



UNIVERSITY OF WASHINGTON

OFFICE OF THE PRESIDENT

*Mark A. Emmert, President*

June 20, 2007

Dean Paul Ramsey  
School of Medicine  
Box 357110

Dean Matthew O'Donnell  
College of Engineering  
Box 352180

Dear Paul and Matthew:

Based on the recommendation of its Subcommittee on Admissions and Programs, the Faculty Council on Academic Standards has recommended approval of the revised requirements for the Bachelor of Science degree in Bioengineering. A copy of the changes is attached.

I am writing to inform you that the School of Medicine and the College of Engineering is authorized to specify these requirements beginning summer quarter 2007.

The new requirements should be incorporated in printed statements and in individual department websites as soon as possible. The *General Catalog* website will be updated accordingly by the Registrar's Office.

Sincerely yours,

Mark A. Emmert  
President

Enclosure

cc: Ms. Chelsea Musick (with enclosure)  
Mr. Robert Corbett (with enclosure)  
Dr. Deborah H. Wiegand (with enclosure)  
Todd Milton, J. D. (with enclosure BIOEN-20070411)



UNIVERSITY OF WASHINGTON  
**CREATING AND CHANGING UNDERGRADUATE  
 ACADEMIC PROGRAMS**

OFFICE USE ONLY
Control # BIOEN - 20070411

After college/school review, send a signed original and 8 copies to FCAS, Box 355850.

For information about when and how to use this form: <http://depts.washington.edu/uwcr/1503instructions.pdf>

College Engineering / Medicine	Department or Unit Bioengineering	Date 4/11/07
-----------------------------------	--------------------------------------	-----------------

### New Programs

- Leading to a Bachelor of \_\_\_\_\_ in \_\_\_\_\_ degree.
- Leading to a Bachelor of \_\_\_\_\_ degree with a major in \_\_\_\_\_
- Leading to a \_\_\_\_\_ Option within the existing major in \_\_\_\_\_
- Leading to a minor in \_\_\_\_\_

### Changes to Existing Programs

- New Admission Requirements for the Major in \_\_\_\_\_ within the Bachelor of \_\_\_\_\_
- Revised Admission Requirements for the Major in \_\_\_\_\_ within the Bachelor of \_\_\_\_\_
- Revised Program Requirements for the Major in Bioengineering within the Bachelor of Science
- Revised Requirements for the Option in \_\_\_\_\_ within the major in \_\_\_\_\_
- Revised Requirements for the Minor in \_\_\_\_\_

### Other Changes

- Change name of program from \_\_\_\_\_ to \_\_\_\_\_
- New or Revised Continuation Policy for \_\_\_\_\_
- Eliminate program in \_\_\_\_\_

Proposed Effective Date:

Quarter:  Autumn  Winter  Spring  Summer Year: 20 07

Contact Person Chelsea Musick	Contact's Phone 206 - 543 - 1143	Contact's Email cmusick@u.washington.edu
----------------------------------	-------------------------------------	---

### EXPLANATION OF AND RATIONALE FOR PROPOSED CHANGE

For new programs, please include any relevant supporting documentation such as student learning outcomes, projected enrollments, letters of support and departmental handouts. (Use additional pages if necessary).

1) To have the Bioengineering undergraduate curriculum comply with the ABET standards and requirements of engineering design component in the curriculum. Our current curriculum provides design experience in a group design project in BIOEN 481 and design elements incorporated into the senior capstone research/design course, BIOEN 482. We wish to strengthen the design component of our undergraduate curriculum by requiring seniors to take a 400-level course that includes design. Please refer to the attached criteria for a design-designated course and to the attached syllabus for a course that meets the criteria, BIOEN 491. When we propose new courses at the 400-level, we will identify them as design-designated or not according to whether they meet our criteria. In the 2006 - 2008 course cycle, the current courses listed in section 2B below (Proposed Catalog Copy) will be modified to earn the design designation.

2) BIOEN 436 is being dropped because this material is covered in BIOEN 302. Please see the course drop form for BIOEN 436.

**CATALOG COPY**

Catalogue Copy as currently written. Include only sections/paragraphs that would be changed if you request is approved. Please cross out or otherwise highlight any deletions.

Bioengineering Senior Electives (15 credits): Fifteen credits chosen from BIOEN 420, BIOEN 436, BIOEN 440, BIOEN 455, BIOEN 457, BIOEN 467, BIOEN 470, BIOEN 485, BIOEN 490, BIOEN 491, BIOEN 492.

**PROPOSED CATALOG COPY**

Reflecting requested changes (Include exact wording as you wish it to be shown in the printed catalog. Please underline or otherwise highlight any additions. If needed, attach a separate, expanded version of the changes that might appear in department publications)

Bioengineering Senior Electives (15 credits): Fifteen credits chosen from BIOEN 420, BIOEN 440, BIOEN 455, BIOEN 457, BIOEN 467, BIOEN 470, BIOEN 485, BIOEN 490, BIOEN 491, BIOEN 492. One of the courses chosen must be a design-designated course. See the department for a list of design-designated courses.

**SIGNATURES (required)**

Chair/Program Director

*Paul You*

Date

4/12/07

Dean

*Steve A. Mohr*

Date

5-9-07

College Committee

*Bradley R. Yate*

Date

5/19/07

Faculty Council on Academic Standards

*Don E. Nunn*

Date

5/23/07

UoW 1503 (12-05) REVERSE

School of medicine, DEAN



## Defining design courses

1. The criteria for a design-designated course is that it must have a required student project that will count for at least 20% of the final grade, and require a minimum of 20 hours of student work. The project must be consistent with the ABET guidelines for what constitutes design, which are as follows:

"Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs "Students must be prepared for engineering practice through the curriculum, culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints." (Both of these are quotes from the ABET Policies and Procedures manual,

- Evaluation of this component should include (but not be limited to):
  - specifications of desired outcome
  - method/design for reaching this outcome
  - appropriate testing and evaluation of this outcome

2. The list of courses which will be design designated are the following:

- a. BIOEN 420: Medical Imaging. Team project to "research a specific problem in medical imaging processing to review an existing algorithm for medical image processing, demonstrate its use and suggest possible avenues for improving it."
- b. BIOEN 440: Intro to Biomechanics. Course has final design project.
- c. BIOEN 485: Computational. Final project tweaked for design project. Talked with Wendy Thomas; she considers it an improvement to her course.
- d. BIOEN 490: Engineering Materials for Biomed Applications. Syllabus states final project will "focus on the development of a new biomaterial or new biomaterials application".
- e. BIOEN 491: Controlled Release Systems. Final project focused on development of an improved drug delivery device.

3. Other courses can be added to the above list as they are changed to include a design project. This could happen if the curriculum committee requests the courses be changed so they include design projects. This includes all other current senior electives (BIOEN 455 (Biomems, Folch), BIOEN 457 (Molecular and Cellular, Stayton), BIOEN 467 (biochemical, Baneyx), BIOEN 470 (Systems, Kim), BIOEN 492 (Surface analysis, Ratner), and certain graduate level courses (BIOEN 568 (Image processing); BIOEN 599 (tissue engineering); BIOEN 599 (microfabrication); etc.

**Course Title:** Bioen 491 –

**UW General Catalog Course Description:**

Mechanisms for controlled release of active agents and the development of useful drug delivery systems for this purpose. Release mechanisms considered include diffusive, convective, and erosive driving forces. Delivery routes include topical, oral and in vivo. Some special case studies covered in detail.

**Instructor:** Pun, Suzie H.

**Instructor's Detailed Course Description:**

Bioen 491 – (3 credits). This course is designed to provide students with an understanding of the principles, strategies, and materials used in controlled drug delivery systems. The course will first cover the fundamentals of drug delivery, including physiology, pharmacokinetics/pharmacodynamics, drug diffusion and permeation, and biomaterials used in drug delivery. Controlled release strategies for various administration routes will then be discussed. The course will conclude with special topics lectures on targeted drug delivery, gene delivery, vaccine delivery, and protein delivery from UW faculty and industry guest lecturers.

**Prerequisites by Topics:**

Organic chemistry, physical chemistry, transport phenomena

**Textbooks:**

"Drug Delivery: Engineering Principles for Drug Therapy". Mark Saltzman, Oxford University Press, 2001 ISBN: 0195085892

"Drug Delivery and Targeting". Eds Anya M. Hillery, Andrew W. Lloyd, James Swarbrick. Taylor and Francis, 2001. ISBN 0415271975

**Course Objectives:**

This course introduces upper division undergraduates in Bioengineering, Chemical Engineering and Chemistry to principles used in designing controlled drug delivery systems. Students will learn basic principles in pharmacology, drug transport, and biomaterials used in drug delivery. The students apply this knowledge in a final team-based design project.

**Topics Covered:**

1. Basic pharmacology (PK/PD) 2. Diffusion in biological systems 3. Drug permeation and transport 4. Biomaterials and modulation of drug activity 4. Drug administration methods 5. Macromolecule drug delivery 6. Targeted drug delivery 7. Intellectual property issues in drug delivery

**Class Schedule:**

- Lectures 1hr20min/lecture, meet twice a week

**Computer Use:**

Students will use computers to prepare their homework, final papers and class presentations.

**Laboratory Projects:**

N/A.

**Design Project:**

A final term paper is required. Students will work in small groups to prepare a project design proposal that is generally 10-15 pages in length. The proposal will focus on the development of a novel controlled drug delivery system for an application specified by the instructor and will include a background section defining the current state of the art and remaining need for improvement, design criteria for an improved system, a novel delivery system designed to meet the defined needs, and assessment methods for meeting the design criteria. In addition, effective proposals will include an economic assessment and discussion of societal impact of the proposed system. Students will also give a 15 minute oral presentation of their paper in class with a 5 minute question/answer period. The final paper and presentation will be worth 30% of the class grade.

**Course Outcome and Assessment:**

Specific outcomes in Bioen 491 and their assessment mechanisms to be used by the department for **program assessment** are:

(c) *an ability to design a system, component, or process to meet desired needs.* Students' ability will be assessed by their final project, in which they will design a controlled release system for a specified application. Students will also be assessed in examinations, where they will be asked to analyze the design of published systems based indicators such as drug release kinetics.

(g) *an ability to communicate effectively.* Written communication will be assessed by homework, exams, and final papers. Some homework and exam questions will require interpretation and analysis of published journal articles. Oral communication will be assessed by in-class presentations of their final projects.

(j) *knowledge of contemporary issues.* Students will be evaluated on their understanding of economic and societal forces driving drug delivery development through homework and exams. Students will also be evaluated on their knowledge of current state-of-the-art drug delivery vehicles through their final projects.

Additional outcomes and their assessment mechanisms considered of **high relevance** to ABET criteria by the department for Bioen 491 are: none

Those specific outcomes and their assessment mechanisms considered of **medium relevance** by the department for Bioen 491 are:

- ☐ (d) *Teamwork* In one set of the homework assignments and their final project, students form their own teams to complete the assignment. Final projects will be completed in teams of 2-4 students, with co-authored reports and team presentations.

### **Relationship of Course to Departmental Objectives:**

Bioen 491 is designed to introduce controlled drug release systems to upper division undergraduates and graduate students. The course reflects in the interdisciplinary science of drug delivery by covering basic pharmacology, mass transport of drugs through diffusion and permeation, the chemistry of materials used in drug delivery systems, and economic and intellectual property considerations in pharmaceutical industries. The course also includes guest lecturers from industry who provide perspective on current development and application of drug delivery devices. Through this training, the students are expected to design and evaluate novel drug delivery devices for specified applications.

In summary, Bioen 491 complies with the departmental objectives by:

- ☐ applying students' knowledge in physics, chemistry, engineering and biology to design and solve biomedical problems.
- ☐ strengthening students' ability to communicate through written and verbal media
- ☐ providing opportunities for students to work in multidisciplinary teams