further expanding their expertise in this dynamic and impactful field.

Common Industries

- Biomedical & Healthcare: Design biomaterials for prosthetics, medical devices, tissue engineering, and drug delivery systems.
- Pharmaceuticals & Biotechnology: Develop biocompatible materials for targeted drug delivery, diagnostics, and therapeutics.
- Aerospace & Defense: Engineer lightweight, high-performance materials for implants, protective gear, and space medicine applications.
- Energy & Sustainability: Create biopolymers and environmentally friendly materials for energy storage and renewable technologies.
- Regenerative Medicine: Innovate biomaterials for wound healing, stem cell therapy, and tissue scaffolding.
- Diagnostics & Biosensors: Develop materials for medical imaging, diagnostic devices, and lab-on-a-chip technologies.
- Consumer & Wearable Tech: Improve smart textiles, antimicrobial coatings, and biocompatible wearables.
- Environmental Engineering: Engineer biodegradable materials for sustainable packaging, water purification, and pollution control.

Career Titles

- **Biomaterials Scientist:** Conducting research to develop advanced biomaterials for medical applications.
- Biomaterial Engineer: Developing and designing materials for medical devices, implants, and drug delivery systems.
- R&D Engineer/Scientist: Innovating biomaterials for drug delivery, diagnostics, and biotechnology.
- Regulatory Affairs Specialist: Ensuring biomaterials and devices meet regulatory standards and compliance.
- Clinical Research Scientist: Evaluating the performance and safety of biomaterial-based products.

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/explorecareers/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.

American Society for Testing & Materials (http://www.astm.org/) Materials Research Society (http://www.mrs.org/home/) National Society of Professional Engineers (http://www.nspe.org/)