

BIEN-140A, Biomaterials – Part I

Lectures: Three lecture periods (50 minutes each) and one discussion session (50 min) per a week

Text: “*Biomaterials Science: an Introduction to Materials in Medicine*,” B. D. Ratner, A. S. Hoffman, F. J. Schoen and J. E. Lemmon (editors).

Class notes and handouts:

An outline of the topics follows at the end of this syllabus. With additional handouts that will be distributed in due time, this rough outline of topics will be further broken in terms of text chapters and sections of particular interests and suggested problems and exercises. Concepts in terms of overarching ideas or paradigms will be built. These paradigms summarized will be distributed as handouts as the course proceeds.

Examinations and grading:

Quizzes: pop-quizzes, small tests and take-home exams will be conducted during the lecture periods throughout the quarter.

Discussions on current publications related to the topics

Final exam

Grades will be assigned on the bases of 100 points averaged with the following breakdown:

Quizzes	50 %
Discussions	30 %
Final Exam	20 %

Objectives of the course:

- To teach students the interdisciplinary issues involved in biomaterials design, synthesis, evaluation and analysis, so that they may pursue higher-level, more focused graduate courses in biomaterials, address research problems, or pursue a job opportunities in the medical-device and tissue engineering industries
- To teach students the use of applied science and mathematics (e.g., physics, chemistry, biology and statistics) for materials engineering
- To teach students the basic classes of biomaterials and their characteristics
- To teach students the basic bulk and surface properties required for biomaterials with various applications
- To teach students the basic techniques for characterization of the mechanical, chemical and biological properties of biomaterials
- To teach students the basic interactions between biomaterials and biological environment
- To provide students with a greater familiarity with the biomaterials research literature
- To provide understanding of ethical issues related to biomaterials research and development
- To provide training in communication of scientific and engineering ideas

Outline of topics and coverage:

1. Introduction to biomaterials
2. Properties of materials
 - 2.1. Bulk properties
 - 2.2. Surface properties
 - 2.3. Characterization of the properties of materials
3. Types of materials used for biological and medical applications
 - 3.1. Polymers
 - 3.2. Silicon based materials
 - 3.3. Hydrogels
 - 3.4. Metals
 - 3.5. Ceramics
 - 3.6. Glasses
 - 3.7. Composites
4. Biomaterial interfaces
 - 4.1. Surface derivatization
 - 4.2. Surface-immobilized biomolecules
5. Interaction of materials with biological systems
 - 5.1. Cells, tissues and ICM
 - 5.2. Protein and cell adhesion
 - 5.3. Mechanical forces on cells and biological macromolecules