Materials Science and Engineering (BS): Biomaterials Concentration

The Materials Science and Engineering (BS): Biomaterials Concentration emphasizes biomedical materials for human compatibility. This concentration introduces the foundation of biomaterials in the areas of biological performance of materials, material design, and appropriateness for medical applications.

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 department.

Curriculum

The MSE curriculum trains students to understand the wide range of phenomena that occur in all classes of materials: metals, polymers, composites, ceramics, and electronic materials.

Fundamental courses provide a foundation in thermodynamics, kinetics, and structure, followed by more applied courses that cover mechanical, thermal, electrical, magnetic, and optical properties of materials.

Two laboratory courses introduce students to analytical methods used to characterize the structure of materials at all length scales and to measure properties of all classes of materials. Cutting-edge technologies in materials science and engineering such as nanotechnology, biomaterials, computer modeling, and forensics (materials degradation and failure analysis) are covered.

As a part of the Biomaterials concentration, students will take BIO 183: Intro Biology: Cellular and Molecular Biology and MSE 485: Biomaterials. Three electives are included, which allow students to select from a broad range of courses in materials processing, engineering, biology, and other disciplines. The flexibility afforded by these electives allows students to customize their education to prepare them for careers in industry or for graduate school.

The two-semester capstone senior design sequence provides a bridge between concepts learned in the classroom and the practical application of these concepts in an industrial setting. Teams of students work on real-world materials problems supported by local industrial sponsors.

Accelerated Bachelor’s/Master’s Program

The Accelerated Bachelor's/Master's (ABM) program (https://www.mse.ncsu.edu/undergraduate/abm/) gives students the opportunity 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

To see more about what you will learn in this program, visit the Learning Outcomes website (https://apps.oirp.ncsu.edu/pgas/)!

Plan Requirements

Code	Title	Hours	Counts towards
Math			
MA 141	Calculus I	4	
MA 241	Calculus II	4	
MA 242	Calculus III	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	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	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 Economics	
Ethics Elective (p. 3)		**3**
Required Courses		
MSE 201	Structure and Properties of Engineering Materials	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
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 Concentration Courses		
BIO 183	Introductory Biology: Cellular and Molecular Biology	4
MSE 485	Biomaterials	3
Biomaterials Elective (5 credit hour minimum) (p.)		5
MSE Processing Elective (p. 3)		3
Orientation Courses		
E 101	Introduction to Engineering & Problem Solving	1
E 115	Introduction to Computing Environments	1
Technical Writing		
ENG 331	Communication for Engineering and Technology	3
or ENG 333	Communication for Science and Research	
GEP Courses		
ENG 101	Academic Writing and Research	4
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		3-6
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 US Diversity, Equity, and Inclusion (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-usdei/)		3
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)		2-5
GEP Global Knowledge (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/) (verify requirement)		

Foreign Language Proficiency (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/foreign-language-proficiency/) (verify requirement)	
Total Hours	**126**

Biomaterials Electives

Code	Title	Hours	Counts towards
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	
MSE 490	Special Topics in Materials Engineering	1-4	
MSE 495	Materials Engineering Projects	1-6	
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 electives (with departmental approval). Contact your MSE academic 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	Counts towards
MSE 440	Processing of Metallic Materials	3	
MSE 445	Ceramic Processing	3	
MSE 455	Polymer Technology and Engineering	3	
MSE 456	Composite Materials	3	
MSE 460	Microelectronic Materials	3	
MSE 540	Processing of Metallic Materials	3	
MSE 545	Ceramic Processing	3	
MSE 556	Composite Materials	3	
MSE 560	Microelectronic Materials Science and Technology	3	

Ethics Electives

Code	Title	Hours	Counts towards
IDS 201	Environmental Ethics	3	
PHI 214	Issues in Business Ethics	3	
PHI 221	Contemporary Moral Issues	3	
PHI 227	Data Ethics	3	
PHI 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	

STS 325	Bio-Medical Ethics	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]	4
E 101	Introduction to Engineering & Problem Solving [1, 2]	1
E 115	Introduction to Computing Environments [1,2]	1
ENG 101	Academic Writing and Research [1, 2]	4
MA 141	Calculus I [1]	4
EC 205 or EC 201 or ARE 201	Fundamentals of Economics [*] or Principles of Microeconomics or Introduction to Agricultural & Resource Economics	3
	Hours	**17**
Spring Semester		
CH 201 & CH 202	Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory	4
MA 241	Calculus II [1]	4
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory [1]	4
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		2
	Hours	**15**
Second Year		
Fall Semester		
MSE 201	Structure and Properties of Engineering Materials [1]	3
BIO 183	Introductory Biology: Cellular and Molecular Biology	4
MA 242	Calculus III	4
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory	4
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		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 (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
	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 (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		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
	Hours	**15**
Fourth Year		
Fall Semester		
MSE 420	Mechanical Properties of Materials	3
MSE 423	Introduction to Materials Engineering Design	1
ENG 331 or ENG 333	Communication for Engineering and Technology or Communication for Science and Research	3
MSE Processing Elective (p. 3)		3
Biomaterials Concentration Elective (p. 3)		2-4
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
	Hours	**15**
Spring Semester		
MSE 470	Materials Science and Engineering Senior Design Project	3
MSE 480	Materials Forensics and Degradation	3
ST 370	Probability and Statistics for Engineers	3
Biomaterials Concentration Elective (p. 3)		2-4
Ethics Elective ((p. 3)GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/))		3
	Hours	**15**
	Total Hours	**126**

[1] Courses required for Change of Degree Audit (CODA). CH 101, CH 102; MA 141, MA 241; PY 205, PY 206 must be completed with a C or higher.

[2] Minimum grade of C-, E 115 requires satisfactory completion (S).

What can I do with a Biomaterials Concentration?

Graduates of the Biomaterials Concentration will be well suited for a career in medical device and medical technology industries that require an understanding of materials selection, processing, and characterization.

Career Opportunities

An MSE degree is interdisciplinary and, upon graduation, will qualify you for a variety of jobs with an average starting salary of $60-70k per year.

Example Job Titles

Materials Engineer, Product Engineer, Metallurgist Engineer, Quality Control Engineer, Failure Analysis Engineer, Renewable Energy Materials Engineer, Biomaterial Engineer, Polymer Materials Engineer, Project Manager

Example Job Description

- Identify and produce a diverse range of materials for applications of interest
- Develop and improve methods for the analysis of complex materials
- Assist in the selection of materials for product application, the calculation of design parameters, the performance of material properties testing
- Apply scientific methods to resolve technical challenges related to materials and their use in products and processes