

Bio-Interfacial Phenomena and Surface Functionalization

1. **Department** Biomedical Engineering
2. **Number** BME 694 (call number 16630-6)
3. **Title of course** Bio-Interfacial Phenomena and Surface Functionalization
4. **Description** (*from Course Description Bulletin*)
Description and principals of biomolecular building blocks and how they interact with surfaces, for application to biomedical research.
5. **Level** Graduate and upper level undergraduate
6. **Credits** 3
7. **Class Time Distribution** two times/week for 1.5 h each time
8. **Prerequisites** junior or senior undergraduate or graduate standing
9. **Quarters Offered** Summer
10. **General Information**
Previous exposure to biochemistry/polymer or material science would be helpful.
11. **Exclusions** Limited to senior undergraduates and graduates only
12. **Cross-Listings**
13. **Other Information**
14. **Course Objectives**
To introduce the physical and chemical properties of biomolecules and cells and how these govern their interactions, adherence and assembly at surfaces. To establish fundamental knowledge of the properties of surfaces and how to modify them for biocompatibility. To understand the techniques used for characterization of biomolecular assemblies and tests for their functionality. To learn the importance of bio-interfacial phenomenon in biomedical applications.
15. **Textbooks and Other Required Material**
The instructor will distribute copies of lecture notes and other relevant reading material as required.
16. **Topics** (*including approximate duration*)
Applications of Bio-Interfacial Interactions-(drug delivery, implants, biomedical devices, biosensors, tissue engineering, fundamental research etc) (1 lecture)

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Biomolecules and their physical and chemical properties-(proteins, lipids, nucleic acids, polysaccharides, etc.) (1 lecture)

Structure of the cell- (origin of the cell, organization, organelles, nuclei) (1 lecture)

The cell membrane- (amphiphilic lipids; types of membrane lipids; bilayer fluidity; mechanisms of transport across membranes; membrane proteins; vesicles and other bilayer structures) (1 lecture)

Techniques for cell membrane and transport studies- (patch clamp, microelectrode, electroporation, microscopic techniques, cell biochemistry) (3 lectures)

Basic thermodynamics and modeling of interfaces-(surface tension; contact angle; the Laplace equation; Young equation: adhesion and wetting) (2 lectures)

Types of interfaces and their surface characteristics- (polymeric, inorganic and biological surfaces) (3 lectures)

Interfacing of biomaterials (self-assembly, chemisorption, physisorption etc) (4 lectures).

Characterization of bio-interfaced surfaces (microscopy, spectroscopy, tests for functionality, etc) (1 lecture)

17. Representative Lab Assignments (*if applicable*)

N/A

18. Grading Plan

Homework (25%); Midterm exam (25%); Final Examination (50%)

19. Contribution to Meeting ABET "Professional Component" (*i.e., to ABET "mathematics and basic sciences, engineering topics, and general education"*) (*if applicable*)

N/A

20. Relationship to ABET-Accredited Program Objectives (*if applicable*)

N/A

21. Preparation Date 04/20/05

22. Preparer Name Gunjan Agarwal, PhD

23 Contact: Melanie Senitko (BME) : senitko.1@osu.edu

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Lecture Schedule: SU05, BME694

1.	Applications of interactions at biological interfaces	G. Agarwal
2.	Types of biomolecules, including amphiphilic molecules	G. Agarwal
3	Structure of the cell	G. Agarwal
4	The cell membrane	J. Rathman
5	Patch clamp, microelectrode and electroporation	C. Carnes
6	Analytical techniques for biomolecules	G. Agarwal
7	Biochemical analysis of cell surfaces	N. Parinandi
8	Types of interfaces: polymers	J. Lee
9	Types of interfaces: inorganics	Andreas von Recum
10	Types of interfaces: biological	Mark Ruegsegger
	Midterm Exam	
11	Basic thermodynamics of interfaces	J. Rathman
12	Fundamentals of modeling for interfacing of biomolecules	Terry Conlisk
13	Self-assembly of biomolecules at interfaces	G. Agarwal/J.Rathman
14	Tailoring of biomolecules for interfacing	Steven Lee
15	Chemical surface modification for biocompatibility	Susan Olesik
16	Physical surface modification for biocompatibility	John Lannutti
17	Characterization of biological interfaces	G. Agarwal
	Final Exam	