BIEN 105: Circulation Physiology
Winter 2018

COURSE OUTLINE

Course Time:	LEC (001): (MWF) 01:10 P.M. – 02:00 P.M.	Sproul Hall 1102
	DIS (021): (T) 2:10 P.M. - 3:00 P.M.	Sproul Hall 2355
	DIS (022): (F) 10:10 A.M. -11:00 A.M.	Olmsted 1212

Instructor: Joshua Morgan (215 MS&E) jmorgan@engr.ucr.edu
Office Hours: W 2:10 - 4:00 PM and by appointment (please email)

T.A.: Basil Baddour (Bourns B242) bbadd001@ucr.edu/basil.baddour@email.ucr.edu
Office Hours Th 3:10 - 5 PM

Textbook: *Transport Phenomena in Biological Systems*, George A. Truskey, Fan Yuan, David F. Katz, Prentice Hall (January 2, 2009), 2nd Edition, ISBN-10: 0131569880, ISBN-13: 978-0131569881

Topic Description:
Like all things in nature, biological processes also follow the conservation laws governing momentum, energy and mass. This is broadly classified as transport phenomena. Circulation physiology specifically addresses processes associated with the conservation of mass and momentum in biology. In this class, you will learn how to recognize, understand, and solve problems related to mass and momentum conservation. As bioengineers, fundamental grounding in the math and physics that underlie complex biological processes is essential. This course will contribute to that foundation.

Course Summary (from Course Catalog)
Introduces vector mathematics that describes the conservation of momentum and mass transport in biological systems; the cardiovascular system, and the pulmonary system. Topics include applied vector mathematics, constitutive equations such as Navier-Stokes, power-law and Casson models; significance of fluid stress in biological vessels, and the physiological relevance of fundamental parameters such as shear stress and vorticity. Emphasis is on the relation between function and system behavior.

Course Goals

1. You will be able to understand the basic governing momentum conservation equations and associated basic constitutive equations for describing biofluid processes.

2. You will be able to apply these governing equations to real biological systems and describe these systems mathematically, develop strategies to analyze the biofluid problem, recognize particular behavior of real processes, and recognize limitations in approximating the process.

3. You will have developed an ability to utilize practical and mathematical tools, an ability to logically think through biomechanical problems from conception to design, and be familiar with the relative significance of your results.

4. You will have had opportunities to further your professional development through practicing written and oral communication skills, working on group assignments, and using modern computer tools.

5. You will demonstrate confidence in assessing and developing basic mathematical/computational models of biomechanical problems using modern tools such as MATLAB and COMSOL.

6. AND, you will demonstrate professional accountability for your engineering design analysis.

Prerequisites
A background in engineering mathematics including vector calculus and statics is necessary. Since solutions will be obtained using numerical methods, working knowledge of computer manipulation and programming is helpful. Commercial computing tools such as MATLAB and COMSOL will be used extensively in the homework and projects. Therefore, students must obtain an engineering computer account.

Grading:
The grading will consist primarily of weekly homework assignments, two midterms, and two reports and one presentation of the one quarter-long continuous group project. The homework will be reviewed with the primary concern being effort, clarity, and professionalism. Consistent with this, homework is expected to be clearly laid out and on time. Late homework will not be accepted and will be assigned a 0 for the assignment. However, the lowest score of each student for the quarter will be discounted when calculating the final grade. Homework will be assigned on Fridays and will be due on the 2nd Monday (10 days).

Students have a responsibility for their own academic success, but are not alone in this process. In addition to my scheduled office hours, I will do my best to ensure availability to scheduled meeting and email questions.

The closed-book exams will be on the fundamentals of vector field theory and momentum transport as applied to biological systems.

The quarter-long project will be based on a biomechanics topic where the students (with approval) choose independent topics. It is expected that the students will be resourceful with projects using tools outside of those presented in this class if necessary. Presentations of the results, both written and oral, are essential parts of the grade.

Collaboration Policy
Any questions about homework problems or projects should be addressed to Professor Morgan. Discussion of homework problems and laboratories with other students in the class is acceptable and encouraged **<u>but direct copying of complete or part of an assignment is not allowed</u>**. Violation of this policy will result in a zero given for the homework set. Cheating on exams may result in an F grade given for the course.

Schedule

Week 1: Applications of Fluid Mechanics and Mass Conservation (Chapter 1)
NO DISCUSSION for Week 1

Week 2: Vector Mathematics and Partial Differential Equations (Notes)

Week 3: Introduction to the Conservation of Momentum and Fluid Flow (Chapter 2)

Week 4-5: Vector Representation of Momentum Conservation and Fluid Flow (Chapter 3)

Week 5-6: Analytical and Approximate Solutions to Complex Fluid Problems (Chapters 3 and 4)

Week 7: Conservation of Mass and Solute Transport (Notes and Chapter 7)

Week 8: Applications of Mass Conservation to Biological Systems (Chapter 6 and 7)

Week 9-10: Transport with Reactions in Biological Systems (Chapter 10)

Schedule and Grading Summary

Homework assigned Friday
Due the 2nd Monday (**100 pts** total)

Assign Project Groups	January 15, 2018
Project Pitch Due (**50 pts**)	January 24, 2018
1st Exam (**200 pts**)	February 14, 2018
Preliminary Project Report (**100 pts**)	February 19, 2018
2nd Exam (**200 pts**)	March 16, 2018
Project Presentation (**100 pts**)	March 21, 2018 (8:00 A.M. - 11:00 A.M.)
Final Project Report (**250 pts**)	March 20, 2018 (due by 11:59 P.M.)

TOTAL POINTS 1000