

MSE-363 Biomaterials

Credit Hours: 2-0

Pre-requisites: Nil

Course Description

Biomaterials is an interesting and an emerging field that combines materials science, biology, engineering, and medicine. In this course, students will learn about the development, characterization, and application of materials used in implants, medical devices, tissue engineering, and drug delivery systems.

Course Contents

- Introduction to biomaterials and biochemistry; biocompatibility and bioactivity, bio-reabsorbable & bio-erodible materials. Hydrogels & smart polymers.
- Cell biology, surface properties of materials, intermolecular forces in biology. Response of materials in human body; effect of mechanical forces on cells & tissues; biomimetic materials; Importance of water in biomaterials.
- In-vivo and In-vitro testing. Biocompatible metals: Ti-based, Stainless Steels, Co-Cr-Mo alloys, nitinol; biomaterials surface & protein; textured & porous materials; Bio active glasses; Bioreabsorbable ceramics; adhesives & sealants.
- Applications (Orthopedic, Dental, cardiovascular, soft tissue replacement, hard tissue replacement); Drug delivery system (nano-carriers, polymer-drug conjugates, nucleic acids, etc.).
- Biomaterial corrosion; blood & materials interaction; tumors associated with biomaterials

Weekly Plan

Week	Topics
1	Introduction to biomaterials and biochemistry.
2	Biocompatibility and bioactivity, bio-reabsorbable & bio-erodible materials. Hydrogels & smart polymers
3	Cell biology, surface properties of materials, intermolecular forces in biology.
4	Response of materials in human body; effect of mechanical forces on cells &
5	tissues; biomimetic materials; Importance of water in biomaterials.
6	In-vivo and In-vitro testing. Biocompatible metals: Ti-based, Stainless Steels,
7	Co-Cr-Mo alloys, nitinol
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9	Mid-Semester Exams
10	Biomaterials surface & protein; textured & porous materials; Bio active glasses;
11	Bioreabsorbable ceramics; adhesives & sealants.

12	Applications (Orthopedic, Dental, cardiovascular, soft tissue replacement, hard tissue replacement); Drug delivery system (nano-carriers, polymer-drug conjugates, nucleic acids, etc.).
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14	Biomaterial corrosion; blood & materials interaction; tumors associated with biomaterials.
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17-18	End Semester Exams

Course Outcomes

At the end of the course, students will be able to:

- Differentiate between different types of biomaterials and explain the properties that are required for various biomedical applications.
- Analyze the principles and methods of in-vitro and in-vivo testing for biomaterials.
- Evaluate how biocompatible materials will interact with proteins and cells in the human body.
- Select the most suitable biomaterial for a specific biomedical application.

Suggested Books

- Biomaterials Science: An Introduction to Materials in Medicine edited by W. R. Wagner, S. E. Sakiyama-Elbert, G. Zhang, M. J. Yaszemski . 4th ed. Academic Press (2020).
- Biomaterials: principles & applications by J. B. Park, J. D. Bronzino. 1st ed. CRC Press (2002)
- An Introduction to Biomaterials by J. O. Hollinger. 2nd ed. CRC Press (2012)