BioE 104: Biotransport

Instructor: Anand Subramaniam, PhD

Catalog Description: Biological Transport Phenomena is the quantitative description of momentum transport (viscous flow) and mass transport (convection and diffusion) in living systems. We will explore the similarities between the fundamental principles of momentum, heat, and mass transfer, develop analogies between the fundamentals that apply at microscopic and macroscopic scales, and use the fundamentals in conjunction with conservation laws to develop mathematical descriptions of physiological and engineering systems. Especial emphasis is placed on identifying assumptions that may be used in developing the mathematical descriptions.

Course Objectives: This course presents, through bi-weekly classes, an opportunity for students to explore a variety of techniques for applying conservation equations of mass and momentum to living and non-living systems and using advanced mathematical techniques for solving such problems. As such, this course addresses certain ABET outcome criteria at a variety of levels.

Specific Outcomes: By the end of the course, students should be able to:

1. Understand conservation of mass, momentum, and energy as applied to the flow of mass and fluids.
2. Use control-volume analysis to formulate governing equations for simple flow and mass transport geometries.
3. Analyze complex fluid flows via approximate analytical tools.
4. Derive appropriate conservation equations, select boundary conditions, and apply analytical and computational techniques to solve flow and mass transfer problems in biological and medical systems.
5. Estimate fluid behavior in compliant structures and unsteady flows.
6. Specify characteristics of fluid and mass transport components in bio/medical systems.

Outcomes Addressed by this Course:

A. An ability to apply knowledge of mathematics, science, and engineering.

E. An ability to identify, formulate, and solve engineering problems.

L. An understanding of biology and physiology.

M. The capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology.

Prerequisites: BIO 002: Introduction to Molecular Biology and MATH 024: Linear Algebra and Differential Equations and (PHYS 009: Introductory Physics II for Physical Sciences or PHYS 009H: Honors Introductory Physics II for Physical Sciences or PHYS 019: PHYS

019: Introductory Physics II for Biological Sciences) and BIOE 030: Introduction to Bioengineering and ENGR 057: Introduction to Bioengineering

Course Policies:

Academic Dishonesty Statement:

a. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work.

b. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e mail, an e mail attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.

c. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

Disability Statement:

Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

Topics (tentative):

	Day		**General Chapter from Fournier**	**HW**
Week 1	January 18	Introduction/Fundamental Concepts	Chapter 1	
Week 2	January 23		Chapter 1	PS 1
	January 25	Diffusive transport	Chapter 3	
Week 3	January 30		Chapter 3	
	February 1		Chapter 3	
Week 4	February 6		Chapter 5	PS 2
	February 8		Chapter 5	

Week 5	February 13		Chapter 5	
	February 15		**Midterm 1**	
Week 6	February 20		President's Day	
	February 22	Convective Transport	Chapter 4	PS 3
Week 7	February 27		Chapter 4	
	March 1		Chapter 4	
Week 8	March 6		Chapter 4	PS 4
	March 8		Chapter 4	
Week 9	Mar 13		Chapter 4	
	Mar 15		**Midterm 2**	
Week 10	Mar 20	Chemical Reactions + Advection	Chapter 6	PS 5
	Mar 22		Chapter 6	
Spring Break	Mar 27		Spring Break	
	Mar 29		Spring Break	
Week 11	Apr 3		Chapter 7	PS 6
	Apr 5		Chapter 7	
Week 12	Apr 10	Complex Transport in Tissues/Implants	Chapter 8	
	Apr 12		Chapter 8	PS 7
Week 13	Apr 17		Chapter 9	
	Apr 19		Chapter 9	
Week 14	Apr 24		Chapter 10	PS 8
	Apr 26		Chapter 10	
Week 15	May 1		Chapter 10	
	May 3		Review	
	May 10		Final Exam	

Class/laboratory Schedule: Monday, Wednesday, 9:30-11:20 am. COB2-170

Assessment/Grading Policy:

- 40% Homework (8 problem sets total)
- 15% Midterm#1 (in-class 60 minute exam)
- 15% Midterm#2 (in-class 60 minute exam)
- 30% Final Exam (in-class 110 minute exam)

You may replace (at most) one of your midterm scores with your score on the final exam. No makeup midterm exams will be given. The replacement policy accounts for situations where you might have to miss a midterm exam for any reason (illness, emergency, conflict with another activity), and rewards improvement in performance later in the semester. The score on the final exam cannot be replaced. Since the course grading, by design weights improvements later in the semester, no extra credit problems, or special accommodation will be given to improve your grade.

Homework: Problem sets are due in class at the end of class a week before the next problem set is assigned (see schedule).

1. Begin each question on a new sheet of paper

2. Write your name at the top of every page

3. Write the names of collaborating students at the top of the first page for each problem. Collaboration and group work is encouraged to enhance learning.

4. Show all work/calculations (i.e. numerical answers that do not show which formulas and/or calculations were used will not receive full credit, even if the answer is correct)

5. If you use Excel, MATLAB, etc. to answer a question print out your excel
6. sheet/MATLAB code/etc.

Homework Collaboration Policy:

1. List all students that worked together at the top of each problem.
2. .
3. Each student must write up his or her own solutions.

4. Failure to do this may result in the assignment being discounted, and possibly more serious consequences.

Late Homework Policy:

Homework handed in after the end of class will be considered late.

Lateness	**Total taken off HW score**
Same day (After HW is collected in class	20 %
2nd Day	40 %
3rd Day (Last day to hand in HW)	60 %

One lowest HW score will be dropped. As such, no extra credit problems or other accommodation will be given.

Teaching Fellow: Edwin Shen

Contact Information:

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