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Proposal 22-05

(Voting Units- Academic Senators)

**Minor in Bioprocess Engineering
(Chemical Engineering and Biological Sciences)**

December 16, 2004 (Contact: Faith A. Morrison, CM; John Adler, BioSci)

1. Introduction

The Department of Chemical Engineering and the Department of Biological Sciences propose that a minor in Bioprocess Engineering be established jointly in the two departments.

2. Rationale

Biological processes are included in most major chemical, pharmaceutical, or food manufacturers and these companies employ large numbers of chemical engineers, biological scientists and chemists. This minor will provide hands-on experience with integrated biological processes. Students will work in interdisciplinary teams with differing expertise, learning not only the biotechnology of modern manufacturing but also current work-place methods. The students who will be interested in the program will be those who want to work in bio-related organizations, including the largest chemical and pharmaceutical companies in the world, several of which are based in Michigan (e.g. Pfizer).

3. Details of Catalog Copy:

I. Title of Minor

Bioprocess Engineering
(Chemical Engineering and Biological Sciences)

II. Catalog Description

This joint minor of the Departments of Chemical Engineering and Biological Sciences prepares students for careers in the field of bioprocess engineering, including pharmaceuticals engineering and manufacturing, and agricultural engineering and processing. Two paths are available, an engineering track and a biological track. The rapid growth of biological processing methods throughout the chemical and pharmaceuticals industries creates a strong demand for graduates with expertise in this area. This minor is most suitable for students in chemical engineering, biological sciences, and chemistry.

III. List of Courses

There are two tracks to the Bioprocess Engineering Minor, the Engineering Track and the Biological Track. The engineering track is designed for access by chemistry and chemical engineering majors; the biological track is designed for access by biological sciences and biomedical engineers. Students from all majors are welcome to take either track of the minor.

On both tracks the lists of required classes include an introductory process engineering course, an introductory biochemistry course, and an interdisciplinary laboratory (CM4125). On the engineering track the students are required to take an engineering-intensive, mathematically based class (CM4710) to allow them to apply their engineering analytical skills to bioprocessing

problems. In the biological track the students are required to deepen their knowledge of industrial microbiology by taking 6 credits of advanced biological sciences courses. The remaining credits of the 16 credit minor are made up with advanced biological sciences courses and engineering courses.

Undergraduate research experiences will be permitted in the minor as long as the topics are in the area of bioprocess engineering.

Proposed Minor in Bioprocess Engineering - 16 credits

(CM and BioSci jointly)

Engineering Track

Required classes: (10 credits)

- (3) CM2120 Fund of Chem Engg 2
 - OR (3) CM2200 Intro to Minerals and Materials
 - OR (3) CM 3810 - Intro to Unit Operations
 - OR (3) CE 3501 - Env Engg Fundamentals
 - OR (3) CE 3503 - Environmental Engineering
- (3) BL2100 Principles of Biochemistry
 - OR (3) CH4710 Biomolecular Chemistry I
- (1) CM4125 Bioprocess Engineering Lab
- (3) CM4710 Biochemical Processes

Elective classes (6 credits)

- (4) BL3210 Microbiology
 - OR (3) BL3310 Environmental Microbiology
- (3) BL4220 Applied and Industrial Microbiology
- (3) CH4720 Biomolecular Chemistry II
- (3) CH4110 Pharmaceutical Chemistry I: Drug Action
- (3) CH4120 Pharmaceutical Chemistry II: Drug Design
- (3) BL4010 Biochem I
- (3) BL4020 Biochem II
- (2) BL4820 Biochem Lab I
- (3) CM4550 Industrial Chemical Production
- (1-3) BL4000 Undergraduate Research in Biological Sciences *topic must be approved by Department Chair
- (1-3) CM4000 Undergraduate Research in Chem Eng *topic must be approved by Department Chair
- (1-3) CM4990 Special Topics in CM *topic must be approved by Department Chair

Biological Track

Required classes: (14 credits)

- (3) CM 3810 - Intro to Unit Operations
 - OR (3) CM4710 Biochemical Processes
 - OR (3) CM2200 Intro to Minerals and Materials
 - OR (3) CE 3501 - Env Engg Fundamentals
 - OR (3) CE 3503 - Environmental Engineering
- (3) BL2100 Principles of Biochemistry
- (1) CM4125 Bioprocess Engineering Lab
- (4) BL3210 Microbiology
- (3) BL4220 Applied and Industrial Microbiology

Elective classes (2 credits)

- (3) CM2200 Intro to Minerals and Materials
- (3) BL4010 Biochem I
- (3) BL4020 Biochem II
- (2) BL4820 Biochem Lab I
- (3) CM4710 Biochemical Processes
- (1-3) BL4000 Undergraduate Research in Biological Sciences *topic must be approved by Department Chair
- (1-3) CM4000 Undergraduate Research in Chem Eng *topic must be approved by Department Chair
- (1-3) CM4990 Special Topics in CM *topic must be approved by Department Chair

IV Prerequisites not listed in the minor

- BL2100 - ((BL1040 or BL1020) and (CH1110 or CH1100))
- BL3210 - (BL2100 and BL1020)
- BL3310 - (BL1060 or BL1040 or permission from instructor)
- BL4000 - (permission from instructor)
- BL4010 - ((BL 1020 or BL 1040) and (BL 2100 or CH2400) and CH 2420)
- BL4020 - (BL 4010 or permission of instructor)
- BL4220 - (BL 3210 or BL 3310)
- BL4820 - (BL 4010 or permission of instructor)
- CE3501 - ((MA2150 or MA2160) and (CH1100 or CH1110))
- CE3503 - ((MA2150 or MA2160) and (CH1100 or CH1110))
- CH4710 - (CH2420)
- CH4110 – (CH4710 or BL4010)
- CH4120 - (CH4110)
- CH4720 - (CH4710 or BL4010)
- CM2120 - (CM2110)
- CM2200 - none
- CM3810 - (CH1100 or CH1110)
- CM4000 - (permission from department)
- CM4125 - CM4710(C) or BL3210 or BL3310 or permission of instructor
- CM4550 – CH2400 or CH2410 and CM3510(C)
- CM4710 - (CM3110 - C)
- CM4990 - (permission from instructor)

4. New Course Descriptions

One new course is listed as required in this minor proposal, but this course has already been developed and approved by the Department of Chemical Engineering using existing resources and faculty time. The course, CM4125 Bioprocess Engineering Lab, is a spin-off of an existing laboratory, CM4120 Chemical Plant Operations Lab, a required senior chemical engineering class. Dr. David Shonnard and Dr. Sue Bagley have worked together on the bioreactor experiment in that laboratory, and that experiment will form the core of CM4125. Three other courses, CH4720, CH4110, and CH4120 are being proposed by the Chemistry Department for inclusion in their proposed new Pharmaceutical Chemistry degree. If these courses do not come into existence, they can be removed from the electives list for this minor. The remaining classes in the minor are all in existence.

5. Estimated Costs

There are no anticipated costs other than minimal advertising costs. Brochures, email, catalog and web site presence will be used for this purpose. These costs will be borne by the Departments of Chemical Engineering and Biological Sciences with no additional funds needed. Additional experiments will be developed for the laboratory over the upcoming years; contacts with Michigan-based pharmaceuticals manufacturers are already ongoing.

6. *Planned Implementation Date*

Because there are no implementation costs associated with this minor, the departments propose to implement the Bioprocess Engineering Minor in the Fall of 2005.

Adopted by the Presidential Advisory Committee (formerly Senate): 23 February 2005

Approved by President Mroz: 28 February 2005