

Course Outline (v. 1.1)
Biophysical Phenomena: Fluid and Mass Transport (and Heat Transfer)
BE-382 (section 001), Winter 2008-2009

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Office Hours: M-Th 9:00 to 10:00, Tu & Th 1:00 to 2:00, other hours by appointment.
Textbook: Fundamentals of Thermal-Fluid Sciences, 3rd ed. Cengel, Turner, & Cimbala. McGraw-Hill. 2008.
Prerequisites: BE-381
Course Room: S-359
Course Times: Monday-Thursday 8:00-8:50pm.
Final Exam: Monday, February 23, 8:00-10:00 am.
Course Materials: Visit <http://people.msoe.edu/~tritt/be382> and my faculty out box on MSOE's m: drive for course materials.

Course Description and Objectives: This course is a continuation of BE-381, in which thermodynamics and introductory fluid mechanics were covered. Upon completion of this course, students should be able to:

- Define viscosity and describe Newtonian fluid behavior.
- Calculate vorticity for a flow field and describe its significance.
- Use the overall momentum balance to relate pressures, velocities, and external forces associated with control volumes.
- Differentiate between laminar and turbulent flows and describe where each is encountered in the human body.
- Apply the concept of flow resistance to solve pipe network problems.
- Define the different types of forces that fluid flow imparts on solid bodies and use correlations to estimate these forces for common geometries.
- Describe the rheological properties of blood.
- Determine the best method for flow measurement in a given situation.
- Set up classic and biomedical engineering problems using the continuity and Navier-Stokes equations and solve simple cases.
- Set up classic and biomedical engineering problems using differential mass and energy balances and solve simple cases.
- Use computers to solve physiological multi-compartment transport models.
- Apply constitutive relations related to mass diffusion and heat conduction.
- Describe the steps necessary to solve differential balances using numerical solutions.
- Solve simple problems involving conductive heat transfer.
- Solve simple problems involving convective heat transfer.
- Design heat and mass exchangers to meet specified requirements.

Grading (approximate weights):

Homework	16%
Computer Projects	12% (total)
Midterm Exams	42% (3 exams, 14% each)
Comprehensive Final	30%

Tentative BE-382 Course Outline:

Week	Day	Date	Chapter	Topic
1	1	12/1	9	Review of Introduction to Fluid Phenomena
	2	12/2	11	Fluid Kinematics
	3	12/3	11	Fluid Kinematics
	4	12/4	13	Integral Momentum Balance
2	1	12/8	13	Integral Momentum Balance
	2	12/9	13	Integral Momentum Balance
	3	12/10	14	Internal Flows
	4	12/11	14	Internal Flows
3	1	12/15	14	Internal Flows
	2	12/16	none	Properties of Blood and Cardiovascular Flows
	3	12/17	none	Flow Measurement
	4	12/18		Midterm Exam I (Chapters 11, 13, 14*)
<i>Holiday Break</i>				
4	1	1/5	15	External Flows
	2	1/6	15	External Flows
	3	1/7	none	Intro to Differential Analysis, Continuity Equation
	4	1/8	none	Intro to Differential Analysis, Continuity Equation
5	1	1/12	none	Differential Linear Momentum Balance, Navier-Stokes
	2	1/13	none	Differential Linear Momentum Balance, Navier-Stokes
	3	1/14	none	Navier-Stokes Applications
	4	1/15	none	Navier-Stokes Applications
6	1	1/19	none	Diff. Component Mass Balance, Membrane Transport
	2	1/20	none	Diff. Component Mass Balance, Membrane Transport
	3	1/21		Midterm Exam II (Chapter 15, Differential Balances*)
	4	1/22	none	Compartmental Modeling
7	1	1/26	16	Mechanisms of Heat Transfer
	2	1/27	16	Mechanisms of Heat Transfer
	3	1/28	none	Differential Energy Balance
	4	1/29	none	Numerical Solutions of the Differential Balances
8	1	2/2	17	Steady Heat Conduction
	2	2/3	17	Steady Heat Conduction
	3	2/4	18	Transient Heat Conduction
	4	2/5	18	Transient Heat Conduction
9	1	2/9	19	Forced Convection
	2	2/10	19	Forced Convection
	3	2/11		Midterm Exam III (Chapters 16, 17, 18, 19*)
	4	2/12	20	Natural Convection
10	1	2/16	20	Natural Convection
	2	2/17	22	Heat Exchangers
	3	2/18	22	Heat Exchangers & Mass Exchangers
	4	2/19	none	Cooling of Electronics

**Note: Exact coverage for Midterm Exams will be announced in class.*

Homework:

Homework will be assigned throughout the course. You are allowed to collaborate with your classmates on assignments, but you are not allowed to copy their completed solutions (verbatim or otherwise). You are also not allowed to use any other prepared solutions from previous students or elsewhere. Each homework submission must include a completed and signed *Homework Resource Disclosure Form*. These forms can be downloaded from the course website and will be available from the instructor on request. Homework assignments will not be accepted without one of these forms (or a reasonable facsimile).

Late Policy:

Late homework and projects will be penalized 10% if submitted within one day of the submission deadline, 20% if submitted within two days of the deadline, etc. up to a maximum of 50% penalty. Assignments will be accepted until the start of the final exam. Under normal circumstances, homework will be graded and returned within two days of submission.

Attendance:

Attendance records will not normally be kept. You are responsible for *all* announcements made during class if you miss. You will receive zero points for in-class assignments if you are absent (whether excused or not). Make-up exams will only be given under extenuating circumstances and if pre-arranged.

Class Conduct:

Laptops are not permitted in class, except during announced laptop activities. You will receive a deduction of up to 10 points from your earned in-class assignment points for any of the following violations:

- Use of a laptop when not permitted or for uses other than the specified activity when permitted
- Use of a cell phone or ringing of a cell phone (one warning for the latter)
- Ringing of a cell phone during an exam
- Conduct that is disruptive to the class, as judged by the instructor

Miscellaneous:

- If you stop attending class, I will not drop you from the course; it is your responsibility to do so.
- If you have questions about grading, please report them to me immediately. I will only adjust grades if I have marked yours inconsistently relative to the rest of the class.
- Exams will be closed book and notes; however, you will generally be allowed to use a single 8.5" by 11" crib sheet. Any necessary charts or tables will be provided.
- Supporting material for the course, including lecture note worksheets, will generally be made available online through the course website or my network faculty outbox. Please let

me know ASAP if you have any trouble finding or accessing this material. You can test it today by looking for this syllabus.

- Please bring your textbook and calculator to class each day. We will have many problem-solving sessions in class that make heavy use of tables in the book.

Student Integrity Policy (as stated in the MSOE Handbook):

The expectations of the university with respect to academic and classroom integrity are reflected in, but not limited to, the following guidelines:

- 1) The student must recognize that even a poorly developed piece of work that represents his or her best efforts is far more worthwhile than the most outstanding piece of work taken from someone else.
- 2) Assignments prepared outside of class must include appropriate documentation of all borrowed ideas and expressions. The absence of such documentation constitutes “plagiarism,” which is the knowing or negligent use of the ideas, expressions or work of another with intent to pass such materials off as one’s own.
- 3) The student should consistently prepare for examinations so as to reduce temptation toward dishonesty.
- 4) A student may not share examination answers with others for the purpose of cheating, nor should he or she, through carelessness, give them an opportunity to obtain them.
- 5) The student should know that a person of integrity will not support, encourage or protect others who are involved in academic dishonesty in any way, and will furthermore attempt to dissuade another student from engaging in dishonest acts.

Acceptance of this responsibility is essential to the educational process and must be considered as an expression of mutual trust, the foundation upon which creative scholarship rests. Students are directed to use great care when preparing all written work and to acknowledge fully the source of all ideas and language other than their own.

In cases of alleged academic dishonesty, procedures involving the student, the instructor, the department chair, and a Board of Review have been established to assess the facts and determine the appropriate penalties. For further information on the policy please see the MSOE Academic Catalog.