

Biomaterial Course

Outline and Overview

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Final Year Bachelor of Chemical Engineering

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Course: Prerequisite

- **Fundamentals of Biology**
- **Fundamentals of Physics**
- **Fundamental of Chemistry**
- **Fundamental of Engineering**

The course will not provide fundamental information of prerequisites.

This class provides an introduction to the interactions between cells and the surfaces of biomaterials. The course covers: surface chemistry and physics of selected metals, polymers, and ceramics; surface characterization methodology; modification of biomaterials surfaces; quantitative assays of cell behavior in culture; biosensors and microarrays; bulk properties of implants; and acute and chronic response to implanted biomaterials. General topics include biosensors, drug delivery, and tissue engineering.

Course: Evaluation

Assignments

Approximately biweekly (7 problem sets).

Tests

Two quizzes, one Mid-Sem exam and one final exam.

Grading

ACTIVITIES	PERCENTAGES
Assignments*	20%
Quiz 1	5%
Quiz 2	5%
Mid Sem Exam	30%
Final Exam	40%

* weighting may vary

Course: Overview and Schedule

S.N.	Topic	Assignments
1	Introduction of Biomaterials	
2.	Biomaterials Surfaces: Structure and Properties, Surface Energy	Problem set 1 assigned
3.	Adsorption and Reconstruction at Surfaces,	Problem set 1 due Problem set 2 assigned
4.	Protein-Surface Interactions	
5.	Proteins: Structure, Properties, Functions, Protein Adsorption: Complex Phenomena, Measurement	Problem set 2 due Problem set 3 assigned
6.	Cell-Surface Interactions: Host Response to Biomaterials	
7.	Cell adhesion mechanism, coagulation cascade, immune response	Problem set 3 due
	Quiz 1	
8.	Surface Characterization: AES, XPS, AFM, Contact Angle	Problem set 4 assigned
	Mid Sem Exam	

Course: Overview and Schedule

S.N.	Topic	Assignments
9.	Quantifying Cell Behavior: Cell Culture, Cellular Assays	Problem set 4 due Problem set 5 assigned
10.	Biosensors and Diagnostic devices	Problem set 5 due Problem set 6 assigned
11.	Drug Delivery: Controlled Release, Diffusion Controlled and Membrane based devices, Mechanical Pumps	Problem set 6 due Problem set 7 assigned
12.	Biomaterial for Organ Replacement Mechanical Properties, Bone Substitutes	
13.	Introduction of Tissue Engineering: Cell, Scaffold design, Artificial liver, pancreas, cartilage	Problem set 7 due
	Quiz 2	
14.	Regulatory overview: India and International	
	Final Examination	

Reading

- Ratner, Buddy D., et al. *Biomaterials Science: An Introduction to Materials in Medicine*. 2nd ed. Burlington, MA: Academic Press, 1996
- Ratner, Buddy D., et al. *Biomaterials Science: An Introduction to Materials in Medicine*. 3rd ed. Burlington, MA: Academic Press, 2004.
- Whitesides, G. M., and A. P. Wong. "The Intersection of Biology and Materials Science." *MRS Bulletin* 31 (2006): 19-27.
- Jacobs, J. J., J. L. Gilbert, and R. M. Urban. "Corrosion of Metal Orthopaedic Implants." *Journal of Bone and Joint Surgery* 80A (1998): 268-282.
- Ikada, Y., and H. Tsuji. "Biodegradable Polyesters for Medical and Ecological Applications." *Macromolecular Rapid Communications* 21 (2000): 117-132.
- Handouts: Principles of Biochemistry, Receptors: Models for Binding, Trafficking, and Signaling.
- Duncan, Ruth. "The Dawning Era of Polymer Therapeutics." *Nature Reviews Drug Discovery* 2 (2003): 347-360.
- **Notes/Further Reading: Please download from <http://www.nano-medicine.co.in/biomaterials.html>**

Thank you

Contact

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