BE 4352: TRANSPORT PHENOMENA IN BIOLOGICAL ENGINEERING

2008-09 Catalog Description: Introduction to biological kinetics; time-temperature-substrate-dependent growth and death of biological organisms; heat and mass transfer in engineering design and analysis; principles of material and energy balances in reactor design.

Credit: 3 hr Credit (lecture).

Prerequisites: BE 2352, BIOL 2051; credit or registration in CE 2200 and ME 3333

Required Textbook: None required. A notes booklet (sold through LSU Union/Paw Prints) or partial notes will be passed out before each class. Material may also be posted on Blackboard.

References:

Datta, A.K. 2002. Biological and Bioenvironmental Heat and Mass Transfer. Marcel Dekker, Inc., New York, NY. ISBN: 0-8247-0775-3*.

Bailey, J., and Ollis. D. 1986. Biochemical Engineering Fundamentals. 2nd Edition, McGraw-Hill, New York, NY. ISBN 0070032122.

Tchobanoglous, G. and Burton F.L. 1991. Wastewater Engineering: Treatment Disposal and Reuse, Metcalf and Eddy Inc. 3rd edition. McGraw-Hill, New York, NY. ISBN 0070416907.

Drapcho, Caye. 2003. Lecture notes developed at LSU for BE 4352.

Campbell, G.S. and Norman, J.M. An Introduction to Environmental Biophysics (2nd Ed). Springer-Verlag, New York, NY. ISBN: 0-387-94937-2.

Class Schedule: **Lecture:** 12:10–1:30 P.M. T, TH; Room 213, Tureaud Hall

Instructor:

Chandra S. Theegala, Associate Professor
Biological and Agricultural Engineering
Office Location: Room 161, E.B. Doran Bldg.
Office Phone: 225-578-1060
Office Hours: 1:30 PM – 2:30 PM Tuesday
11:30 AM – 1 PM Wednesday
Other times are ok – Please schedule before you come.
E-mail: theegala@lsu.edu

Purpose of the Course

This is a Junior/Senior/Graduate level course designed to help the students learn the basics of biological kinetics and apply the principles of material and energy balances in reactor design. The students will also learn the concepts of heat/mass/energy transfer (or balances) that are pertinent to

the biological engineering curriculum. The class project is anticipated to provide an opportunity for students to have hands-on experience on a transport related problem.

Course Objectives:

1. To develop and understanding of biological kinetics and time-temperature-substrate-dependent growth and death of biological organisms
2. To understand and master the principles governing heat and mass transfer in biological systems
3. To understand the principles of material and energy balances in reactor design
4. To allow students to apply gain hands-on experience on the relevant transport problem (via class project).

BE 4352 Course Topics and Class Schedule*:

Week of	Lecture Topics
1/12/09	Course Introduction Transport Definition, Mass Balances, Rate Basis, Problems
1/19/09	Mass Balance Problems Chemical Kinetics – For Mass Balance Computations
1/26/09	Biological Kinetics, Modeling Approaches Growth and enzyme kinetics, computations from experimental data
2/02/09	Biological - MBE Related Topics and Problems
2/09/09	Temperature Dependent Growth Biological Heat Generation
2/16/09	More Biological Topics, Thermo Review, Exam 1 Review **Exam 1 – February 19th (Thursday during class)**
2/23/09	*Feb 23-25 – Mardi Gras Holidays (No Tuesday Class)* Energy and Energy Balances, Heat Transfer Modes
3/02/09	1-D Steady State and Non-Steady State Conduction and Problems 1-D Composite Material Conduction and Insulation Topics/Problems
3/09/09	Fourier' Law, 1-D Conduction in Radial Direction Convection and Related Topics, Project Topics, Project Report Guidelines
3/16/09	Combined Conduction and Convection (including radial) 3-D Diffusion –Derivation
3/23/09	Diffusion Related Problems, Exam Review **Exam 2 – March 26th (Thursday during class)**
3/30/09	1-D Transient Conduction/convection – Heisler 1-D Transient Lumped Capacitance Approach 1-D Transient – Semi-Infinite Approach Related Problems
4/06/09	*April 6-12 – Spring Break (No classes this week)*
4/13/09	Convection Analysis – Forced and Free Related Convection Problems Radiation and Related Topics/Problems
4/20/09	Project Presentations. Mass Transfer
4/27/09	Mass Transfer, Mass Transfer Modes and Boundary Conditions Problems, Transient Mass Transfer – Heisler and Semi-Infinite Approaches and

	Problems. Final Exam Review. *May 2nd - Last Day of Class.*
Final Exam	**Saturday, May 9th, 2009; 10:00 AM -12:00 Noon**

*Note: Instructor reserves the right to alter the schedule during the course of the semester. The instructor also reserves the right to modify the course content to include a lab or advanced topics (such as transport through membranes). However, any alterations will be clarified in the class.

Important Dates to Remember in Spring 2009:
Jan 20: Last day to drop w/o "W" grade.
Jan 22: Last day to add courses for credit and making section changes.
Mar 27: Last day for dropping course (with "W") and/or resign from university.

Exam Schedule:

Tentative Dates for Exam I and Exam II *(can change slightly based on class coverage)*
Exam I: ***February 19th, 2009.***
Exam II: ***March 26th, 2009.***

According to Spring 2009 Class Schedule (for Class Periods of 12:00-1:30 PM, T, TH)
Final Exam Time: Saturday, May 9th, 2009; 10:00AM - 12:00 Noon

Grading Policy:

1.	Homework(s), Quizzes (announced and un-announced) and Attendance/Participation@)	20%
2.	Exam I	20%
3.	Exam II	20%
4.	Project Report/Presentation# (group)	15%
5.	Final Exam (comprehensive)	25%
	**********	
	Total	*100%*

@ *More emphasis will be on quizzes, followed by homework and attendance/class participation. Some or all homework assignments will be graded for completion only and the key will be discussed in class or posted on blackboard.*

\# *Limited funds are available for projects. Please check with instructor before planning a project.*

Grading Scale:

90 - 100%	A
80 - 89%	B
70 - 79 %	C
60 - 69 %	D
Below 60%	F

Course Policies:
Attendance/Class Participation Policy: Attendance is expected. Regular lateness will not be allowed, unless you have a valid excuse. Attendance and class participation accounts for 5% of

grade (at instructor's discretion). I am expecting active class participation and just not your presence (*remember that nappers count as absent)*. I am expecting you not to browse the internet or attend to other pending issues (like assignments from other classes). I am expecting you to bring your calculator and work out the problems in class. Keep in mind that this 5% can make a grade difference. Attendance grades will be as follows:

1-2 lates/absents per semester with good class participation (no disturbance)	+5
3-4 lates/absents per semester with good class participation (no disturbance)	+ 4
5-6 lates/absents per semester with good class participation (no disturbance)	+2
>7 lates/absents per semester with good class participation (no disturbance)	0

I strongly encourage you to let me know via email if you are going to miss a class. Letting me know in advance is very important. I will assign you a "P" (for permission). Although a "P" is not considered present, it will allow you to take a makeup quiz (if given on that day) or get a copy of class notes/handouts.

Submission Policy: Homework assignments and project report must be turned in on or before the due date announced (usually before the beginning of a class period). The format for the project report will be discussed in class (see class schedule). Homework assignments may be graded for completion only. I do not accept late homework. Penalty for late submission of project report will be 5% for each working day (valid until final exam date).

Make-up Exam/Quiz Policy: No make-up exams or quizzes will be given for the scheduled exams/quizzes unless the student has a legitimate excuse documented properly (e.g. letter from court clerk that he/she must appear in a court, or a letter from a physician stating that he/she is/was sick). If you know that you will be missing a class, let me know in advance. If (If) I decide to give a makeup for someone without a valid excuse, it will be graded to a lower maximum score (like 80 or 85%). In such cases, be prepared for a longer (more questions) make up exams and quizzes. This measure is to dissuade students from deciding not to take the exam in the last minute (just because they are not well prepared). Look at the examples below. The first student demonstrates responsibility and is likely to get a take a make-up. I personally feel that giving a make-up exam without any penalty for the second situation is not fair for students who took the exam at the scheduled time (even though they may not be fully prepared).

Situation 1: Student has a presentation/medical procedure/wedding that he/she has to attend/undergo on Feb 19th. He/she let me know 2 weeks ahead and discusses the option of taking the exam early or taking a make up exam.
Situation 2: Student does not show up for exam. Sends an email the night before or during exam time and does not have any legitimate reason for missing the exam.

Graduate Students: Graduate students will be required to prepare a relevant presentation and/or handout that will be useful for the entire class. Depending on the topics of the graduate students' lectures, the instructor will decide if that particular material is valid for the exam.

Academic Misconduct Policy: Cheating and plagiarism will not be tolerated. The Code of Student Conduct defines cheating and plagiarism. I suggest each of you obtain a copy of this document and be familiar with its contents (http://www.lsu.edu/judicialaffairs/code.htm). If you

have any questions/concerns about plagiarism, feel free to ask me. It is my professional, ethical obligation, as a faculty member to uphold its standards. I take this responsibility seriously and will forward the case to respective officials at LSU.

Disruptive Behavior Policy: Absolutely no cell phones and pagers. Avoid going in and out during class. Any behavior that will disturb the attention of fellow students or instructor should be avoided. Additional points (beyond the allocated 5% for attendance) will be taken of for students who disturb the class (cell phones, talking during class, etc).

Contact Numbers (While in Laboratories Working on Projects):
Campus Safety: 578-5640
Emergency Help: 578-4357
Dr. Theegala: 578-1060
Mr. Anna Charron: Teaching Associate, Room 102-B3, Ag Metal Bldg.
Phone: 578-4430; Email: anna.charron@bae.lsu.edu)

Other Helpful Information (to understand the instructor and get better grade)

- Use a 1" or 1.5" ring binder for keeping class material.
- Focus on coverage in class. All tests will be based on the material covered. Study guide for each exam will be handed to you.
- Try to understand the concept. Not just the problem at hand.
- Do not feel shy to ask a simple or basic question. I strongly believe in proper foundation. (my views on this subject).
- Turn all homework assignments and project report on time.
- Do not count on curving at the end (jump clear). Do not shoot at the low end of a particular grade (Example: shoot for 95 or higher instead of 90 for an A).
- Keep track of your grade. See grade calculator from last year. You will get an email of the actual calculator I will use this semester at a later date (in April). Also, you are required to keep graded quizzes, homework assignments, exams till the semester is over. It is your responsibility to keep it till the end of the semester.
- Every single point counts and will add to your grade. So pay attention to homework assignments, quizzes, exams, project report/presentation, and attendance.
- Understand the instructors teaching philosophy (will discuss in class).
- About instructor grading philosophy and grades in the past (will discuss in class, pay attention)
- Moodle/emails will be used for this course. So learn to use it (announcements, downloading course material, discussion forums, etc). Make sure Moodle has your correct email address.
- I cannot overstress the importance of coming to class. I will try my best to make you understand the numerous equations (see the final exam equation sheet from 2008 Spring)

Open Discussion
My research topics