### Proposal Title:
Bioprocess Engineering

**Undergraduate**

**Graduate**

3.0 Credit Hours

**Sponsor(s):**
J. Stewart Cramer and School of Engineering Curriculum Committee

**Department & Telephone#:** Civil Engineering, x4631

**Check One:**
- [ ] Course
- [ ] Minor Program
- [ ] Concentration
- [ ] Specialization
- [ ] Achievement Certificate
- [ ] Certification Program
- [ ] Major Program

### Step 1 (Department)

- **Approved/Date:**
- **Not Approved/Date:** N/A
- **Dept. Curriculum Chair:** N/A
- **Reviewed/Date:**

### Step 2 (Receipt)

- **SCC#:** 05-6-1-2
- **Date Received:** 1/25/96

### Step 3 (School)

- **Reviewed Date:** 2/14/96
- **Recommend to Approve:**
- **Recommend Not to Approve:**
- **Forward for Open Hearing:**
- **Without Reservations:**
- **With Reservations:**
- **Comments:**

### Step 4 (Academic Dean)

- **Recommend:**
- **Not Recommend:**
- **Conditionally Recommend (see comments):**

- **Date & Signature, Dean of School:**

### Step 5 (Senate Curriculum Committee)

- **Date of Open Hearing:** 3/3/96
- **Approved by Senate Curriculum Committee (Date):** 3/3/96
- **Returned to Sponsor(s) for the Following Reasons:**

### Step 6 (Senate)

- **Date Presented to Senate:** 3/5/96
- **Approved**
- **Not Approved**

- **Notification to Executive Vice President/Provost (Date):**

- **Senate Curriculum Committee Chair Signature/Date:**

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**Rowan College Curriculum Committee**

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**Bioprocess Engineering**

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**J. Stewart Cramer and School of Engineering Curriculum Committee**

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**Civil Engineering, x4631**

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**Check One:**
- [ ] Course
- [ ] Minor Program
- [ ] Concentration
- [ ] Specialization
- [ ] Achievement Certificate
- [ ] Certification Program
- [ ] Major Program

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**Approved/Date:**

**Not Approved/Date:** N/A

**Dept. Curriculum Chair:** N/A

**Reviewed/Date:**

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**SCC#:** 05-6-1-2
**Date Received:** 1/25/96

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**Reviewed Date:** 2/14/96
**Recommend to Approve:**
**Recommend Not to Approve:**
**Forward for Open Hearing:**
**Without Reservations:**
**With Reservations:**
**Comments:**

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**Recommend:**
**Not Recommend:**
**Conditionally Recommend (see comments):**

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**Date & Signature, Dean of School:**

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**Date of Open Hearing:** 3/3/96
**Approved by Senate Curriculum Committee (Date):** 3/3/96
**Returned to Sponsor(s) for the Following Reasons:**

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**Date Presented to Senate:** 3/5/96
**Approved**
**Not Approved**

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**Notification to Executive Vice President/Provost (Date):**

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**Senate Curriculum Committee Chair Signature/Date:**

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**Rowan College Curriculum Committee**

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**Bioprocess Engineering**

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**J. Stewart Cramer and School of Engineering Curriculum Committee**

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**Civil Engineering, x4631**

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**Check One:**
- [ ] Course
- [ ] Minor Program
- [ ] Concentration
- [ ] Specialization
- [ ] Achievement Certificate
- [ ] Certification Program
- [ ] Major Program

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**Approved/Date:**

**Not Approved/Date:** N/A

**Dept. Curriculum Chair:** N/A

**Reviewed/Date:**

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**SCC#:** 05-6-1-2
**Date Received:** 1/25/96

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**Reviewed Date:** 2/14/96
**Recommend to Approve:**
**Recommend Not to Approve:**
**Forward for Open Hearing:**
**Without Reservations:**
**With Reservations:**
**Comments:**

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**Recommend:**
**Not Recommend:**
**Conditionally Recommend (see comments):**

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**Date & Signature, Dean of School:**

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**Date of Open Hearing:** 3/3/96
**Approved by Senate Curriculum Committee (Date):** 3/3/96
**Returned to Sponsor(s) for the Following Reasons:**

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**Date Presented to Senate:** 3/5/96
**Approved**
**Not Approved**

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**Notification to Executive Vice President/Provost (Date):**

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**Senate Curriculum Committee Chair Signature/Date:**

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STEP #7 (EXECUTIVE VICE PRESIDENT/PROVOST)

DATE RECEIVED ____________________

APPROVED: ___ YES ___ NO

IF NO, REASONS ARE AS FOLLOWS:

__________________________

STUDENT CREDIT HOURS

FACULTY LOAD HOURS

EQUALIZED CREDIT HOURS

OFFICIAL COPY & APPROVAL SHEET FILED (DATE) ____________________

SIGNATURE, EXECUTIVE VICE PRESIDENT/PROVOST ____________________

REGISTRAR

DATE APPROVED COURSE DESCRIPTION RECEIVED ____________________

REGIS TAXONOMY AND COURSE NUMBER ASSIGNED ____________________

DATE/SIGNATURE OF REGISTRAR ____________________

NOTIFICATION FORWARD:

___ SENATE CURRICULUM COMMITTEE CHAIRPERSON

___ DEPARTMENT CHAIRPERSON(S)

___ ACADEMIC DEAN(S)

___ REGISTRAR

___ SPONSOR(S)
Course Proposal

1. Details:

a) Course Title: Bioprocess Engineering
b) Sponsor: School of Engineering Curriculum Committee
Dr. C. Stewart Slater, Chemical Engineering
c) Credit Hours: 3 credit hours
d) Course Level: Senior (0906.462)
e) Curricular Effect: Technical Elective for Chemical Engineering majors
f) Prerequisites: Reaction Engineering, Separation Processes
g) Suggested Time/Scale of Implementation: Spring 2000 1 section
h) Resources: Faculty will be hired and laboratory equipment obtained consistent with Engineering School multi-year budget. Library acquisitions will be required.

2. Rationale:

The proposed course is a new offering consistent with other courses in the Engineering Curriculum Proposal approved by the College Senate in December 1994. The proposed course is consistent with the establishment of the School of Engineering approved by the Board of Trustees in February 1995.

The proposed course is Technical Elective for all Chemical Engineering majors and satisfies the Engineering Topics credit requirements of the Education and Accreditation Committee (EAC) of the American Institute of Chemical Engineers (AIChE) for accreditation of the Chemical Engineering program by the Accreditation Board for Engineering and Technology (ABET).

The course will address the process aspects of biotechnology - one of the most widely recognized emerging multidisciplinary fields for the 21st century. Bioprocess engineering principles are critical in the research and development of new drug production, health care devices, bioremediation of hazardous waste, and specialty chemical/biochemical production. This course will allow chemical engineering students to broaden their career options.

3. Essence of the Course:

a) Objectives:

Upon completion of the course, students will be able to:

1. Understand the different fields of biotechnology.

2. Combine the essential aspects of biochemistry, microbiology, and genetics with
engineering principles.

3. Understand how to mathematically model bioprocesses.

4. Perform design and scale-up calculations on bioreactors.

5. Select the proper purification and recovery process and design a series of processes.

6. Work in groups to solve open-ended design problems.

7. Collect and analyze laboratory data using experimental systems such and fermentors and microfiltration units.

b) Topical Outline:

The topics to be covered are listed below. The instructor will supply the students with a syllabus during the first week of classes. The instructor will assess any technology advances in the subject matter prior to the course and make topic changes as deemed appropriate to maintain the level and currency of instruction.

Introduction
   Biotechnology and biochemical engineering
   Interface between science and engineering

Overview of biotechnology basics necessary for processing
   Cells and microbial diversity
   Enzyme kinetics
   Cell function
   Metabolic pathways

Cell growth and product formation
   Batch growth and kinetics
   Continuous culture growth
   Stoichiometry of microbial growth and product formation

Process considerations for bioreactors for suspensions and immobilized cultures
   Batch and continuous reactors
   Immobilized cell systems
   Solid-state fermentations

Selection, scale-up, and control of bioreactors
   Scale-up difficulties
   Bioreactor instrumentation and control
Sterilizing process fluids

Separation of insoluble products
  Filtration/microfiltration
  Centrifugation
  Cell disruption

Isolation/purification of soluble products
  Extraction
  Adsorption
  Chromatography
  Precipitation

Finishing steps for purification
  Crystallization
  Drying

Ancillary process operations
  Water quality
  Solvent recovery
  Waste disposal

Laboratory experiments and demonstrations will be integrated throughout the course.

c) Evaluation and Grading Procedure of Students:

Student grades will be based on examinations, homework and/or projects. A course syllabus with a stated method of arriving the final grade, e.g., number of exams, projects, homework, percentage of grade, will be distributed to students the first week of classes.

d) Course Evaluation:

The proposed course will be evaluated on the basis of student evaluations and curriculum review by appropriate faculty.

4. Results of Consultations:

The proposed course is part of the Engineering Curriculum Proposal approved by the Faculty Senate in December 1994. Consultations were submitted with original proposal as specified by the Curriculum Committee. Consultations have been made with Chemistry faculty in the Department of Chemistry and Physics who have provided a letter of support.
Catalog Description

Bioprocess Engineering (0906.462)

(Prerequisite: Reaction Engineering, Separation Processes)

This course reviews the fundamentals and engineering of bioprocess engineering with emphasis on applying biotechnology to industrial processes. Essential aspects of biochemistry, microbiology and kinetics are presented. This course discusses bioreactor engineering, and recovery and purification processes. Processing applications of engineering kinetics and enzyme technology are included. Laboratory experiments and demonstrations will be integrated throughout the course.
To: Curriculum Committee
From: Robert Newland, Chairperson
Subject: Chemical Engineering Technical Electives
Date: February 15, 1996

I have examined the course proposals listed below and find them in accord with the previously submitted curriculum plan. I also have noted where courses require chemistry and/or physics prerequisites and am convinced there are no additional resources required to meet this demand for our courses. We fully support these proposals.

Electrochemical Engineering
Environmental Regulations in Technology Industries
Environmental Considerations in Process Design
Process Safety
Membrane Process Technology
Advanced Separation Technology
Process Heat Transfer
Fluid Flow in Processing and Manufacturing
Advanced Reactor Design
Bioprocess Engineering
Transport Phenomena