BME 505 LA
Biomaterials Laboratory

College of Engineering/ Biomedical Engineering
Spring 2023

Instructor:	Peter S. Popolo, PhD
Course Website:	see canvas
Meeting Times:	Monday 2-3:50pm (LA)
Classroom Location:	McLean B10/B11
Contact Info:	Altorfer 213, ppopolo@stevens.edu
Office Hours:	TBD (Please schedule ahead of time via email)
Prerequisite(s):	E344
Corequisite(s):	BME 306
Cross-listed with:	BME 505

COURSE DESCRIPTION

Intended as an introduction to materials science for biomedical engineers, this course first reviews the materials properties relevant to the application to the human body. It goes on to discuss proteins, cells, tissues, and their reactions and interactions with foreign materials, as well as the degradation of these materials in the human body. The course then treats various implants, burn dressings, drug delivery systems, biosensors, artificial organs, and elements of tissue engineering. Laboratory exercises accompany the major topics discussed in class and are conducted at the same time.

STUDENT LEARNING OUTCOMES

Program Outcome 6: (Experimentation)
6.1 Design and conduct experiments and use the experimental data to draw conclusions in the development of an implanted design.

Biomaterials Laboratory Course Outline (Tentative Schedule)

Week	Topic	Assignment
Week 1- Mon 1/16	**No class – MLK Day of Service**	
Week 2- Mon 1/23	**Introductions, Module 0-** Syllabus, Course Layout and Expectations -Lab Safety, Writing a Lab Report, Engineering Notebook, References, Strengths and weaknesses *Team development	Team development; Purchase engineering notebooks
Week 3- Mon 1/30	**Module 1- Bone Testing** Introduction to biomechanical properties of bone, scaffolds	Read Chapter 2, page 23- 31 Setup and familiarize yourself with Solidworks
Week 4- Mon 2/6	**Quiz #1 (Module 0, 1)** **Module 2- Scaffold design**	
Week 5- Mon 2/13	**Module 3- Analysis of design** **FEA, Failure Analysis (why-why/ fish-bone diagrams)**	
Week 6- **WED 2/22** Monday Class Schedule	**Monday 2/20: President's Day; No Classes** **Wed, 2/22: No class this week**, work on Lab Report (groups) & Engineering Notebook	**Lab Report** - (Includes module 1-3) & **Engineering Notebooks** due **Friday 2/24 at 12:00 noon** in front of the lab (box will be labeled)
Week 7- Mon 2/27	**Quiz #2 (Module 2, 3)** **Module 4- Introduction to manufacturing, 3D printing; Scaffold printing** **3d print designs x2**	
Week 8- Mon 3/6	**No class this week**	
Week 9- Mon 3/13	**SPRING RECESS – No Class**	
Week 10- Mon 3/20	**Module 5- Mechanical testing and comparison with theoretical values obtained in Module 1**	
Week 11- Mon 3/27	**No class this week**, work on Engineering Notebooks	**Engineering Notebooks** due **Friday 3/31 at 12:00 noon** in front of the lab.
Week 12- Mon 4/3	**Quiz #3 (Module 4, 5)** **Module 6- Cell Proliferation Testing**	
Week 13- Mon 4/10	**No class this week**	
Week 14- Mon 4/17	**Quiz #4 (Module 6); Final Recap; Design Pitch Competition**	
Week 15- Mon 4/24	**No Class,** work on Final Abstract & Engineering Notebooks	**Final Abstract**- due on CANVAS; **Engineering Notebooks** due **Friday 4/28 at 12:00 noon** in front of the lab.
Week 16- Mon 5/1	**No Class**	

*Please check CANVAS regularly as the schedule and deadlines may change.

COURSE REQUIREMENTS and GRADING

Quizzes (40%):
After various modules throughout the semester have been completed, you will have a quiz. The topics in the quiz will entail material from the lectures, lab and reading material posted on CANVAS.

Engineering Notebooks (20%):
Engineering notebooks must follow the guidelines provided at the beginning of the semester and can be located in CANVAS. Each lab member's notebook will highlight their understanding and contribution of the lab report. Your engineering notebook will be your own independent grade and will be due as per the syllabus deadline.

Reports (30%):
All lab reports must be typed and follow the format outline at the beginning of the semester. Briefly, reports should have the format of a Title page, Abstract, Introduction, Materials and Methods, Results, Discussion and Conclusions, References. These guidelines can be found with greater detail on CANVAS for your reference. Please note, all lab reports will be graded according to these grading rubrics.

Attendance and Participation (10%):
Everyone is expected to attend each class that is scheduled, and attendance will be taken promptly at the beginning of class. It is imperative that you come to class on time as two late arrivals will result in an absence. We are covering a great deal of information per week. If you run into any issues and must miss class, please contact me so that I can help you navigate with each week's expectations.

ACADEMIC INTEGRITY

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at http://web.stevens.edu/honor/

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"*I pledge my honor that I have abided by the Stevens Honor System*."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at www.stevens.edu/provost/graduate-academics.

Special Provisions for Undergraduate Students in 500-level Courses

The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Dean of Graduate Academics or to the Honor Board, who will refer the report to the Dean. The Honor Board Chairman will give the Dean of Graduate Academics weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/office-disability-services. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone (201) 216-3748.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and in-class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments are strongly encouraged and can be made by phone (201-216-5177) or in-person (on the 7th floor of the Howe Center). CAPS is open from 9:00 am – 5:00 pm Mondays, Wednesdays, Thursdays and Fridays and from 9:00 am – 7:00 pm on Tuesdays during the Fall and Spring semesters.

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. Other 24/7 resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.

Syllabus and schedule for BME505 (2023 Spring)

week	dates	Lecture topics	notes
1	01/23	Introduction: Biomaterials in clinical devices. Historical Background. FDA	
2	01/30	Various processing methods for biomaterials(3D printing, inkjet printing…)	Quiz
3	02/06	Metals: Stainless Steels, Cobalt-Chromium, Titanium alloys	HW
4	02/13	Hard Materials: Bioceramics, Bioglasses, Carbons.	Quiz
5	02/22 (Wed on Monday schedule)	Polymers as Biomaterials	HW
6	02/27	Natural Biomaterials. Collagen, gelatin, etc.	Quiz
7	03/06	Biological reactions to implants: Blood clotting, foreign body reaction, infection	HW
8	03/20	Recitation	
9	03/27	Closed book mid-term	
10	04/03	Devices & Implants: Material Choices in the design and development of Commercialized and Patented Devices.	
11	04/10	Hard Tissue Replacement and Repair	Quiz
12	04/17	Soft Tissue Devices: Design of a Catheter	HW
13	04/24	Failure of Implants: Mechanical & Infection	Quiz
14	05/01	Biomimetic materials/nanobiomaterials	HW

Textbook:

Biomaterials Science 2nd edition, An Introduction to Materials in Medicine, Edited by Buddy D. Ratner, et al, Academic Press, 2004

Reference Texts:

Handbook of Materials for Medical Devices, Edited by J. R. Davis, ASM International, 2003

Biomaterials: Principals and Applications, Edited by Joon B. Park and Joseph D. Bronzino, CRC Press, 2003

Biomaterials, An Introduction, 3rd Edition, Joon Park and R.S. Lakes, Sringer, 2007

The Medical Device R&D Handbook, Theodore R. Kucklick, CRC Press, 2006

Class time: 6:15pm-8:45pm
Location: McLean 105

Office hours: Thursday 11:30pm-1:00pm
Zoom: meeting ID: 380 641 5462

Grading Scheme for BME 505:

- **Attendance – 5%**
- **Homework – 10%**
- **Quiz –10%**
- **Lab Reports – 30%**
- **Midterm – 15%**
- **Final Exam – 20%**
- **Project presentation – 10%**

100%

Class and Lab Observation / Participation Factor: +/- 10% applied to Attendance, Homework, and Lab reports.

Grading will not be curved, and it is based on individual performance throughout the semester (>94 points for A…).

Course Policies:

Attendance—Attendance at lectures, although not mandatory, is important for your mastery of the subject materials. In addition, in-class discussion requires your attendance.

Homework— Homework must be handed in time. Any submission after due will not be considered except valid reason (usually medical).

Mid-term Exam—one 2-hr midterm exam is scheduled. The exam will be closed book and closed notes. Requests for regarding must be submitted to the professor within 1 week after the graded exam has been returned.

Final Exam—Final exam will be a 2-hr close book/taking home exam.

Project — Group project for design of devices (4-5 students/group)-coming up a viable design for specified device

Cheating and plagiarism—both are strictly forbidden.

Class Policies:

No phone ring and texting

Active involvement