**Biomedical Engineering (Undergraduate Program)**

**ACADEMIC OBJECTIVES**

**Mission Statement**

**THE MISSION** of the Department of Biomedical Engineering is to bridge engineering, science, and medicine:
• To educate and train the next generation of diverse biomedical engineers
• To promote a culture of inclusion amongst all biomedical engineers
• To conduct research leading to significant discoveries in medical sciences
• To develop innovative medical technology
• To translate scientific discovery and medical technology to industry or clinical practice
• To engage with the regional to international community for knowledge dissemination

**Vision**

**THE VISION**

The Biomedical Engineering Department will innovate and excel in education and research to translate knowledge and technologies that advance clinical medicine and promote biomedical industry growth.

**ASSESSMENT PLAN, MECHANISMS AND PROCEDURES**

**Introduction**

The department of Biomedical Engineering at College of Engineering and Computing, Florida International University uses several mechanisms to assess the extent to which our undergraduate student learning outcomes and program educational objectives are being met. The department defines procedures to evaluate the assessment results and to identify ways to improve its curriculum based on the assessment results, as deemed necessary and appropriate by its faculty.

The department uses the following primary outcome measures to assess its Student Learning Outcomes (SLOs) via the following primary outcome measures (since 2018):

* Senior Design Project Evaluation (Faculty Assessment)
* Senior Design-1 Course Assessment
* BME Lab Course Assessment
* Student Exit Survey – indirect measure

In addition, several other assessments are carried out as secondary outcome measures, which include Course outcomes for BME 1xxx-4xxx level core courses, Transcripts, Course Outcome Surveys, Student Resumes Senior Design Project External Evaluation, Senior Design Project Sponsor Surveys – indirect measure, and Self-Assessment Student Surveys (since Fall 2021) – indirect measure.

The undergraduate Program Educational Objectives (PEOs) are assessed via surveys from alumni, and Academia/Industry/Clinical advisory board. In addition to these direct survey measures, the department seeks recommendations from our three constituents – current students, industry advisory board (IAB), alumni panel discussions, our student chapters, and clinicians.

**Administrative Structure**

To administer and evaluate these assessments, the department has created an administrative structure that includes:

* Undergraduate Program Director (UPD)
* Undergraduate committee – constituting of instructors, tenure/tenure-track faculty and BME advisors.

The Undergraduate Program Director and the undergraduate committee members are appointed by the department chair. The Undergraduate Program Director in consultation with the Chair, is responsible for overseeing the ABET and other accreditation, undergraduate curriculum development, revisions and approvals, collection of data related to undergraduate student success and program compliance. The Undergraduate Program Director will evaluate the need for teaching and learning assistants for the different courses and submit the recommendations to the Chair.

**Assessment instruments and procedures**

**STUDENT LEARNING OUTCOMES (SLOs)**

**The Primary Program Outcome Measures are as follows:**

Three of the Primary Outcome Measures are derived from student performance on the Senior Design Project and BME Lab courses. These directly measure student achievement of outcomes. The FIU BME curriculum is designed such that all knowledge gained through the curriculum is put into practice via this set of courses. Therefore, each of these courses encompasses the entire set of Student Learning Outcomes. The fourth Primary Outcome Measure indirectly measures Student Learning Outcomes.

**A. Senior Design Project Faculty Assessment**

Each Senior Design Project team is assigned a faculty advisor/mentor. The faculty advisor employs a rubric to assess the quality of the project and assign a grade. Each item on the rubric assessment tool is assigned a grade of A-F (Outstanding, Very Good, Good, Acceptable and Unacceptable) that is then converted to a quantitative score from 4-0. Each of these items in turn contributes to a score for each program outcome, also on a 4.0 scale. The faculty uses the same taxonomy as the external evaluators to base their assessments. This results in a direct measure of each program outcome based on specific performance on the senior design project. Student Learning Outcome #E (ability to function on multidisciplinary teams) was partially assessed through a separate Self & Peer Evaluation tool. This assessment tool is given to each student team member to fill out upon completion of the project.

**B. BME Senior Design-1 Course Assessment**

Each BME student is required to complete Senior-1 (BME 4800+ BME 4880 or BME 4800C since Fall 2019) prior to Senior-2. The Student Learning Outcomes that are high in priority for Senior-1 are assessed and used as primary measures.

The Senior Design-1 Instructor uses the Senior Design-1’s Course Assessment tool to assess the quality of the initial phase of their senior-design project’s design and assign a grade. Each item on the assessment tool is assigned a grade of Outstanding, Very Good, Good, Acceptable and Unacceptable that is then converted to a quantitative score from 4-0. The students/teams are assessed based on the evaluations done by the course instructor (Quizzes, Mid-Term Exam, In-class Activities/Presentations, Final Exam, Project Proposal Presentation to the department faculty, Peer Review, and/or a Written Proposal). Each ABET outcome that is supported with high degree by this course is measured using examples selected from the evaluations.

**C. BME Lab Courses Assessment**

Each BME student is required to complete BME Lab Courses (BME 4050L and BME 4051L) during their senior year. The Student Learning Outcomes that are high in priority for these lab courses are assessed and used as primary measures.

The Laboratory Instructor uses the Lab Course Assessment tool to assess the quality of the laboratory work and assign a grade. Each item on the assessment tool is assigned a grade of Outstanding, Very Good, Good, Acceptable and Unacceptable that is then converted to a quantitative score from 4-0. Each of these items in turn contributes to a score for each program outcome, also on a 4.0 scale. This results in a direct measure of each program outcome based on specific performance in the two BME Lab courses.

**D. Student Exit Survey (Indirect Measure)**

Each graduating senior is required to complete the Exit Survey. This survey asks each graduate to assess their own capabilities and rate how well they have achieved these outcomes, in their opinion, after completing the entire curriculum. The scale is 1-4 with the following definitions: 1 – strongly disagree, 2 – disagree, 3 – agree and 4 – strongly agree.

**The Secondary Program Outcome Measures are as follows:**

1. **BME 1xxx-4xxx Core Course Outcomes**

All BME required courses from 1xxx-4xxx levels are assessed here. Excluding the Senior Design Project (BME 4908) and Senior Design-1 (BME 4800+4880 or BME 4800C), and BME Lab courses (BME 4050L and BME 4051L), all BME 4xxx level core courses are assessment for the respective Student Learning Outcomes, which is in High priority in the respective courses.

Each BME 1xxx, 2xxx, 3xxx and 4xxx core course outcome has an associated student output (homework or exam question, part of written report, etc.) that is used to assess the student’s ability to master that capability. The course instructor uses these data as a discussion item during the course review at the Faculty and Staff Annual Retreat, towards continuous improvement in the formative years towards an improved summative assessment (in our Primary Outcome Measures).

1. **Transcripts**

Since each course has outcomes that contribute to the overall Student Learning Outcomes, the grades each student earns in the required BME courses is also a measure of their ability to master the expected capabilities.

1. **Course Outcomes Surveys**

At the end of each course, students are surveyed as to their opinion of their own mastery of the outcomes stipulated for each course. These data are quantified (achieved – 1.0, partially achieved – 0.5 and not achieved – 0.0) and used as another discussion item for each course review at the BME Annual Faculty and Staff Retreat.

1. **Student Resumes**

At the time of graduation from the program, each student is expected to provide a professional resume to the Department after review by personnel from the university’s Career and Talent Development Center or qualified industry professional, research mentor, or internship supervisor. Their resumes contain extracurricular activities that contribute to the demonstration of their experiences and capabilities, particularly for Student Learning Outcome #8. Examples of such activities are participation in student organizations, working in research laboratories, internships or co-op experience, etc.

**E. Senior Design Project External Evaluation**

 At the end of each Fall and Spring terms, student teams completing their Capstone Senior Design Projects present their projects at the annual Biomedical Engineering Expo and Competition. This event, which is open to the public, is comprised of student presentations of their projects and are evaluated by a panel of judges who are practicing engineers and scientists from the Medical Device Manufacturing industry, as well as clinicians and occasionally, legal experts on intellectual property. On account of their evaluations of engineering competence, product development acumen, ability to communicate technical information and respond to technical interrogation, judges determine winners of the competition, who are recognized by the department and their peers, and are awarded prizes for first second and their place finishes. also rate the student teams on their ability to demonstrate, through activities required to complete the design project, all FIU BME Student Learning Outcomes. The presentations are 10-12 minutes followed by 10 minutes of questions from the judges. Each judge receives a 4-page executive summary, and project documentation approximately a week in advance. Based on this input, the judges rate on a scale of 4-0 (Excellent, Very Good, Good, Fair and Poor) the student team’s ability to demonstrate each Student Learning Outcome. To ensure that and evaluations are consistent for making their assessment judges receive a taxonomy defining these terms and their relationship to the expected student performance. Projects are also evaluated with respect to ABET outcomes A-G and results are recorded and evaluated by the department’s Undergraduate Program Committee.

**F. Senior Design Project Sponsor Surveys (Indirect Measure)**

Sponsors of Senior Design Projects are required to provide two project assessments during the Senior Design Project semester. A midterm assessment for the purpose of evaluating progress in all aspects of the project including student performance, team responsiveness, technical competence demonstrated, resources management, and professionalism. The second report is the final evaluation of the team’s performance and reflects the contents of the Student Learning Outcomes and ABET outcomes. The sponsors’ evaluation is based on a five point Likert scale, are incorporated into the evaluation of each student in determining his grade for the course. Sponsor’s evaluations provide feedback on the readiness of graduates for industry placement and advanced studies in engineering, medicine or healthcare related fields. They also provide feedback on how well the biomedical engineering program is meeting ABET outcomes.

**G. Self-Assessment Student Surveys (Indirect Measure)**

Starting from Fall 2021, self-assessment student surveys are initiated across the formative and summative years of the students. These self-assessment surveys is initiated in the first few weeks of the semester across sophomores, juniors, seniors, and graduating seniors in BME 2740 (Modeling & Simulation), BME 3404 (EABS-2), BME 4800C (Senior Design-1), and BME 4908 (Senior Design-2). The same set of questions that relate to the Student Learning Outcomes will be asked across the students at different stages of their BS BME program. During BME 4908 course, the survey was given at the beginning and end of the course as well. The scale is 1-5 with the following definitions: 1- novice, 2 – advanced beginner, 3 – competent, 4- proficient, and 5 – expert. This is an indirect measure that spans across the formative and summative years of the BSBME program.

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

The significant constituents of the Biomedical Engineering (BME) program at FIU are:

* FIU BME undergraduate students
* FIU BME undergraduate program alumni
* Biomedical industries that hire FIU BME graduates
* Graduate and Health Professional (*e.g.,* Medical) Schools where FIU BME graduates seek advanced degrees

The two survey instruments used to assess the PEOs include:

1. **Alumni surveys:** Starting 2021, alumni surveys will be conducted once in three years. An alumni survey (generated via Qualtrics) will be sent to all alumni in early Fall semester via personal email and social media (facebook and LinkedIn) to participate in the survey. The alumni survey and the questions asked are included in the survey template. (Alumni Survey).
2. ***Academic/Industry/Clinical Advisory board surveys***: In Fall 2021, the department began a new academic/industry/clinical advisory board (<https://bme.fiu.edu/biomedical-engineering-advisory-committee/>). This board will meet annually and surveys will be conducted to obtain input on the program educational objectives. This advisory board plans to meet annually every Fall starting 2021. The survey template is included in this link (Academic/Industry/Clinical Advisory Board Survey).

**Recommendations**

The department of Biomedical Engineering periodically seeks recommendations for curricular changes from diverse bodies and interest groups. In all cases, these recommendations will be discussed at the annual ABET retreat (end of Spring semester) towards curriculum modifications.

1. **Industry Advisory Board (IAB):** Our annual Industry advisory board (IAB) event is organized by the BMES student chapter every Fall semester, where invited speakers from industry as well our own BME faculty present their work, followed by interactions with students regarding what industry seeks, their prospects, and providing input on potential job opportunities and experiences expected from BME graduates in their firms.
2. **BME Alumni:** Since Fall 2018 a 90-min panel discussion with BME alumni is conducted during the Annual BME Undergraduate Research Day. BME alumni from industry, academic, medical school, and graduate school are invited in an open forum discussion with BME students (mostly graduating seniors) to learn of what each career path needs are and also provide feedback on how BSBME program objectives will allow meeting them. The feedback from these alumni prepares our current BME undergraduates towards their future, and the outcomes also assist the department in assessing our program objectives on a continuous basis.
3. **Student Chapters:** The department has 5 student chapters, which are very active and periodically meet throughout the year. These chapters include BMES, AEMB, IEEE-EMBS, IEEE-EPS, and SPIE. Recommendations made by this group through their faculty advisor are reviewed by the UPD and chair annually and as needed in between.

Various other recommendations are sought from senior design project sponsors, IAB industry lecture series invited speakers, FIU pre-med advisors and admission committee members, and clinicians and researchers via their invited guest lectures of the Coulter Seminar Series.

**Implementing Curriculum Changes**

The department meets annually at the end of each Spring semester for a whole day retreat to present the outcome of all the surveys from SLOs and PEOs and identify areas that require improvement, modifications, or new additions to the curriculum across each course as a continuous improvement process. More specifically, the results of the data collected from the undergraduate program verification process throughout the previous academic year (fall, spring, summer) are thoroughly reviewed. First, the major accomplishments of the undergraduate program and the major changes made to the undergraduate program are summarized for the recent academic year. The course outcomes as assessed from student surveys on BME required courses obtained each semester are discussed. Results related to the Primary measures are discussed, followed by detailed discussion of the Secondary measures, particularly those derived from each of the required courses of the program. All recommendations from various constituents will be discussed and appropriate changes to curriculum implemented to meet our program educational objectives (PEOs) as well as student learning outcomes (SLOs).The Undergraduate program committee meets once a month during the fall and spring semesters to discuss undergraduate program related issues. These undergraduate program issues are also summarized and updated/discussed at every departmental faculty meeting.