Syllabus

Fall 2021 Undergraduate Course

14:125:304 Introduction to Biomaterials

Section 01: In-person in EN-B120

Section 02: Remote via Zoom: (for students only)

Schedule: Mondays and Thursdays; 11:00 AM-12:20 PM

BME POLICY REGARDING SWITCHING SECTIONS

- Students can switch registration between sections during the add-drop period, which ends September 9.
- In-person students can switch to online freely - no limit
- Online can switch to in-person up to a limit set by each instructor or the capacity of the classroom, whichever is lower.
    - Students will be given SPNs to switch from online to in-person based on first come-first serve up to the limit

Students are expected to adhere to their section unless approved by instructor (i.e. students feeling ill cannot attend in person so can attend remotely)

Course Instructor: Prof. Kristen Labazzo kristen.labazzo@rutgers.edu

Office Hours: By appointment in Dr. Labazzo's personal Zoom room: or in person in BME 328.

TA: Sonal Gahlawat (sg1389@scarletmail.rutgers.edu)

Office Hours: Every Thursday 9-10 am in my personal Zoom room. TA hours might change during the Fall semester, which will be conveyed in the class.

Prerequisites: Introduction to Biomedical Engineering (14:125:201) and Biomedical Engineering System Physiology (14:125:255)

Course Description: This course is designed to introduce the subjects of material properties, testing, biomaterial requirements and device design. It focuses first and foremost on basic principals in materials science and how these principals apply towards the design of materials intended to interface with biological systems. It will examine the material properties of hard (ceramics, metals) and soft (polymers, hydrogels) materials, and how these properties translate to bulk characteristics and biocompatibility. It is intended to convey the basic knowledge of this large volume of information and to give an elementary understanding of the terminology used in the academic and commercial settings. This will provide the student with rudimentary skills that will allow them to succeed in grasping the ideas and theories of biomaterial science for future work.

Objectives: The primary aim of this course is to expose students to the diverse range of materials used in biomedical applications. In particular, the students will gain an appreciation for the role of biological-materials interactions in determining the utility of a biomaterial. Upon completion of this course, students will learn the following:

1. Materials Science fundamentals: SP^3; defects, mechanical properties and testing, corrosion, device failure
2. The major classes of biomaterials: metals, ceramics, polymers, composites, and naturally-derived materials; degradable versus inert materials
3. Biocompatibility: Immune system; Inflammation; Infection; Allergic reactions; Carcinogenic materials; Material-biosystem interface; foreign body response; normal wound healing, implant wound healing
4. Industry considerations and various examples of medical devices to demonstrate principles

Textbook:

Since there is no ideal biomaterials book, content for this course will be derived from several sources. You are not required to purchase any, but can if you are interested in the material. Most should be available in the library. Course content will also be posted on Canvas under each appropriate module.

“Biomaterials: A Basic Introduction” Q. Chen and G. Thouas (2015).

“Biomaterials Science: An Introduction to Materials in Medicine” B.D. Ratner, A. S. Hoffman, F. J. Schoen, J. E. Lemons (2013). Available without charge online via the Rutgers Digital Library system.

“Materials Science and Engineering: An Introduction” W. D. Callister Jr., D. G. Rethwisch**.** 9th edition

Grading

Exams (three; October 4, November 8, December 13) 20% each. **No cumulative final!**

Students with disabilities will be accommodated per their instructions from the Office of Disability Services

Participation and attendance 15%

All absences will be marked as a zero. However, your three lowest class scores will be dropped. Exceptions to the attendance policy will be made for valid reasons (i.e. heath, religious, professional, etc).

Homework 25%

Note: Syllabus subject to change depending on needs of the course and exams may be shifted

#	Date	Topic
1	Sept 2, Th	Introduction/Biomaterials Overview
2	Sept 8, W	Materials Science Basics (Overview, sp3) (Monday Class Schedule)
3	Sept 9, Th	Materials Science Basics (bonds, atomic structures)
4	Sept 13, M	Materials Science Basics (physical properties)
5	Sept 16, Th	Materials Science Basics (physical properties, defects)
6	Sept 20, M	Toxicity and Corrosion
7	Sept 23, Th	Mechanical Properties
8	Sept 27, M	Mechanical Properties
9	Sept 30, Th	Exam Review /Metals
	Oct 4, M	**Exam 1**
10	Oct 7, Th	Metals
11	Oct 11, M	Ceramics
12	Oct 14, Th	Ceramics
13	Oct 18, M	Polymers
14	Oct 21, Th	Polymers
15	Oct 25, M	Finish Polymers, Intro to Naturally-Derived Biomaterials
16	Oct 28, Th	Naturally-Derived Biomaterials; Collagen (featuring guest speakers)
17	Nov 1, M	Composites; Exam Review
	Nov 4, Th	Basic Physiology
18	Nov 8, M	**Exam 2**
19	Nov 11, Th	Basic Physiology
20	Nov 15, M	Biocompatibility
21	Nov 18, Th	Biomaterial Interface

22	Nov 22, M	Protein Adsorption
	Nov 25, Th	NO CLASS (Thanksgiving)
	Nov 29, M	NO CLASS (Observe Wed schedule)
23	Dec 2, Th	Regulation, Industry Considerations
24	Dec 6 M	Tissue Engineering for Regenerative Medicine
25	Dec 9, Th	Lab Day?
	Dec 13, M	**Exam 3**
	Dec 16	**FINAL EXAM 8 am-11 am**

Participation

Questions will be asked during class to encourage participation and help me understand what you know. If students cannot attend synchronously, you will be given an alternative assignment after viewing the lecture video. **Given the hybrid nature of the class, polling tools/scoring is TBD.**

Grading Information

Participation polls/quizzes will be worth 15% of your final grade. Each absence/lack of informing me and making up work will be marked as a 0. However, your three lowest in-class grades will be dropped meaning you can miss up to three classes without penalty.

Academic Integrity:

Students are expected to familiarize themselves with and adhere to the University policy on academic integrity at: http://nbacademicintegrity.rutgers.edu/home/academic-integrity-policy/ . It is understood that a student's name on any individual quiz, or exam indicates that he/she neither gave nor received unauthorized aid. Quizzes and exams are tests of individual performance. The student is not permitted to obtain assistance from any other person (or persons) during quizzes or exams. The student must adhere strictly to the instructions provided by the professor regarding what is permissible to be used during the exam. The exams in this course will be closed-book / closed-notes. Exams will likely be administered to all students via Canvas on personal computers. However, use of cell phones, other laptops, or browsing the internet during an online exam is PROHIBITED. Disciplinary actions for academic misconduct will be in accord with the University policy on academic integrity.

Further, all material presented is copyrighted and belongs to the instructor. Posting of any course material to sites such as Course Hero is considered a COPYRIGHT INFRACTION and could result in consequences. DO NOT DO THIS! I work closely with Course Hero and I will post material as deemed necessary.

We understand that we are still living in challenging times, and the return to campus after so long may be difficult. Please use Rutgers resources as needed for psychological support. In case of emergencies, please call 911.

Link to academic integrity resources, accommodations through the Office of Disabilities, and Other Resources (CAPS): https://nbprovost.rutgers.edu/academic-integrity-students

ABET related (Accreditation Board for Engineering and Technology, Inc.):

Contribution of Course to Meeting the Professional Component of ABET:

Upon completion of the course the students will be equipped with the basic knowledge of biomaterials needed for them to work in the biomedical industry. This will be achieved by a series of lectures, homeworks, and worked examples demonstrating the use of materials in biomedical applications.

The course fulfills the following ABET criteria:

(a) an ability to apply knowledge of mathematics, science, and engineering

(c) an ability to design a system, component, or process to meet desired needs

(e) an ability to identify, formulate, and solve engineering problems

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.