CHE 449 – Bioseparations

Spring 2012

Classes: Mon, Wed & Fri, 11:15 – 12:05, Fenske 140

Course Website… ANGEL

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Required Text: *Bioseparations Science and Engineering*
Todd, Harrison, Rudge, and Petrides

Course Objectives:

The overall objective of this course is to provide students a solid background in the principles and applications of important technologies used for the separation and purification of biological products, ranging from small primary metabolites and biopharmaceuticals to recombinant proteins. By the end of the course students will be able to:

1. Appreciate the complexity of biological samples and the ever-growing need for efficient separation processes to economically recover bioproducts
2. Understand the physical parameters governing mass transfer and extend this understanding to the separation of biological mixtures
3. Identify the relevant properties of a biological mixture leading to the appropriate choice of unit operation for effecting separation / Understand the relevant design parameters of each unit operation
4. Perform design and scale-up calculations for specific separations including centrifugation, filtration, chromatography, extraction, precipitation and membrane processes
5. Understand the experimental data required to design and scale-up a separation process. Provide a general experimental strategy for obtaining such data
6. Develop outlines of overall separation schemes that could be used to achieve the required removal of key impurities and contaminants

Approximate Course Grading Outline

Problem Sets:	approx biweekly	~ 20%

Problem sets are primarily to be used as study tools, reflecting the types of questions that will show up on the exams. Attempting to solve the problem sets in a timely manner will help you to identify topics you are not clear on. They will be due on Fridays a week from when it is assigned. **Groups of three will be assigned that will work on homework assignments throughout the semester.** This will help you get prepared for the group dynamics in team projects common in most companies and research groups. There will be a mid and end-term survey of group participation where you can provide input on your group

members in order to provide accountability. Request for changes in group assignment will not be considered unless there are extenuating circumstances.

Exams: Exams will be based on material covered in lectures, textbook, handouts, and homework. There will be two exams and a final exam, the final exam counting substantially less than the others. The final will be not comprehensive and only cover materials covered towards the end of the semester but could include materials from presentations of your classmates. This is to allow more time for teams to focus on and work on the end of semester project.

Exam 1— on or around February 17th	~ 25%
Exam 2— on or around March 30th	~ 25%
Final Exam – Scheduled by University	~ 10%

These dates and times need to be confirmed and room locations determined. Firm times and locations will be announced in class and via Angel mail. Review sessions will be scheduled the evening before each exam

Final Project and Presentation: end of term ~ 20%

A course project will be assigned mid-semester and due on the last day of classes. Students will work in groups of 6 (two groups will be combined into one and here the two groups get to decide who they team with), with one written report and a class presentation required. Groups will be assigned based on your answers to the "First Day Survey." Grades will be assigned based on the accuracy and presentation quality of the final report.

Comments:

Late assignments will not be accepted since homework solutions will be made available after class period in which assignments are due.

Students should feel free to ask for help while working on the problem sets. Solutions to problem sets should be truned in as group efforts but an assigned group may not copy work from other groups. Solutions which are copied from another group / student will be considered as plagiarism and will be handled accordingly.

Please do not hesitate to ask for additional clarification on these policies at any time during the semester.

General Course Outline

1. Introduction to Bioprocessing **Text**

- Overview of biological products
  - biological products (metabolites, proteins, etc) Chapters 1 & 11
  - impurities and contaminants Chapter 2
- Overview of separation processes
  - classification of separation processes ---
  - physical basis for separations ---

2. Case Studies (note: not all of these may be covered depending on availability of time and hwo indepth we go into each case study.

a. Penicillin (antibiotic)

b. Herceptin (monoclodal antibody)

c. Erythrocytes (red blood cells)

d. Zoloft (chiral anti-depressant)

e. Insulin (hormone)

f. Gardasil (vaccine)

g. Artemisinin (malaria treatment)

Unit Operations Summary

1. Primary Recovery – Cell Removal

- centrifugation (batch and continuous) Chapter 5
- filtration (dead-end and rotary) Chapter 4
- crossflow microfiltration Chapter 4
- cell lysis / rupture Chapter 3

2. Product Isolation - Concentration

- extraction Chapter 6
- precipitation Chapter 8
- crystallization Chapter 9
- ultrafiltration ----

3. Product Purification

- chromatography (bind-and-elute, flow-through, and differential) Chapter 7
- high performance tangential flow filtration ----
- electrophoresis ----

4. Product Formulation

- virus clearance (removal and inactivation) ---
- sterile filtration ---
- ultrafiltration and diafiltration ---
- drying Chapter 1