DYNAMICS OF BIOLOGICAL SYSTEMS

BIEN 159 – Winter 2018

Catalog Description

BIEN 159. Dynamics of Biological Systems (4)
Lecture, 3 hours; discussion, 1 hour.

Prerequisite(s): BCH 100 or BCH 110A. Covers engineering principles for the analysis and modeling of biological phenomena. Topics include molecular diffusion and transport, membranes, ligand-bioreceptor interactions, enzyme kinetics, and dynamics of metabolic pathways. Examines the application of these principles to the design of bioreactors, bioassays, drug delivery systems, and artificial organs.

Textbook
Dynamics of Biological Systems, 3rd edition, Michael Small
Notes, Jerome S. Schultz (provided as PDF)

Suggested Reference	Basic Transport Phenomena in Biomedical Engineering, Ronald Fournier, 3ed. CRC Press
Meeting times & locations:	Lectures – TR 11:10am - 12:30pm OLMH 421 Discussion – W 11:10am - 12:00pm MSE 103
Office Hours:	Dr. Freedman: MW 10am to 11am Bourns A211 (or by an appointment)
Contact Information:	Dr. Freedman: kfreedman@engr.ucr.edu TA – Shane Hoang shoan012@ucr.edu

Grading Scheme

Quiz	5%
Homework	20%
Project	10%
Mid-Term Exam	25%
Final Exam	40%

Course Schedule

Week	Dates	Topics	Exams/Project
1	01/09 -	Approaches to Modeling Biological Systems Concepts of response time and scale	
2	01/18 -	Multiple binding and Macromolecules Protein Binding Phenomena	
3	01/23 -	Introduction to Enzymes Enzyme Regulation and Pathways	
4	01/30 -	Diffusion Applications Diffusion Coefficients	
5	02/06	Diffusion, Membranes, Mass Transfer Coefficients Reaction and Diffusion	
6	02/13	Hindered Diffusion and Irreversible Thermodynamics	Mid Term 02/13
7	02/22	Edited Orders of Magnitude from Palsson UCSD	Project assigned
8	02/27	HBARTON pharmacokinetics	
9	03/06	Countercurrent Exchange	
10	03/13	Review Physics and Chemistry	
11			Final Exam

Introduction
- Approaches to Modeling Biological Systems
- Concepts of response time and scale

I. Biological Reactions
- Biomolecules
- Multiple Binding Sites -
- Forms of biopolymers
- Biochemical reactions

II. Diffusion and Mass Transfer
- Models for molecular mobility
- Mass Transfer

III. Diffusion and reaction - Coupled systems
- Bioreactors
- Immobilized enzyme reactors
- Cell Growth – Continuous Fermentors

IV. Extracoporeal Devices
- Hemodialyzers
- Blood Oxygenators
- Hybrid Systems