

**Educational Objectives:**

- Development of global perspective of interdisciplinary issues (biology, materials science, chemistry, and engineering) involved in biomaterials.
- Learn how to design, synthesize, evaluate, and analyze biomaterials.
- Critical thinking and analysis.
- Communication of ideas; communication to coordinate work
- Familiarization with biomaterials literature.

**Learning outcomes:**

The aim of this course is to describe how cells exploit signaling components to assemble the specific signaling pathways, which they require to communicate with each other or to adapt to changes of external environment. The components and properties of major cell signaling pathways will be characterized. Attention will be focused on the role of signaling pathways in control of gene expression and cellular metabolism. The course will also deal with cell cycle signaling system and cell death.

**Structure of Lectures**

1. Bulk properties and surface properties of materials (Lectures 1-2)
2. Class of materials used in biomedical applications (Lectures 3 - 12)
3. Biological interactions with materials (Lectures 13 - 27)

Proteins, cells, and tissues Biological responses: Inflammation, immunity, toxicity, coagulation, tumorigenesis. Biofilms, Pathological calcification, Biocompatibility

Applications of biomaterials (All throughout the course): drug delivery, tissue engineering, cardiovascular, orthopedic, dental, functional tissues, etc.)

**Course Contents**

1. Orientation and Introduction to Biomaterials

2. Material Properties, Surface Characterization
3. Polymers and Hydrogels
4. Smart Polymers
5. Medical Fibers and Biotextiles,
6. Biodegradable materials
7. Natural materials
8. Surface Modification
9. Surface Patterning,
10. Metals, Ceramics and Glasses
11. Composites, Pyrolytic Carbon, Porous materials
12. Cells, Stem Cells, Cell injury response
13. Proteins on biomaterials \
14. Non fouling surfaces
15. Cell/tissue biomaterial interactions, Cells and surfaces
16. Biological response to biomaterials
17. Inflammation and immunity
18. Innate Immunity
19. Adaptive Immunity
20. Toxicity, Hypersensitivity, Tumorigenesis
21. Clotting and Unclotting, Blood-Material interactions
22. Biofilms
23. Pathological Calcification
24. Biocompatibility, Biological testing of biomaterials
25. Overall Course Review

**Recommended Books:**

1. Ratner, B. D.; Hoffman, A. S.; Schoen, F. J.; Lemons, J. E., 3rd Eds,  
Biomaterials Science: An Introduction to Materials in Medicine, Elsevier  
Academic Press, 2012. ISBN :9780123746269 eBook ISBN :9780080877808