BMEn 4015 CAE of Biomechanical/transport Devices

1 Credit

Instructor: Ismail Guler

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Lectures: Time TBD, Location IT Instructional Computer Lab (TBD)

Office Hours: One hour following each lecture at IT Instructional Computer Lab

Course Goals and Objectives

1) Learn fundamentals of Computer Aided Engineering (CAE)
2) Gain hands on experience with a commercial CAE software
3) Use the CAE software to analyze transport and mechanics problems involving biomedical engineering and medical devices

Prerequisites

BMEn upper-division undergraduate and completion of BMEn 3011/15 (Biomechanics) and BMEn BMEn 3111/15 (Biomedical Transport Processes).

Required Materials

There is no required textbook for this course. The following reference materials are available either through the CAE software or the University of Minnesota Libraries online:

- Introduction to COMSOL Multiphysics
- COMSOL Multiphysics User's Guide
- COMSOL Multiphysics Reference Guide
- Computational Engineering: Introduction to Numerical Methods, Michael Schafer, Springer, 2006.
- An Introduction to Modeling of Transport Processes: Application to Biomedical Systems, Ashim K. Datta and Vineet Rakesh, Cambridge University Press, 2010.

Assignments and Projects

Homework assignments will mainly consist of analysis of biotransport and biomechanics related problems using the CAE software. They will be related to lectures and you will apply what you learn in class. Unless indicated otherwise, all assignments will have the same value. No credit will be given for homework submitted late.

A final project is required for the course. The final project will be on a transport or mechanics problem from biomedical engineering field. You are free to choose your project topic. You can look into the biomedical engineering literature for ideas. You are highly encouraged to discuss the selected topic with the instructor early in the project. A report for the final project is due on final exam day. A late project report won't be accepted. A poster presentation is also required on the final exam day. There won't be a final exam for this course.

Course meetings outside of class

There won't be any meetings outside of class.

Attendance Requirements/Penalties
Students are expected to be in class on time. They are highly encouraged to utilize the office hours as much as possible.

Statement on Extra Credit
There won't be any extra credit for this course.

Policy for makeup work
No make-up work will be offered unless approved by the instructor in advance.

Final Exam
There won't be a final exam for this course. Instead poster presentations for the final projects will take place on the final exam day.

Grading Policy

Homeworks	70%
Final Project	30%

The course will be graded using the scale below:

93-100: A	90-92.9: A-	
87-89.9: B+	84-86.9: B	81-83.9: B-
78-80.9: C+	75-77.9: C	72-74.9: C-
66-71.9: D+	60-65.9: D	<60: F

Depending on the overall performance of the class, the course grade may be based on a curve established by the instructor.

Lecture	Week	Topic
1	1	Course overview, An introduction to CAE for biomedical engineers
2	2	Anatomy and physiology of a CAE software, An introduction to COMSOL
3	3	Spatial discretization (an introduction to finite element method), Case study: Blood flow through a stented artery
4	4	Time discretization and verification of computational models, Case study: Drug release from a stent coating
5	5	Case study: Transmural fluid flow in an arterial wall (Darcy's equations for flow in porous media)
6	6	Element types and numerical integration, Case study: Drug transport in an arterial wall (convection, diffusion, binding)
7	7	Convergence and grid independence, Case study: Hemodynamics of a cerebral aneurysm treated by a flow diverting stent
8	8	Coupled problems, source terms, Case study: Thermo-electrical analysis of RF ablation of liver tumors, thermal damage
9	9	TBD
10	10	Case study: Torsion of a circular shaft, Stresses in driveshaft of a chronic total occlusion (CTO) device
11	11	Validation of computational models, Case study: Bending stiffness of a catheter shaft
12	12	Case study: Distension of an artery during cardiac cycle (arterial wall mechanics)
13	13	Nonlinear problems and linearization, Case study: Radial force analysis of a stent
14	14	Solution of linear algebraic system of equations, Case study: Fatigue analysis of a stent
15	15	TBD
Final	16	Final project report due and poster presentation during finals

Grade Definitions
Please see the University of Minnesota's Grading and Transcripts policy at
http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html

Student Conduct Code
Students in this course are expected to adhere to the University of Minnesota's Student Conduct Code:
http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf

Administrative Policy for Legitimate Absences
Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include illness of the student or his or her dependent, participation in intercollegiate athletic events. For other University of Minnesota policies regarding absences and makeup work, please see http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html

Board of Regents and Administrative Policy on Conduct, Teaching, and Learning
Please ensure that you are familiar with both the Student Conduct Code and Administrative Policy on Teaching and Learning:
http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html
http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf

Board of Regents Policy on Sexual Harassment
Please see this important information on the University of Minnesota's Policy on Sexual Harassment
http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf

Board of Regents Policy on Equity, Diversity, Equal Employment Opportunity, and Affirmative Action
Please see this important information on the University of Minnesota's Board of Regents Policy on Equity, Diversity, Equal Employment Opportunity, and Affirmative Action
http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf

Mental Health and Stress Management Services
Please know that as part of your experience here at the University of Minnesota, there are resources for you in time of stress. Please visit http://mentalhealth.umn.edu/ for several resources for students, their parents, faculty, and staff.

Board of Regents Policy on Academic Freedom
Please see this important information on the University of Minnesota's Board of Regents Policy on Academic Freedom and Responsibility
http://regents.umn.edu/sites/default/files/policies/Academic_Freedom.pdf