Undergraduate **Advising Manual**

Welcome To Materials Science & Engineering

2023/2024

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Welcome **Message**

On behalf of all the faculty and staff in the Department of Materials Science and Engineering at Johns Hopkins University, I am pleased to welcome you to our department! We are excited to have you join us and begin your journey as a materials science and engineering student.

Michael Kessler

As America's first research university, Johns Hopkins University has a long history of excellence in cutting-edge scholarship, with faculty and staff dedicated to helping you excel. You have made a great choice to study here.

You have also made a great choice to major in materials science and engineering. From the stone, bronze, and iron ages to the silicon chip age of today, it is no coincidence that the history of civilization is characterized by new eras fueled by new materials. From solar cells to microelectronics to advanced prosthetics, nearly all modern technologies are limited by the performance and properties of the materials they are made of.

Materials scientists and engineers play a vital role in developing and improving technologies essential to modern life and critical to solving some of the world's most pressing problems.

During your time with us, you will learn from world-class faculty, work on impactful projects, and develop the skills and knowledge necessary to make a meaningful impact in materials science and engineering.

Our department is committed to fostering a supportive and inclusive community where everyone feels welcome and valued. We encourage you to take advantage of all the resources available to you. We know that starting college can be both exciting and overwhelming, and we are here to support you every step of the way. Please don't hesitate to contact us with any questions or concerns. We are committed to helping you achieve your goals.

We hope that you will find the undergraduate advising manual to be a helpful resource. Please do not hesitate to reach out to your advisor or any of the other members of our department if you have any questions. Once again, welcome to our department, and we look forward to getting to know you.

Sincerely,

Michael R. Kessler, Ph.D.

About **Johns Hopkins**

The university takes its name from 19th-century Maryland **philanthropist Johns Hopkins**, an entrepreneur with Quaker roots who believed in improving public health and education in Baltimore and beyond. Hopkins is the first research university in America, a place that has revolutionized higher education in the U.S. and continues to bring knowledge and discoveries to the world.

Introduction
Materials Science & Engineering

Materials are essential to the construction of any engineering structure, from the smallest integrated circuit to the largest bridge. In almost every technology, the performance, reliability, or cost is determined by the materials used. As a result, the drive to develop new materials and processes (or to improve existing ones) makes materials science and engineering one of the most important and dynamic engineering disciplines.

The central theme of materials science and engineering is that the relationships among the structure, properties, processing, and performance of materials are crucial to their function in engineering structures. Materials scientists seek to understand these fundamental relationships, and use this understanding to develop new ways for making materials or to synthesize new materials. Materials engineers design or select materials for particular applications and develop improved processing techniques. Since materials scientists and engineers must understand the properties of materials as well as their applications, the field is inherently interdisciplinary, drawing on aspects of almost every other engineering discipline as well as physics, chemistry, and, most recently, biology. Because the field encompasses so many different areas, it is often categorized according to types of materials (metals, ceramics, polymers, semiconductors) or to their applications (biomaterials, electronic materials, magnetic materials, or structural materials).

The department prepares students for successful careers in materials science and engineering, for advanced study in science or engineering, and for professional education in other fields. The goal of the undergraduate program is to provide a rigorous and comprehensive curriculum in materials science and engineering as well as in mathematics, basic sciences, humanities, and social sciences. Our low student-to-faculty ratio allows students close contact with faculty in both classroom and research environments, as well as with other students and researchers in the department. The student is encouraged to proceed at his or her own rate, and to participate in interdisciplinary, interdepartmental, and interschool programs. In the tradition of Johns Hopkins, all of our undergraduate students are encouraged to participate in research, often beginning in their sophomore year, working closely with faculty and graduate students.

In recognition that biomaterials and nanotechnology represent two of the most rapidly developing areas of materials science and engineering, the Department of Materials Science and Engineering currently offers challenging concentrations (tracks)in biomaterials or nanotechnology within its undergraduate program. The successful completion of the Biomaterials Concentration and Nanotechnology Concentration will be formally noted on the student's transcript.

The field of biomaterials is concerned with the science and engineering of materials in biology and medicine. Engineered materials are increasingly used in applications such as drug delivery and gene therapy, scaffolds for tissue engineering, replacement body parts as well as biomedical and surgical devices. Biomaterials are an inherently interdisciplinary field that requires deep understanding of the properties of materials in general and the interactions of materials with the biological environment.

The Biomaterials Track is designed to provide a firm grounding in the physics, chemistry, and biology of materials, as well as breadth in general engineering, mathematics, humanities, and social science. In addition, students are encouraged to gain hands-on experience in biomaterials research laboratories. The program seeks to educate students to reach the forefront of leadership in the field of biomaterials engineering. While the fundamental principles of materials science still apply, a complete understanding of biomaterials and their interactions with biological environments requires a greater degree of specialization than the standard undergraduate curriculum provides. In recognition of completion of the biomaterials concentration, a student can elect to have his or her academic transcript annotated to indicate a specialty in biomaterials.

Nanotechnology advances the utilization of materials and devices with extremely small dimensions. Nanotechnology is a visionary field, as micro and nanostructured devices impact all fields of engineering, from microelectronics (smaller, faster computer chips) to mechanical engineering (micromotors and actuators) to civil engineering ("smart", self-healing nanocomposite materials for buildings and bridges) to biomedical engineering (biosensors and tissue engineering). Materials Science is central to nanotechnology because the properties of materials can change dramatically when things are made extremely small. This observation is not simply that we need to measure such properties or develop new processing tools to fabricate nanodevices. Rather, our vision is that the wide (and sometimes unexpected!) variety of phenomena associated with nanostructured materials allow us to envision radically new devices and applications that can only be made with nanostructured materials.

The Nanotechnology Track encompasses a curriculum designed to train students in the fundamental interdisciplinary principles of materials science including physics and chemistry, and also to expose students to the forefront of nanomaterials research through elective classes as well as in research laboratories. Students in the Nanotechnology Track will be well-prepared for successful careers in materials engineering across a wide range of disciplines. In recognition of completion of the nanotechnology track, a student can elect to have his or her academic transcript annotated to indicate a specialty in nanotechnology.

Whether a student chooses to pursue studies following the standard program, the biomaterials concentration or the nanotechnology concentration, the coursework specified for the degree will provide a firm grounding in the principles of materials science and engineering. The Materials Science and Engineering faculty strives to maintain the Johns Hopkins University tradition: to train a small number of students of highest quality, whose impact on the scientific and engineering community is large compared with the size of the Department and the University. This institutional aspiration can only be realized with the success of our students as they pursue career directions beyond their time at Hopkins. Our degree program is designed to provide an optimum starting point for students with a diversity of career aspirations providing a solid foundation for future career development.

Program Objectives

These goals are succinctly stated by our degree Program Educational Objectives. Namely, within 3-5 years of graduation, our graduates will:

1. Be engaged in advanced education, research, and development to advance materials science and engineering; or in professional disciplines that benefit from an understanding of MSE.

2. Employ elements of the materials research process in their careers including the use of:
- critical reasoning to identify fundamental issues and establish directions for investigation
- creative processes to define specific plans for problem solution
- analytical thought to interpret results and place them within a broader context.
- application of materials science and engineering solutions to enhance or improve existing and future technology

3. Conduct themselves to the highest standards of ethical professional practice, understanding the societal and global effects of their work, and using their knowledge and skills to improve the human condition.

4. Maintain their curiosity and expand their knowledge and skills through lifelong learning.

Advising Procedures

When entering the Department of Materials Science and Engineering you will be assigned an academic advisor who is a full-time faculty member in the Department. Students will plan their programs of study in consultation with their advisors (see sample programs later in this manual). These programs will be designed to meet the University and Departmental degree requirements as well as reflect the individual interests of the student. An anticipated program of study signed by your advisor should be filed as early as possible during your residence, and as subsequent changes are made to the program, it is your responsibility to see that a revised and signed program is filed with your advisor. You must have an approved program on file no later than the semester before you expect to graduate.

Your assigned academic advisor is your primary resource for information regarding your degree program in Materials Science and Engineering and will ensure that you have accurate information regarding degree program requirements. Your advisor can also assist you in course selections and program scheduling so that courses are completed in an appropriate sequence. You will meet with your advisor at least once a semester to plan your course selections for the next semester. After this meeting, your academic advisor will electronically remove your registration hold allowing you to register for courses online. A similar process is followed for the add-drop period at the beginning of each semester.

For situations that cannot be resolved using the online system, paper forms are available and your advisor's signature is required on all course registration and course change forms.

You should consult with your advisor when you are in the process of identifying educational opportunities outside the degree program such as internships and research experiences as well as study abroad programs. Your advisor can also serve as a resource for career planning information especially as it applies to graduate studies in materials science and engineering or in related science and engineering fields. General information on career planning can be obtained from the Johns Hopkins Career Center (https://studentaffairs.jhu.edu/careers/). Students interested in pursuing advanced professional studies in medicine or in law are encouraged to contact the Office of Pre- professional Advising (https://studentaffairs.jhu.edu/preprofadvising/) early in their planning process so that entrance requirements for medical and law programs are fulfilled before the fourth year.

While pursuing your degree, you might decide to take selected courses at other universities, transfer the associated credits to Johns Hopkins and use these credits towards completion of your degree requirements. The Whiting School Office of Academic Affairs (https://engineering.jhu.edu/academics/wse-academic-advising/) is available to guide you through this process and can provide you with the appropriate forms. This office also provides information on study abroad programs and can assist you in identifying scholarship opportunities associated with special programs that are available to Hopkins students. This office is responsible for monitoring student progress and will notify those students who are not making satisfactory progress towards their degree and will place them on academic probation if their term grade point average falls below 2.0.

This office also provides guidance to students who need assistance in improving their academic performance by referring them to programs designed to refine student work habits. These programs are administered by the Undergraduate Academic Advising Office (http://www.advising.jhu.edu/) and are described in this office's website.

Faculty members in the Department of Materials Science and Engineering are committed to assisting in the development of our students and you should feel comfortable consulting informally with faculty members other than your advisor to obtain ideas and directions for your course choices and career development. If you are inclined to do so, you may formally request a change in faculty advisor by contacting the department chair in writing. Students interested in fulfilling the degree requirements in Materials Science and Engineering in addition to those of another department should consult with the advising coordinator of both departments to determine feasibility. **The Director of Undergraduate Studies for Materials Science and Engineering is Professor Orla Wilson, owilson@jhu.edu, Room 108, Maryland Hall.**

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3400 N. Charles St.
Wyman Park Building, Suite 125
Baltimore, MD 21218
Voice: 410-516-7395
email: wseadvising-at-jhu.edu

Johns Hopkins Life Design Lab
3400 N. Charles St. Wyman Park Building
Suite 2 West
Baltimore, MD 21218
Voice: 410-516-8056
email: career-at-jhu.edu

Office of Pre-Professional Advising
3400 N. Charles St. Garland Hall Suite 300
Student Advising Space – Shriver Hall 030
Baltimore, MD 21218
Voice: 410-516-4140
email: preprofessional-at-jhu.edu

Undergraduate Academic Advising Office
3400 N. Charles St. Garland Hall Baltimore, MD 21218

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Requirements
B.S Materials Science & Engineering

The Department of Materials Science and Engineering offers a program leading to the Bachelor of Science degree. The B.S. for the Materials Science and Engineering degree program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. The student must meet the general University requirements for this degree as well as the departmental requirements and must complete the program approved by the student's advisor.

General Degree Requirements for the B.S Degree

- Complete program of study outlined by concentration (standard, biomaterials or nanotechnology)
- Fulfill the university writing requirement
  Two writing intensive (W) courses, at least 3 credits each
- Fulfill 75 credits earned in courses coded (E), (Q), (N) – at least 30 credits must be outside Materials Science and Engineering, at least 30 credits must be (N) or (Q) with no course counted twice
- Fulfill 18 credits of courses coded (H) or (S) – 6 courses, 3 credits each
- Take a minimum of 126 credits – at least 100 credits must be from Johns Hopkins (for students entering directly from high school)

Degree Requirements for the Department of Materials Science & Engineering

A convenient course-check off list is provided below. Please note the grade requirements associated with the course requirements.

Three B.S. degree tracks are offered by the Department of Materials Science and Engineering.

(1) **Standard Track.** The Standard Track is intended for those students with general interests in materials science and engineering. It permits the student to tailor the degree program by allowing a broad range of choices for upper level science and engineering electives.

(2) **Biomaterials Concentration.** The Biomaterials Track is intended for those students with a focused interest in biomaterials. To receive commendation for completion of the Biomaterials Concentration, the student must complete Biochemistry and Molecular Engineering as a Science and Engineering elective, three electives at 300-level or above with a focus on biomaterials, a biomaterials laboratory course and a biomaterials senior design project. **Approval of electives must be made by a student's academic advisor prior to taking the courses, and approval of the senior design project must be pre-approved by the senior design instructor.**

An intent to follow the Biomaterials Concentration in Materials Science and Engineering must be made by the student's 5th semester (1st semester junior year). Students should declare their intent in writing or by e-mail to their department advisors and copy the academic coordinator.

(3)**Nanotechnology Concentration.** The Nanotechnology Concentration is intended for those students with a focused interest in nanomaterials. To receive commendation for completion

Double Majoring in Materials Science & Engineering

A student whose primary major is in another department (either in Engineering or Arts & Sciences) may elect to fulfill the requirements for a major in Materials Science and Engineering as well. Upon graduation, a notation is placed on the student's academic record acknowledging completion of the requirements for the major in MSE. The student receives the degree (BS or BA) associated with his or her primary major. Completing a second major does not entitle the student to a second degree.

To add or drop a second major, complete the appropriate form (available from the Registrar's office). This form must be signed by the chair of the undergraduate program in MSE before it is submitted to the Registrar.

Students double-majoring in MSE are required to fulfill all of the requirements for the MSE Degree, including successful completion of the year-long senior design project. This includes the minimum grade requirement of earning a letter grade of C or higher for the MSE core courses.

In certain cases, a student may petition the Undergraduate Program Committee for an exception to the requirements. The Undergraduate Program Committee considers each such request on a case- by-case basis, and a student should not necessarily expect that his or her request will be granted if it represents a significant deviation from the prescribed program. Students are encouraged to plan their academic coursework carefully and consult with their academic advisors early to avoid difficulties in completing the degree requirements.

Professor Todd Hufnagel (hufnagel@jhu.edu) is the academic advisor for all students from other departments pursuing double majors in MSE. If you have any questions about double majoring, please contact him. (Questions regarding your primary major should be addressed to your academic advisor in the corresponding department.) If you do decide to pursue a double major in Materials Science & Engineering, please make an appointment to meet with Professor Hufnagel as early as possible to plan your program of study.

Description of the Biomaterials Concentration

Biomaterials are an exciting and rapidly developing field at the multi-disciplinary interface of Materials Science, Engineering, Biology, Chemistry and Medicine. Our unique biomaterials program is designed to provide a broad educational basis with emphasis on principles and applications of biomaterials. Our biomaterials curriculum covers a variety of topics including biomimetic materials and natural materials, host responses to biomaterials and biocompatibility, and applications of biomaterials, particularly to tissue engineering, drug delivery as well as medical devices and implants. The goal of the Biomaterials Concentration in the Department of Materials Science and Engineering is to train students in the basic principles of materials science and engineering as these principles are applied to develop novel materials that benefit human health.

Biomaterials are an inherently interdisciplinary field that requires deep understanding of the properties of materialsin general, and the interactions of materialswith the biological environment. The Biomaterials Track is designedto provide a firm grounding in the physics, chemistry, and biologyof materials, and well as breath in general engineering, mathematics, humanities and social science.

Students who complete the Biomaterials Track will be well- prepared for successful careers in biomaterials engineering or any biomedical related field. Successful completion of the Biomaterials Concentration will be noted on the student's transcript.

Students interested in satisfying pre-med requirements should coordinate their curriculum with the guidelines offered by the Office of Pre-Professional Advising.

Description of the Nanotechnology Concentration

Nanotechnology advances the utilization of materials and devices with extremely small dimensions. Nanotechnology is a visionary field, as micro and nanostructured devices impact all fields of engineering, from microelectronics (smaller, faster computer chips) to mechanical engineering (micromotors and actuators) to civil engineering ("smart", self-healing nanocomposite materials for buildings and bridges) to biomedical engineering (biosensors and tissue engineering).

Materials Science is central to nanotechnology because the properties of materials can change dramatically when things are made extremely small. This observation isn't just that we need to measure such properties or develop new processing tools to fabricate nanodevices. Rather, our vision is that the wide (and sometimes unexpected!) variety of phenomena associated with nanostructured materials allow us to envision radically new devices and applications that can only be made with nanostructured materials.

It is with the goal of developing a broad vision for the application of nanostructured materials that the Department of Materials Science offers a Nanotechnology Concentration, a curriculum designed to train students in the fundamental interdisciplinary principles of materials science including physics and chemistry, and also to expose students to cutting edge nanomaterials research, both in elective classes and in research laboratories. Students in the Nanotechnology Concentration will be well-prepared for successful careers in materials engineering across a wide range of disciplines. Successful completion of the Nanotechnology Concentration will be noted on the student's transcript.

Sample Undergraduate Programs for MSE:
Standard Track (For a student beginning with Calculus I)

First Year Fall		
030.101	Introductory Chemistry I	3
110.108	Calculus I	4
030.105	Intro. Chem. Lab I	1
171.101	General Physics I or 171.107 General Physics for Physical Sciences Majors (AL)	4
173.111	General Physics Lab I	1
510.106	Foundations of Materials Science & Engineering*	3
Total		16

*Students are encouraged to take this course, and count it as an unrestricted elective

First Year Spring		
030.102	Introductory Chem. II	3
030.106	Intro. Chem. Lab II	1
171.102	General Physics II or 171.108 General Physics for Physical Sciences Majors (AL)	4
173.112	General Physics Lab II	1
110.109	Calculus II	4
500.113	Gateway Computing – Python	3
Total		16

Second Year Fall		
510.311	**Structure of Materials**	**3**
030.205	Intro. Organic Chem. I	4
110.202	Calculus III	4
	Math/Sci/Eng elective	3
	H/S elective	3
Total		17

Second Year Spring		
510.312	**Physical Chemistry of Materials. I: Thermodynamics**	**3**
510.316	**Foundations of Biomaterials**	**3**
553.291	Linear Algebra and Differential Equations	4
553.311	Probability and Statistics for Bio. Sci. Eng.	4
	H/S elective	3
Total		17

Third Year Fall		
510.315	**Physical Chemistry of Materials II: Kinetics and Phase Transformations**	**3**
510.313	**Mechanical Properties of Materials**	**3**
510.428	**Materials Science Lab I**	**3**
	H/S Elective	3
	Math/Sci/Eng elective	3
Total		15

Third Year Spring		
510.314	**Electronic Properties of Materials**	**3**
510.429	**Materials Science Lab II**	**3**
	H/S elective	3
	Unrestricted elective	3
	Math/Sci/Eng elective	3
Total		15

Fourth Year Fall		
510.433	**Senior Design I**	**3**
510.4##	**MSE elective**	**3**
510.4##	**MSE elective**	**3**
	Unrestricted elective	3
660.463	Engineering Management and Leadership	3
Total		15

Fourth Year Spring		
510.434	**Senior Design II**	**3**
510.4##	**MSE elective**	**3**
510.4##	**MSE elective**	**3**
	H/S elective	3
	H/S elective	3
Total		15
Grand Total		**126**

Sample Undergraduate Programs for MSE:
Biomaterials Concentration (For a student beginning with Calculus I)

First Year Fall		
030.101	Introductory Chemistry I	3
110.108	Calculus I	4
030.105	Intro. Chem. Lab I	1
171.101	General Physics I or 171.107 General Physics for Physical Sciences Majors (AL)	4
173.111	General Physics Lab I	1
510.106	Foundations of Materials Science & Engineering*	3
Total		16

*Students are encouraged to take this course, and count it as an unrestricted elective

First Year Spring		
030.102	Introductory Chem. II	3
030.106	Intro. Chem. Lab II	1
171.102	General Physics II or 171.108 General Physics for Physical Science Majors (AL)	4
173.112	General Physics Lab II	1
110.109	Calculus II	4
500.113	Gateway Computing - Python	3
Total		16

Second Year Fall		
510.311	**Structure of Materials**	**3**
030.205	Intro. Organic Chem. I	4
110.202	Calculus III	4
580.221	Biochemistry and Molecular Engineering*	4
	H/S elective	3
Total		18

*This General Math/Sci/Eng elective is required for Biomaterials Concentration

Second Year Spring		
510.312	**Physical Chemistry of Materials. I: Thermodynamics**	**3**
510.316	**Foundations of Biomaterials**	**3**
553.291	Linear Algebra and Differential Equations	4
553.311	Probability and Statistics for Bio. Sci. Eng.	4
	H/S elective	3
Total		17

Third Year Fall		
510.315	**Physical Chemistry of Materials II: Kinetics and Phase Transformations**	**3**
510.313	**Mechanical Properties of Materials**	**3**
510.428	**Materials Science Lab I**	**3**
	H/S elective	3
	Math/Sci/Eng elective	3
Total		15

Third Year Spring		
510.314	**Electronic Properties of Materials**	**3**
510.429	**Materials Science Lab II**	**3**
	H/S elective	3
	Unrestricted elective	3
	Math/Sci/Eng elective	3
Total		15

Fourth Year Fall		
510.438	**Biomaterials Senior Design I**	**3**
510.4##	**MSE elective (Biomolecular Materials)**	**3**
510.4##	**MSE elective (Chemistry Physics of Polymers)**	**3**
510.4##	**MSE elective (Biomaterials Principles and Applications)**	**3**
660.463	Engineering Business and Leadership	3
Total		15

Fourth Year Spring		
510.439	**Biomaterials Senior Design II**	**3**
510.4##	**MSE elective (Biomaterials Lab)**	**3**
	Unrestricted elective	3
	H/S elective	3
	H/S elective	3
Total		15
Grand Total		**127**

Sample Undergraduate Programs for MSE:
Nanotechnology Concentration (For a student beginning with Calculus I)

First Year Fall		
030.101	Introductory Chemistry I	3
110.108	Calculus I	4
030.105	Intro. Chem. Lab I	1
171.101	General Physics I or 171.107 General Physics for Physical Sciences Majors (AL)	4
173.111	General Physics Lab I	1
510.106	Foundations of Materials Science & Engineering*	3
Total		16

*Students are encouraged to take this course, and count it as an unrestricted elective

First Year Spring		
030.102	Introductory Chem. II	3
030.106	Intro. Chem. Lab II	1
171.102	General Physics II or 171.108 General Physics for Physical Sciences Majors (AL)	4
173.112	General Physics Lab II	1
110.109	Calculus II	4
500.113	Gateway Computing - Python	3
Total		16

Second Year Fall		
510.311	**Structure of Materials**	**3**
030.205	Intro. Organic Chem. I	4
110.202	Calculus III	4
560.201/211	Statics and Mechanics of Materials	4
	H/S elective	3
Total		18

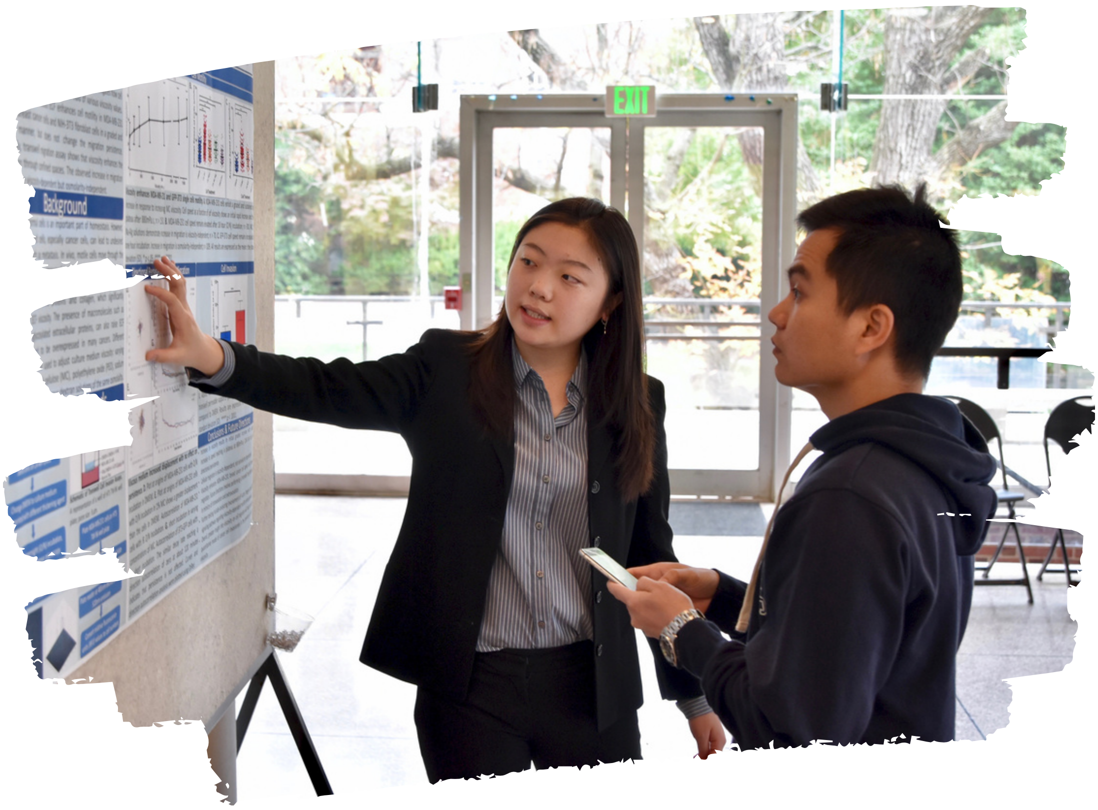
Second Year Spring		
510.312	**Physical Chemistry of Materials. I: Thermodynamics**	**3**
510.316	**Foundations of Biomaterials**	**3**
553.291	Linear Algebra and Differential Equations	4
553.311	Probability and Statistics for Bio. Sci. Eng.	4
	H/S elective	3
Total		17

Third Year Fall		
510.315	**Physical Chemistry of Materials II: Kinetics and Phase Transformations**	**3**
510.313	**Mechanical Properties of Materials**	**3**
510.428	**Materials Science Lab I**	**3**
	H/S elective	3
	Math/Sci/Eng elective	3
Total		15

Third Year Spring		
510.314	**Electronic Properties of Materials**	**3**
510.429	**Materials Science Lab II**	**3**
	H/S elective	3
	Unrestricted elective	3
	Math/Sci/Eng elective	3
Total		15

Fourth Year Fall		
510.440	**Nanomaterials Senior Design I**	**3**
510.4##	**MSE elective (Nanomaterials Lab)**	**3**
510.4##	**MSE elective (Materials Characterization)**	**3**
	Unrestricted elective	3
660.463	Engineering Business and Leadership	3
Total		15

Fourth Year Spring		
510.441	**Nanomaterials Senior Design II**	**3**
510.4##	**MSE elective (Micro Nano Mater. Devices)**	**3**
510.4##	**MSE elective (Nanoparticles)**	**3**
	H/S elective	3
	H/S elective	3
Total		15
Grand Total		**127**



Requirement Check List (& sign-off sheet) for B.S in MSE

To be filled in by students before meeting with your advisor each semester. For open electives, fill in the line with the class used to satisfy the requirement (the same course cannot be used to fulfill more than one requirement). This form can also be used as the sign-off sheet for graduation. To petition for waiver/substitution of a course, a separate form is available on MSE department website.

Student's Name__________________ Advisor's Name____________Date_______

MATERIALS SCIENCE CORE CLASSES

- Must be passed with letter grade of C or higher
- 30 credits

Course #	Course name	Instructor	Semester	Credits	Grade
510.311	Structure of Materials			3	
510.312	Phys. Chem. I: Thermodynamics			3	
510.313	Mechanical Properties			3	
510.314	Electronic Properties			3	
510.315	Phys. Chem. II: Kinetics			3	
510.316	Foundations of Biomaterials			3	
510.428	Materials Science Lab I			3	
510.429	Materials Science Lab II			3	
510.433 or 438/440	Senior Design/Research I			3	
510.434 or 439/441	Senior Design/Research II			3	
Total				30	

- *Senior design has requirements specific to the Biomaterials and Nanotechnology tracks*

UPPER LEVEL MATERIALS SCIENCE ELECTIVES

- Letter grade of C or higher
- 300-level or higher
- relevant courses in other departments with prior permission
- 12 credits

Course #	Course name	Instructor	Semester	Credits	Grade
Total				12	

- *Independent research can only count toward three (3) credits of this requirement.*
- *Biomaterials/ Nanotechnology Concentration requires 9 credits plus Lab focused on Bio/Nano. Independent Research can only count toward three (3) credits of the 9 credits required for Bio/Nano electives.*

BASIC SCIENCES AND ENGINEERING

- Letter grade of C- or higher
- 28 credits

Course #	Course name	Instructor	Semester	Credits	Grade
171.101	General Physics II or 171.107 General Physics for Physical Science Majors (AL)			4	
171.102	General Physics II or 171.108 General Physics for Physical Science Majors (AL)			4	
173.111	General Physics I Lab			1	
173.112	General Physics II Lab			1	
030.101	Intro Chem I			3	
030.102	Intro Chem II			3	
030.105	Intro Chem Lab I			1	
030.106	Intro. Chem Lab II			1	
030.205	Intro. Organic Chemistry I			4	
500.113	Gateway Computing - Python			3	
660.463	Engineering Management & Leadership			3	
Total				28	

MATHEMATICS

- Letter grade of C- or higher
- 20 credits

Course #	Course name	Instructor	Semester	Credits	Grade
110.108	Calculus I			4	
110.109	Calculus II			4	
110.202	Calculus III			4	
553.291	Linear Algebra & Differential Equations			4	
553.311	Probability & Statistics for the Biological Sciences & Eng.			4	
Total				20	

HUMANITIES (H OR S)

- Letter grade of C- or higher required if taken for letter grade; S required if taken S/U
- 18 credits; 3-credit courses only (WSE requirement)

Course #	Course name	Instructor	Semester	Credits	Grade
Total				18	

- *Introductory language courses, even if not w/ H or S designator, can substitute for H designated courses*

GENERAL MATHEMATICS, SCIENCE AND ENGINEERING ELECTIVES

- Three courses of 200- level or above in engineering, natural sciences or mathematics
- 9 credits
- Letter grade of C- or higher required if taken for letter grade; S required if taken S/U
- At least one of the three electives must be from another department in WSE (to ensure the exposure to another engineering field)

Course #	Course name	Instructor	Semester	Credits	Grade	WSE Dept.
Total				9		

- *For Biomaterials Concentration, one of these must be 580.221 Biochemistry and Molecular Engineering (4 credits). Students can substitute with Cell Bio + Biochem., ask your advisor to check Approved alternatives for some MSE required courses.*
- *For other students, a possible choice is 560.201 + 560.211(Lab) Statics and Mechanics (3+1=4 credits).*

UNRESTRICTED ELECTIVES

- *9 credits of unrestricted electives*
- *Letter grade of C- or higher required if taken for letter grade; S required if taken S/U*

Course #	Course name	Instructor	Semester	Credits	Grade
Total				9	

- A student who has taken 510.106 Foundations of MSE may count it toward one unrestricted elective.

TOTAL NUMBER OF REQUIRED CREDITS **126**
(**127** for biotrack)

Additional independent research credits can be counted towards General Math, Sci and Eng electives or Unrestricted electives: 12 is the upper limit of the number of such research credits, see Minutes of Faculty Meeting, Dec. 4, 2017.

Regarding letter grade versus S/U: Students are encouraged to challenge themselves by taking courses that are outside of their core area or at higher level than they might otherwise consider. Such courses may be taken with the S/U option. The JHU policy is that only one course per semester or summer may be taken for S/U credit. However, an eligible student who registers for a course that is only offered for S/U credit may select an additional S/U course in the same semester. For MSE, all the core requirements should be taken for a letter grade. The electives that can be taken S/U are specified in the list above (Gen. Math Sci. & Eng. Electives, Humanities, and Unrestricted electives).

This sheet should be updated each semester by the student's faculty advisor. Certification is required for graduation:

Certification by Faculty Advisor:

Name____________________ Signature________________ Date_________

Certification by Chair of Undergraduate Program Committee:

Name____________________ Signature________________ Date_________

APROVED ELECTIVES FOR NANOTECHNOLOGY AND BIOMATERIALS CONCENTRATIONS

Course Number	Course Title	Instructor
Nanotechnology Concentration (select 3, to go with required 510.442)		
510.442	Nanomaterials Lab	McGuiggan
510.427	Chemistry of Nanomaterials	Hall
510.422	Micro- and Nano- Structured Materials and Devices	Hall
510.400	Introduction to Ceramics	McGuiggan
510.453	Materials Characterization	McGuiggan
510.405	Materials Science of Energy Technologies	Erlebacher
510.414	Transmission Electron Microscopy: Principle & Practice	Chen
510.420	Stealth Science and Engineering	Spicer
510.451	Quantum Physical Interactions	Spicer
510.415	Chemistry of Materials Synthesis	Katz
510.443	Chemistry and Physics of Polymers	Katz
510. 425	Advanced Materials for Energy Storage	Chen
510.457	Materials Science of Thin Films	Weihs
530.417	Fabricatology – Advanced Materials Processing	Kang
530.495	Microfabrication Laboratory	Wang
540.403	Colloids and Nanoparticles	Bevan
540.415	Interfacial Nano Systems	Frechette
540.440	Micro/Nanotechnology: The Science and Engineering of Small Structures	Gracias

Biomaterials Concentration (select 3, to go with required 510.430)		
510.430	Biomaterials Laboratory	Hristova
510.407	Biomaterials Principles and Applications	Gu
510.426	Biomolecular Materials	Hristova
510.435	Mechanical Properties of Biomaterials	Weihs
510.402	Dynamics of Soft Materials	McGuiggan
510.436	Biomaterials for Cell Engineering	Gu
530.436	Bioinspired Science and Technology	Kang
540.402	Metabolic Systems Biotechnology	Betenbaugh
580.441	Cellular Engineering	Green/Yarema
580.442	Tissue Engineering	Elisseeff/Grayson
510.437	Biosensor Materials and Mechanisms	Katz
510.415	Chemistry of Materials Synthesis	Katz
510.443	Chemistry and Physics of Polymers	Katz
540.403	Colloids and Nanoparticles	Bevan
580.444	Biomedical Applications of Glycoengineering	Yarema
580.452	Cell and Tissue Engineering Lab	Haase
540.465	Engineering Principles of Drug Delivery	Sofou
540.428	Supramolecular Materials and Nanomedicine	Cui
530.445	Intro to Biomechanics	MechE faculty

This list is NOT meant to be exhaustive. Other courses on campus can be selected, as long as they focus on bio or nano (email Prof. Orla Wilson owilson@jhu.edu if you have candidates or questions).

APROVED ALTERNATIVES FOR SOME MSE REQUIRED COURSES

Listed in the following are some courses on Homewood campus that the MSE department has approved a priori as choices for satisfying the MSE requirements. These are alternatives that each has a title very similar, or a content roughly equivalent, to the courses we require, such that a separate substitution/waiver form is not necessary (although you may choose to keep one for your record). In other words, the student and his/her faculty advisor can simply fill the slot in the check/sign-off list with one of these pre-approved choices.

To use other relevant courses as substitution, i.e., candidate classes that are not equivalent to our courses, you need to obtain permission from the faculty advisor and UG Committee using the Substitution/Waiver form.

BASIC SCIENCES AND ENGINEERING
Letter grade of C- or higher
28 total credits

Course #	Course name and credits	Alternative	Dept.	Credits to receive	Notes
171.101	General Physics I (4)				
171.102	General Physics II (4)				
173.111	General Physics I Lab (1)				
173.112	General Physics II Lab (1)				
030.101	Intro Chem I (3)				
030.102	Intro Chem II (3)				
030.105	Intro Chem Lab I (1)				
030.106	Intro. Chem Lab II (1)				
030.205	Intro. Organic Chemistry I (4)				
500.114	Gateway Computing (3)	510.112 GC Java + (recommended) Matlab bootcamp 510.113 GC Python + (recommended) Matlab bootcamp	WSE WSE	3+1 3+1	
660.463	Engineering Management and Leadership		CLE	3	

MATHEMATICS

- Letter grade of C- or higher
- 20 total credits

Course #	Course name & credits	Alternative	From dept.	Credits to receive	Notes
110.108	Calculus I (4)				
110.109	Calculus II (4)				
110.202	Calculus III (4)				
553.291	Linear Algebra & Differential Equations (4)	110.201 or 110.202 LA (4) + 110.302 DE (4) i.e., take two separate from Math, not the combined one from Appl Math	Math	4+4	Use excess credits for General Math elective
553.311	553. 311 Probability and Statistics for the Biological Sciences and Engineering (4)	560.348 Probability & Statistics for Engineers (3)	Civil	3	Need to find one more Math credit

GENERAL MATHEMATICS, SCIENCE AND ENGINEERING ELECTIVES

- Three courses of 200-level or above in engineering, natural sciences or mathematics
- 9 credits
- At least one of the three electives must be from another department in WSE

Course #	Course name & credits	Alternative	From dept.	Credits	Notes	WSE Dept.
580.221	Biochemistry and Molecular Engineering (4), required for Biomater. track	AS.020.306 Cell Biology (4) + AS.020.305 Biochemistry (4) or EN.540.307 Cell Biology for Engineers (3) + AS.020.305 Biochemistry (4)	Biology ChemBE + Biology	4+4 3+4	use the excess credits to satisfy General Science elective	No. They are from Krieger Yes, the first one is from WSE

RECEIVING CREDITS FOR RESEARCH IN MSE

Independent Research in MSE (or Design Team Project) aims to provide more scope and depth in the MSE curriculum, helping students to improve their problem-solving skills and the ability to apply theoretical knowledge. Through research in labs under faculty guidance, a student taking this course should learn to be able to:

- articulate a materials research question, with a working hypothesis
- execute a literature search related to the topic selected with a clear explanation how the project fills a knowledge gap
- communicate confidently and effectively with mentors and team mates
- identify appropriate research methodologies and lab skills/tools, and use them for the project chosen
- work collaboratively with other researchers in the lab, while delineating his/her own contribution
- manage time (and other resources) effectively, setting and meeting deadlines
- maintain a lab notebook to record, organize, evaluate and interpret data
- apply problem-solving to constructively address research setbacks, identifying lessons learned and ways to improve
- practice research ethics and responsible conduct in the lab environment
- explain learning objectives and research results to others using various modes (written reports, progress updates, Powerpoint presentations, proposals, …)
- 1infer the relevance of research experience to his/her coursework at Hopkins and professional future

The faculty advisor, in connection with the student, will determine which of the above objectives will apply to each enrollment and the assessment mechanisms (see below) that will be used.

ASSESSMENT

- Work for the designated amount of time each week in the lab/team, commensurate with the credits assigned to your "research for credit" course. On average, it will require a minimum of 10 hours per week in the laboratory to earn 3 credits in a semester.
- Participate in weekly or bi-weekly lab/team meetings.
- Show your faculty advisor your lab notes and progress reports, periodically during the semester.
- Around the end of the semester, submit to your supervisor a one-page summary or a Powerpoint presentation, or another form of document that summarizes the objectives that have been met (e.g., the materials science question you have addressed, the methods you have used, and your role in the project …). This written summary needs to be approved by your supervisor before you receive the credits, and a copy with this approval signature should be filed with Mrs. Lauren Rodgers to be kept in the "Research for credits in MSE" record maintained by the MSE Department.

MATERIALS SCIENCE & ENGINEERING SELECTED UNDERGRADUATE PROGRAM COURSE DESCRIPTIONS

510.106 (E, N) Foundations of Materials Science and Engineering (3 credits, Fall)
Basic principles of materials science and engineering and how they apply to the behavior of materials in the solid state. The relationship between electronic structure, chemical bonding, and crystal structure is developed. Attention is given to characterization of atomic and molecular arrangements in crystalline and amorphous solids: metals, ceramics, semiconductors and polymers (including proteins). The processing and synthesis of these different categories of materials. Basics about the phase diagrams of alloys and mass transport in phase transformations. Introduction to materials behavior including their mechanical, chemical, electronic, magnetic, optical and biological properties.

510.311 (E,N) Structure of Materials (3 credits, Fall)
First of the Introduction to Materials Science series, this course is devoted to study of the structure of materials. Lecture topics include bonding, atomic packing, crystal structure, imperfections in crystals, noncrystalline solids, and composite materials. Among the techniques treated are X-ray diffraction, stereographic projection, and optical and electron microscopy. **Prerequisites: 500.113 Gateway Computing: Python, Calculus I, freshman/sophomore chemistry and physics, or permission of instructor.**

510.312 (E,N) Physical Chemistry of Materials I: Thermodynamics (3 credits, Spring)
Second of the Introduction to Materials Science series, this course examines the principles of thermo-dynamics as they apply to materials. Topics include fundamental principles of thermodynamics, equilibrium in homogeneous and heterogeneous systems, thermodynamics of multicomponent systems, phase diagrams, thermodynamics of defects, and elementary statistical thermodynamics. **Prerequisites: Calculus II, 510.311**

510.313 (E,N) Mechanical Properties of Materials (3 credits, Fall)
Third of the Introduction to Materials Science series, this course is devoted to a study of the mechanical properties of materials. Lecture topics include elasticity, anelasticity, plasticity, and fracture. The concept of dislocations and their interaction with other lattice defects is introduced. Among the materials studied are metals, polymers, ceramics, glasses, and composites. **Co-requisite: 510.311 Prerequisite: 500.113 Gateway Computing: Python.**

510.314 (E,N) Electronic Properties of Materials (3 credits, Spring)
Fourth of the Introduction to Materials Science series, this course is devoted to a study of the electronic, optical and magnetic properties of materials. Lecture topics include electrical and thermal conductivity, thermoelectricity, transport phenomena, dielectric effects, piezoelectricity, and magnetic phenomena. **Prerequisite: 510.311 or permission of instructor**

510.315 (E,N) Physical Chemistry of Materials II: Kinetics and Phase Transformations
(3 credits, Fall)
Fifth of the Introduction to Materials Science series, this course covers diffusion and phase transformations in materials. Topics include Fick's laws of diffusion, atomic theory of diffusion, diffusion in multicomponent systems, solidification, diffusional and diffusionless transformations, and interfacial phenomena. **Prerequisite: 510.311, 510.312.**

510.316 (E,N) Foundations of Biomaterials (3 credits, Spring)
Sixth of the Introduction to Materials Science series, this course offers an overview of principles and properties of biomedical materials. Topics include properties of materials used in medicine, synthesis and properties of polymeric materials, polymeric biomaterials, natural and recombinant biomaterials, biodegradable materials, hydrogels, stimuli-sensitive materials, and characterizations of biomaterials. **Prerequisites: 030.205 Organic Chemistry I, Chem I & II**

510.428 (E,N,W) Materials Science Laboratory I (3 credits, Fall)
This course focuses on characterizing the microstructure and mechanical properties of structural materials that are commonly used in modern technology. A group of A1 alloys, Ti alloys, carbon and alloy steels, and composite materials that are found, for example, in actual bicycles will be selected for examination. Their microstructures will be studied using optical metallography, scanning electron microscopy, X-ray diffraction, and transmission electron microscopy. The mechanical properties of these same materials will be characterized using tension, compression, impact, and hardness tests. The critical ability to vary microstructure and therefore properties through mechanical and heat treatments will also be demonstrated and investigated in the above materials. **Pre- or co-requisites**: **510.311, 510.313 (co-req.) & 510.15 (co-req.)**

510.429 (E,N,W) Materials Science Laboratory II (3 credits, Spring)
This laboratory concentrates on the experimental investigation of electronic properties of materials using basic measurement techniques. Topics include thermal conductivity of metal alloys, electrical conductivity of metals/metal alloys and semiconductors, electronic behavior at infrared wavelengths, magnetic behavior of materials, carrier mobility in semiconductors and the Hall effect in metals and semiconductors. Additional topics considered include basic processing of electronic materials and electronic device construction. Prerequisite: 510.311 or permission of instructor. **Pre- or co-requisites: 510.311 & 510.314 (co-req.)**

510.433 (E,N,W) Senior Design/Research Experience in Materials Science & Engineering I (3 credits, Fall)
This course is the first half of a two-semester sequence required for seniors majoring or double majoring in materials science and engineering. It is intended to provide a broad exposure to many aspects of planning and conducting independent research. During this semester, students join ongoing graduate research projects for a typical 10-12 hours per week of hands-on research. Classroom activities include discussions, followed by writing of research pre-proposals (white papers), proposals, status reports and lecture critiques of the weekly departmental research seminar. **Prerequisites: 510.311-316, 510.428-429.**

510.434 (E,N,W) Senior Design/Research Experience in Materials Science and Engineering II (3 credits, Spring)
This course is the second half of a two-semester sequence required for seniors majoring or double majoring in materials science and engineering. It is intended to provide a broad exposure to many aspects of planning and conducting independent research. During this semester, verbal reporting of project activities and status is emphasized, culminating in student talks presented to a special session of students and faculty. Written final reports describing the research projects provide lasting mementos of this course. **Prerequisites: 510.311-316, 510.428-429, 510.433.**

510.438 (E,N,W) Biomaterials Senior Design I (3 credits, Fall)
This course is the first half of a two-semester sequence required for seniors majoring in materials science and engineering with the biomaterials concentration. It is intended to provide a broad exposure to many aspects of planning and conducting independent biomaterials research. During this semester, students join ongoing graduate research projects for a typical 10-12 hours per week of hands-on experiences in design and research. Classroom activities include discussions, followed by writing of research pre-proposals (white papers), proposals, status reports and lecture critiques of the weekly departmental research seminar. **Prerequisites: 510.311-312, 510.428-429.**

510.439 (E,N,W) Biomaterials Senior Design II (3 credits, Spring)
This course is the second half of a two-semester sequence required for seniors majoring in materials science and engineering with the biomaterials concentration. It is intended to provide a broad exposure to many aspects of planning and conducting independent biomaterials research. During this semester, verbal reporting of project activities and status is emphasized, culminating in student talks presented to a special session of students and faculty. Students also prepare a poster and written final report summarizing their design and research results. **Prerequisites: 510.311- 312, 510.428-429.**

510.440 (E,W) Nanomaterials Senior Design I (3 credits, Fall)
This course is the first half of a two-semester sequence required for seniors majoring in materials science and engineering with the nanotechnology concentration. It is intended to provide a broad exposure to many aspects of planning and conducting independent nanomaterials research.
During this semester, students join ongoing graduate research projects for a typical 10-12 hours per week of hands-on experiences in design and research. Classroom activities include discussions, followed by writing of research pre-proposals (white papers), proposals, status reports and lecture critiques of the weekly departmental research seminar. **Prerequisites: 510.311-312, 510.428-429.**

510.441 (E,W) Nanomaterials Senior Design II (3 credits, Spring)
This course is the second half of a two-semester sequence required for seniors majoring in materials science and engineering with the nanotechnology concentration. It is intended to provide a broad exposure to many aspects of planning and conducting independent nanomaterials research. During this semester, verbal reporting of project activities and status is emphasized, culminating in student talks presented to a special session of students and faculty. Students also prepare a poster and written final report summarizing their design and research results. **Prerequisites: 510.311-312, 510.428-429.**

Upper Level Materials Science and Engineering Undergraduate Electives.
Not all electives are offered each academic year.

510.400 (E,N) Introduction to Ceramics (3 credits, Spring)
This course will examine the fundamental structure and property relationships in ceramic materials. Areas to be studied include the chemistry and structure of ceramics and glasses, microstructure and property relationships, ceramic phase relationships, and ceramic properties.
Particular emphasis will be placed on the physical chemistry of particulate systems, characterization, and the surface and colloid chemistry of ceramics. **Prerequisites: 510.311, 510.312 or permission of the instructor.**

510.403 (E, N) Materials Characterization (3 credits, Fall)
This course will describe a variety of techniques used to characterize the structure and composition of engineering materials, including metals, ceramics, polymers, composites, and semiconductors. The emphasis will be on microstructural characterization techniques, including optical and electron microscopy, x-ray diffraction, and acoustic microscopy. Surface analytical techniques, including Auger electron spectroscopy, secondary ion mass spectroscopy, x-ray photoelectron spectroscopy, and Rutherford backscattering spectroscopy. Real-world examples of materials characterization will be presented throughout the course, including characterization of thin films, surfaces, interfaces, and single crystals.

510.405 (E, N) Energy Engineering: Fundamentals and Future (3 credits)
This course examines the science and engineering of contemporary and cutting-edge energy technologies. Materials Science and Mechanical Engineering fundamentals in this area will be complemented by case studies that include fuel cells, solar cells, lighting, thermoelectrics, wind turbines, engines, nuclear power, biofuels, and catalysis. Students will consider various alternative energy systems, and also to research and engineering of traditional energy technologies aimed at increased efficiency, conservation, and sustainability. Prerequisite: undergraduate course in thermodynamics

510.407 (E, N) Biomaterials Principles and Applications (3 credits, Fall)
This course focuses on the interaction of biomaterials with the biological system and applications of biomaterials. Topics include host reactions to biomaterials and their evaluation, cell- biomaterials interaction, biomaterials for tissue engineering applications, biomaterials for controlled drug and gene delivery, biomaterials for cardiovascular applications, biomaterials for orthopedic applications, and biomaterials for artificial organs. **Prerequisites: 510.316**

510.415 (E, N) The Chemistry of Materials Synthesis (3 credits)
Many of the latest breakthroughs in materials science and engineering have been driven by new approaches to their synthesis, which has allowed the preparation of materials with fanciful structures and fascinating properties. This advanced course will explore synthetic approaches to multifunctional and nanostructured materials, ranging from opals to complex polymers to nanowires and quantum dots . Applications include electronics, energetics, and drug delivery. Participants will gain sufficient familiarity with synthesis options to be able to design research programs that rely on them. Emphasis will be placed on broad strategies that lead to material functionality, rather than detailed step-by-step sequences. Some topics will be selected "on the fly" from the most exciting current literature. **Prerequisites: 030.205 Organic Chemistry I, and 510.312 or equivalent thermodynamics course.**

510.416 (E, N) Applications of X-Ray Diffraction (3 credits)
Practical aspects of structural characterization with x-ray diffraction. Topics include orientation of single crystals; lattice parameter measurement; phase identification; quantitative phase analysis; crystallographic texture determination; stress measurement; diffraction from long-period structures including superlattices, multilayers, and layered molecular solids; and scattering from liquids and amorphous solids. The course will combine lectures with several laboratory exercises intended to give students experience in data collection and analysis for a variety of diffraction techniques.

510.419 (E, N) Physical Metallurgy (3 credits)
This course examines the relationship between microstructure and mechanical properties of metals and alloys. Starting from fundamentals (phase diagrams and phase transformation kinetics), we will explore how the structure of metals and alloys can be manipulated by thermomechanical processing to achieve desired properties. Detailed examples will be drawn from several alloy systems, including steels, aluminum, and titanium. A theme of the course will be the impact of materials processing and materials selection on the environment, including considerations of lightweight materials and processing techniques for minimizing energy consumption. **Prerequisites: 510.311-312, 510.314-315.**

510.422 (E, N) Micro- and Nano-Structured Materials and Devices (3 credits, Spring)
Almost every materials property changes with scale. We will examine ways to make micro- and nano-structured materials and discuss their mechanical, electrical, and chemical properties. Topics include the physics and chemistry of physical vapor deposition, thin film patterning, and microstructural characterization. Particular attention will be paid to current technologies including computer chips and memory, thin film sensors, diffusion barriers, protective coatings, and microelectromechanical devices (MEMS). Prerequisites: 510.311, 510.312, 510.315.

510.426 (E, N) Biomolecular Materials I (3 credits, Fall)
Structure and function of cellular molecules (lipids, nucleic acids, proteins, and carbohydrates). Structure and function of molecular machines (enzymes for biosynthesis, motors, pumps). Protein synthesis using recombinant nucleic acid methods. Advanced materials development. Interactions of biopolymers, lipid membranes, and their complexes. Mean field theories, fluctuation and correlation effects. Self assembly in biomolecular materials. Biomedical applications. Characterization techniques.

510.430 (E,N) Biomaterials Lab (3 credits, Spring)
This laboratory course concentrates on synthesis, processing and characterization of materials for biomedical applications, and characterization of cell-materials interaction. Topics include synthesis of biodegradable polymers and degradation, electrospinning of polymer nanofibers, preparation of polymeric microspheres and drug release, preparation of plasmid DNA, polymer- mediated gene delivery, recombinant protein synthesis and purification, self-assembly of collagen fibril, surface functionalization of biomaterials, cell culture techniques, polymer substrates for cell culture, and mechanical properties of biological materials. **Pre-or co-requisite: 510.407.**

510.435 (E, N) Mechanical Properties of Biomaterials (3 credits)
This course will focus on the mechanical properties of biomaterials and the dependence of these properties on the microstructure of the materials. Organic and inorganic systems will be considered through a combination of lectures and readings and the material systems will range from cells to bones to artificial implants.

510.442 (E,W) Nanomaterials Lab (3 credits, Fall)
The objective of the laboratory course will be to give students hands on experience in nanotechnology based device fabrication through synthesis, patterning, and characterization of nanoscale materials. The students will use the knowledge gained from the specific synthesis, characterization and patterning labs to design and fabricate a working nanoscale/nanostructured device. The course will be augmented with comparisons to microscale materials and technologies. These comparisons will be key in understanding the unique phenomena that enable novel applications at the nanoscale. **DMSE Seniors or permission of the instructor.**

510.443 (E, N) Chemistry and Physics of Polymers (3 credits, Fall)
The course will describe and evaluate the synthetic routes, including condensation and addition polymerization, to macromolecules with varied constituents and properties. Factors that affect the efficiencies of the syntheses will be discussed. Properties of polymers that lead to technological applications will be covered, and the physical basis for these properties will be derived. Connections to mechanical, electronic, photonic, and biological applications will be made.
Prerequisites: Organic Chemistry I and one semester of thermodynamics

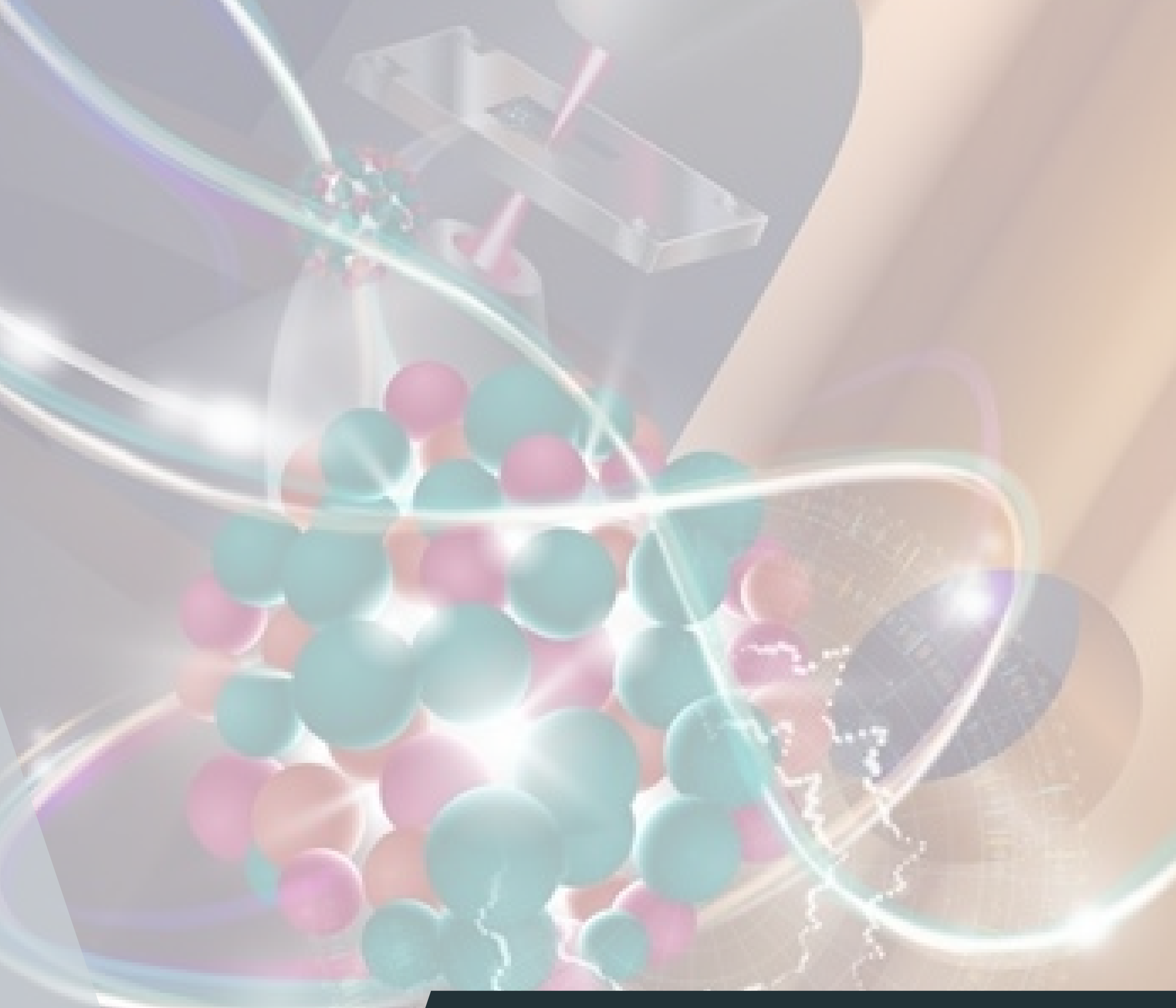
510.457 (E, N) Materials Science of Thin Films (3 credits)
The processing, structure, and properties of thin films are discussed emphasizing current areas of scientific and technological interest. Topics include elements of vacuum science and technology; chemical and physical vapor deposition processes; film growth and microstructure; chemical and microstructural characterization methods; epitaxy; mechanical properties such as internal stresses, adhesion, and strength; and technological applications such as superlattices, diffusion barriers, and protective coatings.

510.501-502 (E, N) Research in Materials Science and Engineering (1-3 credits)
Student participation in ongoing research activities. Research is conducted under the supervision of a faculty member and often in conjunction with other members of the research group.

510.503-504 (E, N) Independent Study in Materials Science and Engineering (1-3 credits)
Individual programs of study are worked out between students and the professor supervising their independent study project. Topics selected are those not formally listed as regular courses and include a considerable design component. **Prerequisite: permission of instructor.**

510.597 (E, N) Summer Independent Research in Materials Science and Engineering
(1-3 credits)

510.466 (E, N) Introduction to Computational Materials Modeling (3 credits, Fall)
Moore's law has given rise to the silicon age, where computational modeling can provide high-fidelity predictions to address challenges spanning climate change and renewable energy to economic stability and global pandemics. The skills to solve scientific problems computationally have become invaluable in virtually all industries. This introductory course is project-based and puts into practice the fundamentals of software development, numerical analysis, and scientific programming. Topics covered include methods for solving differential equations, Monte Carlo and atomistic simulations, machine learning, and data visualization. The course is taught in Python, and support for non-UNIX architectures is limited.
Prerequisites: 500.113: Gateway Computing – Python; 510.311: Structure of Materials; 510.312: Physical Chemistry of Materials I: Thermodynamics.



Academic Ethics

The strength of the university depends on the integrity of those who engage in its mission. Ethical behavior results in trust providing an atmosphere in which the open and free exchange of ideas can occur. Trust allows us to come together, helping each of us reach levels that we could never achieve alone. The absence of ethical and considerate behavior engenders mistrust among the members of the university community and erodes the quality discourse. It divides us and ultimately degrades what we know and who we are.

The Department of Materials Science and Engineering strives to uphold the ideals of academic integrity and seeks to create an atmosphere in which all members of the Department display the highest degree of ethical conduct. Creating this atmosphere is the responsibility of all members of the Department – students, faculty and staff – and can only be achieved with the consistent education of its members about the standards of academic honesty and ethical behavior.

Briefly, acts of academic dishonesty include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. University approved procedures for addressing academic ethics violations are published in the Undergraduate Academic Ethics Board Constitution (http://e-catalog.jhu.edu/undergrad-students/student-life-policies/#UAEB). Students accused of academic dishonesty are encouraged to consult the Ethics Board Constitution as well as with the Dean of Student Life in Office of Homewood Student Affairs. More information on academic ethics at Johns Hopkins is available, at https://studentaffairs.jhu.edu/student-life/student- conduct/academic-ethics-undergraduates/ and at https://studentaffairs.jhu.edu/student- life/student-conduct/resources-conduct-ethics/.

Office of the Dean of Student Life
Mattin Center
Offit Building Suite 210
The Johns Hopkins University 3400 N. Charles St.
Baltimore, Md. 21218
Voice: 410-516-8208

Counseling Resources

Making the transition to the university can be difficult and the pressures of coursework, relationships and career decisions can be overwhelming. You are not alone. While your roommate, your friends or your advisor might be able to help you get through difficult times, there are problems that you might face that are best addressed by seeking out counselors who can best guide and advise you on how to handle them. There are trained professional counselors available in the Counseling Center (https://studentaffairs.jhu.edu/counselingcenter/) who can confidentially assist you in addressing your problems. Staffed by professional psychologists and consulting psychiatrists, the Counseling Center offers counseling services that are free and confidential, as prescribed by law. Typical concerns may include test anxiety and academic performance, relationship issues, family problems, career concerns, stress, general unhappiness, self-confidence, as well as many other concerns. There also exists a confidential peer-counseling program (A Place to Talk – APTT, http://pages.jh.edu/~aptt/about.html) staffed by undergraduate students who are familiar with the pressures of undergraduate life at Hopkins and can assist students with those common problems that all undergraduates face during their time here.

The Counseling Center
3003 N Charles St Homewood Apartments Suite S-200
Baltimore, MD 21218
https://studentaffairs.jhu.edu/counselingcenter/
https://studentaffairs.jhu.edu/counselingcenter/additional-resources/
Voice: 410-516-8278

APTT – A Place to Talk
Facebook: APLACETOTALKJHU
email: admin.aptt@gmail.com

Meet
The Staff

Sainjali Hussain
Budget Specialist

John Modica
Sr. Grants & Contracts Analyst

Melissa Gaines
Sr. Grants & Contracts Analyst

Meet
The Staff

Lauren Rodgers
Academic Program Administrator

Jack Darrell
Communication Specialist

Alden Murphy
Lab Manager

About **Baltimore**

Baltimore has so much to offer. Museums, restaurants, concert venues, coffee houses, and one-of-kind shops are just a short walk or a free shuttle ride away from our four Baltimore campuses.

A city with a rich history as a working-class port, Baltimore has blossomed into a hub of social, cultural, and economic activity but retains the small-town feel that has earned it the nickname Charm City. From popular tourist attractions—the Inner Harbor, the National Aquarium, or Fort McHenry (birthplace of "The Star Spangled Banner")—to more off-the-beaten path destinations—the Edgar Allan Poe House and Museum, or the tranquil Sherwood Gardens—there is always something new to discover.

Our students enjoy exploring Baltimore many neighborhoods, including Charles Village and Hampden (home to the famous holiday lights on 34th Street and the colorful, quirky Honfest); Mount Vernon and Station North, a prime destination for artists and arts enthusiasts alike; the historic waterfront neighborhoods of Fells Point, Canton, and Federal Hill.

The city hosts events both big and small throughout the year. Baltimore sports fans are passionate about their Orioles and the Ravens; sci-fi lovers can geek out at Baltimore Comic-Con; and hundreds drop by the Baltimore Farmer's Market each Sunday to pick up fresh local meats, cheeses, flowers, and produce (and perhaps a cup of locally roasted Zeke's coffee, too). There's the Maryland Film Festival each spring, a book festival each fall, and Artscape—America's largest free crafts festival—in the summer.



Contact Us

The offices for the staff of Materials Science & Engineering are located in Maryland Hall on the second floor. The staff works a hybrid schedule where some days are remote. The Program Administrator works in the office Tuesday-Thursday and remotely Monday/Wednesdays.

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- ***Message***

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- ***Website***

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- ***Address***

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