Texas A&M University
Departmental Request for a New Course
Undergraduate • Graduate • Professional
• Submit original form and attach a course syllabus.

1. This request is submitted by the Department of Biological and Agricultural Engineering

2. Course prefix, number and complete title of course: BAEN 631: Bioprocesses and Separations in Biotechnology

3. Course description (not to exceed 50 words):
Application of engineering principles to recovery and purification of biological compounds derived from cell grown in bioreactors, transgenic animals, and plants. Process development, design, and scale up of downstream processes used in biotechnology and pharmaceutical industry. Emphasis on extraction, sedimentation, membrane filtration, precipitation, and liquid chromatography.

4. Prerequisite(s):
Senior classification in engineering, G7, G8, or approval of instructor

Cross-listed with:

5. Is this a variable credit course? □ Yes □ No If yes, from ______ to ______

6. Is this a repeatable course? □ Yes □ No
   Will this course be repeated within the same semester? □ Yes □ No
   If this course may be taken ______ times.

7. Has this course been taught as a 489/689? □ Yes □ No If yes, how many times? 2
   Indicate the number of students enrolled for each academic period it was taught: 3, 11

8. This course will be:
   a. required for students enrolled in the following degree program(s) (e.g., B.A. in history)
   b. an elective for students enrolled in the following degree program(s) (e.g., M.S., Ph.D. in geography)

BS, MS, Ph.D. in any engineering field and MS, Ph.D. in BIOT

9. If other departments are teaching or are responsible for related subject matter, the course must be coordinated with these departments. Attach approval letters.

10. Prefix Course # Title (excluding punctuation)
    
    | BAEN | 631 |
    | BIO | PRC S | SEP | BIOTE C |
    | Lect. Lab SCI CIP and Fund Code | Admin. Unit | Aead. Year | FICE Code |
    | 03 00 031 4030100060 043309 - 10 00 3632 |

Approval recommended by: Head of Department Date
Head of Department (if cross-listed course) Date

Submitted to Coordinating Board by: Associate Director, Curricular Services Date

Questions regarding this form should be directed to Sandra Williams at 845-8201.
Curricular Services – 11/07
Bioprocesses and Separations in Biotechnology

BAEN 631
Spring 2009

TR 11:10-12:25
COURSE INFORMATION

<table>
<thead>
<tr>
<th>Instructor:</th>
<th>E-mail Address</th>
<th>Telephone</th>
<th>Office Location</th>
<th>Office Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Zivko Nikolov</td>
<td><a href="mailto:znikolov@tamu.edu">znikolov@tamu.edu</a></td>
<td>458-0763 (O)</td>
<td>Scoates 303F</td>
<td>by appointment</td>
</tr>
</tbody>
</table>

Course Web Site:
http://elearning.tamu.edu/

Prerequisite:
Senior classification in engineering, G7, G8, or approval of the instructor

Reference Texts:
Bioseparations Science and Engineering,
R.G. Harrison, P. Todd, S.R. Rudge, D.P. Petrides

Course Description:
Application of engineering principles to recovery and purification of biological compounds derived from cell grown in bioreactors, transgenic animals, and plants. Process development, design, and scale up of downstream processes used in biotechnology and pharmaceutical industry. Emphasis on extraction, sedimentation, membrane filtration, precipitation, and liquid chromatography.

Course Goals:
- To provide students with an overview of important industrial and novel bioprocesses
- To enable the student to analyze the mechanisms by which separation occurs
- To equip students with a tool to analyze bioprocesses (SuperPro Designer)
- To provide an opportunity for the student to demonstrate knowledge by effectively communicating what they have done in writing

Course Grading:
HWs 20%
Exams (2) 40%
Project assignments 10%
Term Project 30% (Final oral and written report)

Grading Scale
A – 90-100
B – 80-89
C – 70-79
D – 60-69
F – 59 and below
Homework: Homeworks may be discussed with others but have to be independent efforts. Group assignments will be submitted as a single assignment for each group.

Exams: The exams and term projects must be independent and original efforts. Make-up exams will be allowed only for university excused absences. The instructor must be notified prior to the exam for absences other than emergency illness or injury.

Academic Honesty: Aggies do not lie, cheat or steal; nor do they tolerate those who do. The policies of Texas A&M University will be followed in regard to academic dishonesty.

Americans with Disabilities Act
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, in Cain Hall, Room B118, or call 845-1637. For additional information visit http://disability.tamu.edu.

TENTATIVE COURSE OUTLINE

Week 1-2: Review of Industrial Bioprocesses
1. Introduction to bioseparations (downstream processing)
2. Introduction to process design

Week 3-4: Basic phenomena and mechanisms
1. Physico-chemical properties of biomolecules
2. Rate-controlled processes
3. Equilibrium controlled processes

Week 5-7: Separations from solids
1. Solid-liquid separation processes
2. Filtration
3. Sedimentation and centrifugation

EXAM I

Week 8-11: Separations from liquids
1. Membrane separations (proteins isolation and concentrations, water purification, etc.)
2. Adsorption (pharmaceuticals, organic molecules, blood proteins, whey proteins)
3. Precipitation (proteins, organic acids and soy protein isolates)
4. Crystallization (sugars, proteins and salts)

Week 12-13: Process analysis
1. Process integration
2. Process design
3. Process cost
WEEK 14: Project reports
Student Presentations
EXAM II

TERM PROJECT:

Term project will include developing a design of an integrated bioprocess using SuperPro Designer. Students have to learn by themselves how to utilize the bioprocessing software in order to perform assigned process design and cost analysis.

Each student will prepare a written report of 6-8 pages (typed, double-spaced) of text in length on a process approved by the instructor. An oral presentation (20-25 min) to the class will be required and graded.

Guidelines to selecting project and preparing report

- Select a product/process of interest
- Research available production processes (need to have at least three typical downstream processing steps such as MF, chromatography, sedimentation, centrifugation, precipitation, etc.)
- Clearly describe the fundamentals and application of separations methods
- In the course of your description, show that you have an understanding of how your topic relates to the material covered in the course (i.e. there should normally be evidence in your paper/presentation of what you have learned in the course), and introduce quantitative aspects of the project

Examples for projects:

- tPA by mammalian (CHO) cell culture
- tPA production by E. coli
- Polypeptide acid from Bacillus subtilis
- Human insulin by yeast
- Chymosin by E. coli
- Other proteases by microbial fermentation
- Biopharmaceuticals by transgenic plants (MAb, lactoferrin, insulin)
- scFab by E. coli or yeast
- Antibiotics by fermentation
- Organic acids by microbial fermentation (other than citric acid)
- Problems 11.2 through 11.5 in Harrison et al., 2003.

TERM PROJECT TIMELINES

<table>
<thead>
<tr>
<th>Date</th>
<th>Milestone</th>
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<tbody>
<tr>
<td>February 2, 2009</td>
<td>Confirm your selection with the instructor</td>
</tr>
<tr>
<td>February 23, 2009</td>
<td>Submit a detailed process outline. Include key references</td>
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<tr>
<td>TBD</td>
<td>The written report DUE.</td>
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<tr>
<td>TBD</td>
<td>Oral presentations – 20-25 min + 5 min for questions</td>
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Term projects grading:

1. Written report will be graded based on content (75%) and mechanics (25%) (spelling, format, etc.)
2. The total project grade will consist of 75% (75 pts) from the written report and 25% (25 pts) from the oral presentation.