Unit Plan for Assessing and Improving Student Learning in Degree Programs

Unit: Bioengineering

Unit Head approval:  **Date: 5/9/08**

SECTION 1: PAST ASSESSMENT RESULTS

Brief description of changes or improvements made in your unit as the result of assessment results since 2000.

The Bioengineering Department was established in 2004. We have continually assessed our degree programs during the past four years, making improvements every year. Our primary assessment tools at this early stage of curriculum development have been student course grades and student focus groups. The department's graduate and undergraduate curriculum committees have met several times over the past four years to discuss assessment results and ways of improving the Bioengineering curriculum to better meet the needs of our students.

In the undergraduate program we have made several changes in our required core courses and concentration areas.

To increase the ability of our students to model biological systems we have expanded the quantitative content and increased computer usage in three core courses: Circuits and Systems in Bioengineering, Biomechanics, and Modeling Human Physiology. The students are introduced to linear algebra in Circuits and Systems in Bioengineering, after which they will use it again in Biomechanics and in Modeling Human Physiology. Similarly, the students learn to use MATLAB as a modeling tool for biological systems in Circuits and Systems in Bioengineering, and then continue to apply it in Biomechanics and in Modeling Human Physiology.

To provide a more comprehensive coverage of the vast spectrum of biological systems, MCB 252 Cells, Tissues, & Development was added to the curriculum. This course in combination with Bioengineering's Modeling Human Physiology course provides Bioengineering students with fundamental biological knowledge that spans the gamut from cells to physiological systems.

Based on student course performance and to better prepare them for employment in the industrial sector we have made several changes to our five concentration areas (Biomaterials, Biomechanics, Computational Biology/Bioengineering, Biomolecular, and Electrical Systems). For example, in the biomechanics concentration we now require two fundamental mechanical engineering courses: TAM 210 Introduction to Statics and TAM 212 Introduction to Dynamics.

At the graduate level a core of four graduate level bioengineering courses has been developed.

SECTION 2: REVISED ASSESSMENT PLAN

(a) PROCESS: Brief description of the process followed to develop or revise this assessment plan.

Susan McCormick initially wrote this document. It was then sent to Prof. Mike Insana, Interim Department Head and Prof. Bruce Wheeler for refinement and approval.

(b) STUDENT OUTCOMES: List Unit's student learning outcomes (knowledge, skills, and attitudes).

Outcomes for the BS program:

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to design and conduct experiments, as well as to analyze and interpret data
3. An ability to design a system, component, or process to meet desired needs
4. An ability to function on multi-disciplinary teams
5. An ability to identify, formulate, and solve engineering problems
6. An understanding of professional and ethical responsibility
7. An ability to communicate effectively
8. The broad education necessary to understand the impact of engineering solutions in a global and societal context
9. The recognition of the need for, and an ability to engage in life-long learning
10. A knowledge of contemporary issues
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
12. An understanding of biology and physiology
13. The capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology
13. The ability to make measurements on and interpret data from living systems
14. The ability to address problems associated with the interaction between living and non-living materials and systems.

Outcomes for the PhD program also include:

15. The ability to conduct original research
16. The ability to write journal papers

(c) MEASURES AND METHODS USED TO MEASURE OUTCOMES:

For the BS program the majority of student outcome assessment will be performed in core Bioengineering courses. All students are required to take these courses ensuring that each student will be assessed. Each outcome will be mapped to a minimum of two core courses. Measurement tools include homework problems, term projects and exam questions. At least two measurements will be made for each learning outcome, in each course. Student scores for each exercise that is used as a measurement will be recorded and averages used to determine if students are learning the outcomes. In addition, for each exercise three examples of student work will be collected. They will be representative of high, medium and low performance scores. These samples will assist in determining proper corrective action to increase student learning.

The senior design course provides additional opportunities to assess undergraduate outcomes. This is a capstone course that requires comprehensive final reports and presentations that can be used to assess multiple outcomes. The curriculum committee will use them to measure student outcomes.

Since the above methods are heavily dependent upon faculty evaluation and thus subject to faculty bias, additional faculty independent assessment methods will be used. The draw backs of these methods are that they are indirect and provide measurements that are less specific for student learned outcomes when compared to course base measurements. However, they will provide a measurement of general student learning and curriculum appropriateness. These methods include

1. Focus meetings with a subset of graduating seniors, which will assess what the students perceive they have learned while attending U of I.
2. Tracking student coops and internships.
3. Tracking student employment after graduation.

For the PhD program the primary method for assessing student-learning outcomes will be written and oral qualifying exams, preliminary exams and Doctoral Theses. Less outcome specific methods will include the tracking of publications/presentations at national meetings as well as student employment after graduation.

SECTION 3: PLANS FOR USING RESULTS

(a) PLANS: Brief description of plans to use assessment results for program improvement.

Assessment results will be used by the undergraduate and graduate curriculum committees, as well as core course instructional faculty to improve both curriculum and course content. Course assignment measurements, such as exam problems, will be used to determine if the students are learning the outcomes expected for that course. If they are not, then the samples of student work will be reviewed to aide in the refinement of the course. That the material may be more appropriately covered and assessed in another course will also be considered. It will be important to consider what the students perceive they are learning in the different courses and determine if this matches with the department's outcome mapping. The employment, internship, and coop tracking data will be used as an indirect measurement of the learning outcomes. If those data indicate that students are having difficulties connecting with companies, than the curriculum committee will reevaluate student attainment of learning outcomes and their appropriateness for bioengineers.

(b) TIMELINE FOR IMPLEMENTATION:

The department is already tracking the employment of its graduates as well as internships and coops. The extremely dynamic nature of new curriculums and courses has thus far been a determent to the mapping of student outcomes to courses. However, the rate of curriculum changes has begun to decrease as our first class of students has successfully completed the program. In addition, a core set of Bioengineering courses has been developed and student tested. Thus, the department is now ready to complete its first iteration of outcome mapping to core courses. This will be completed in the fall semester of 2008. Course assessment will begin in spring of 2009. In the spring of 2010, the curriculum committee will go over assessment results. At this time they will also meet with the instructors of core courses to discuss the results and ways of improving courses and curriculum. Any curriculum or course changes deemed necessary will be implemented in fall 2011.