

Undergraduate Advising Manual



Welcome To Materials
Science & Engineering

2024/2025

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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.

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.



Michael Kessler



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 a mentor who is a full-time faculty member in the Department as well as an academic advisor. Students will plan their programs of study in consultation with their advisors. 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 mentor 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 mentor. 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 mentor 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 and mentor at least once a semester to plan your course selections for the next semester. After this meeting, your advisors 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 mentor 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. Students interested in pursuing advanced professional studies in medicine or in law are encouraged to contact the Office of Pre-Professional Advising 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 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 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 mentor 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.**

WSE Office of Academic Affairs

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

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
studentaffairs.jhu.edu/preprofadvising

Johns Hopkins Life Design Lab

113 W. University Parkway
Baltimore, MD 21218
Voice: 410-516-8056
email: career-at-jhu.edu
imagine.jhu.edu/channels/life-design-lab

Undergraduate Academic Advising Office

3400 N. Charles St. Garland Hall
Baltimore, MD 21218
Voice: 410-516-8216
engineering.jhu.edu/ug-academic/advising/

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, under the General Criteria and the Program Criteria for Materials (1), Metallurgical (2), Ceramics (3), and Similarly Named Engineering Programs. 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 the First-Year Seminar requirement: 2-3 credits completed in the first year of study.
- Fulfil 18 credits of courses codes (H) or (S) - 6 courses, 3 credits each.
- Take a minimum of 125 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 concentrations are offered by the Department of Materials Science and Engineering.

(1) **Standard Concentration.** The Standard Concentration 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 Concentration 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 administrator.

(3)Nanotechnology Concentration. The Nanotechnology Concentration is intended for those students with a focused interest in nanomaterials. The nanotechnology concentration 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 and research laboratories. In recognition of completion of the Nanotechnology Concentration, a student may elect to have his or her academic transcript annotated to indicate a specialty in nanotechnology.

To receive commendation for completion of the Nanotechnology Concentration, the student must complete three electives with a focus on nanotechnology, a nanomaterials laboratory course and a nanotechnology 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.**

Students must declare their intent to satisfy the requirements of the Nanotechnology Concentration in Materials Science and Engineering by their 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 administrator.

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 director 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 their 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 mentor 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 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, and well as breadth 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.



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

Student-Facing Staff



Lauren Rodgers
*Academic Program
Administrator*



Conner Allen
*Communications
Specialist*



Alden Murphy
Lab Manager



Pamela Jackson
*Sr. Administrative
Coordinator*

About Baltimore

Baltimore has so much to offer. Museums, restaurants, concert venues, coffee houses, and one-of-a-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 Tuesdays and Thursdays and remotely Mondays, Wednesdays, and Fridays.

- **Phone**



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- **Message**



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- **Website**



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