

ChE 475 – Introduction to Bioprocess Engineering – Fall 2005
Sloan Hall Room 161 – 9:10 to 10 AM MWF

Instructor:

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Office Hours:

Afternoon open door and by appointment

Main Text:

Bioprocess Engineering Basic Concepts 2nd Edition by Michael L. Shuler and Fikret Kargi, Prentice Hall (www.phptr.com)

Supplemental Texts:

1. Bailey and Ollis, Biochemical Engineering Fundamentals, 1986, 2nd ed., McGraw-Hill Book Co., N.Y.
2. James Lee, 1992, Biochemical Engineering, Prentice Hall.
3. Madigan et al., 2003, Brock Biology of Microorganisms, 10th ed. Prentice Hall.
4. T. A. Brown, 2001, Gene Cloning and DNA analysis, 4th ed. Blackwell Science.
5. David White, The Physiology and Biochemistry of Prokaryotes, 2nd ed. Oxford University Press, New York.

Technical Journals:

Applied and Environmental Microbiology, Applied Microbiology and Biotechnology, Bioresource Technology, Biotechnology and Bioengineering, Biotechnology Progress, CRC Critical Reviews in Biotechnology, Developments in Industrial Microbiology, Enzyme and Microbial Technology, Environmental Science and Technology, World Journal of Microbiology and Biotechnology, Journal of Applied Chemistry and Biotechnology, Journal of Chemical Technology and Biotechnology, Nature, Nature Biotechnology, and Science etc.

Course Objectives:

One of the objectives of this course is the integration Biological Sciences with Chemical Engineering. At the completion of the course, you should be able to:

1. Discuss biological processes (microbial, plant, and animal cell cultures)
2. Understand the principles of enzyme and cell kinetics
3. Understand the principles of genetic engineering
4. Apply chemical engineering principles to biological processes
5. Design bio-reactors and optimization of various parameters for the production of useful bio-products, and recovery and purification of products

Finally you will be able to understand roles of biochemical engineers in Biotechnology

| Week | Dates | Topic | Reading |
|-------------|------------------|---|---|
| 1 | Aug 22 to 26 | Introduction: Biochemical Engineering and Biology Basics (Typical Bioprocessing, Prokaryotes and Eukaryotes, and Biomolecules) | Chapters 1, 2, and Supplemental Text |
| 2 – 4 | Aug 29 to Sep 16 | Enzyme Nomenclature; Enzymes Kinetics; Allosteric Enzymes; Enzyme Inhibition Kinetics (Competitive, non-competitive, Uncompetitive, and Substrate Inhibition); pH and Temperature effects; Immobilization, and Industrial Application of Enzymes | Chapter 3 and Supplemental Text |
| 5 – 7 | Sep 19 to Oct 7 | Genetic Engineering (Construction of a Recombinant DNA Molecule, Transformation, Selection of a Desired Clone, Polymerase Chain Reaction, and DNA sequencing); Metabolic Pathways (Structures of DNA and RNA; Mechanisms of DNA Replication, Transcription, and Translation; Metabolic Regulation; Glycolysis, TCA cycle, Respiration, and Fermentation) | Chapters 4, 5, and 8 |
| 8 – 10 | Oct 10 to Oct 28 | Cell Growth Measurement, Cell Growth Kinetics, Effects of Environmental Conditions of Growth Kinetics, Batch and Continuous Cell Culture Growth Kinetics; Stoichiometry of Microbial Cell Growth and Product Formation | Chapters 6, 7, and Supplemental Text |
| | Nov 2 | Midterm 1 (Chapters 1 to 5 and 8) | |
| 11 - 13 | Oct 31 to Nov 18 | Bioreactor Design (Batch Vs CSTR, Chemostat with recycle, Multistage Chemostat Systems, Fed-batch operation), Basic Type of Reactors, Sterilization, Aeration, Agitation, Scale-up and Recovery and Purification of Products (Filtration, Centrifugation, Cell Disruption, Liquid-liquid extraction, Precipitation, Dialysis, Ultrafiltration, Microfiltration, and Chromatography) | Chapters 9, 10, 11, and Supplemental Text |
| 14 | Nov 21 to Nov 25 | Thanksgiving! | |
| 15 | Nov 28 to Dec 2 | Introduction to Animal and Plant Cell Cultures | Chapters 12 and 13 |
| 16 | Dec 5 to 9 | 10 minute individual in-class presentations on special projects | |
| 17 | Dec 14 | FINAL EXAM | |

The topics indicated are guide. Topics may take longer or less time to cover.

Examination and Final Grade:

Two mid-term examinations, unannounced quizzes, and a 10 minute individual in-class presentation on special projects are planned. No excuses for missed exams will be accepted other than certified medical excuses. The approximate contribution to the term grade is as follows:

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| Homework* | 150 |
| Unannounced Quizzes | 50 |
| Mid-term Exam | 100 |
| Final Exam | 100 |
| Special Projects [#] | 50 |

*Homework is due in class. Use engineering or plain paper, one side of each page. Put your name at the top right corner of the first page and staple it at the top left corner (Do not fold). Late homework will not be accepted unless it is arranged with me in advance.

[#]One 50 point special project will be assigned. It will require library/on-line research to produce a 3 page paper that includes an introduction, methods, discussion, and conclusions. This 3 page paper must be submitted to me in advance and presented in class (10 minute presentation).

About Mid-term and Final Exams:

Terminology and concepts, and numerical problems. Closed book. 50 minutes. GOOD LUCK!

Finally:

Suggestions for improvements to class format, teaching style, or content are highly welcomed!