



July 2010

DRAFT - Bachelor of Science in Mechanical Engineering Eastern Washington University

Introduction

Eastern Washington University (EWU) proposes to offer a Bachelor of Science in Mechanical Engineering (BSME) beginning Fall 2010. The proposed program would complement a Bachelor of Science in Mechanical Engineering Technology (BSMET) currently offered in the Department of Engineering and Design. EWU projects enrollment of 25 FTE BSME students the first year, increasing to full enrollment of 70 FTE¹ by the fourth year. At full enrollment, the proposed program would graduate 20 students per year.

Relationship to Institutional Role and Mission and the Strategic Master Plan for Higher Education

EWU's mission is to "prepare broadly educated, technologically proficient, and highly productive citizens to attain meaningful careers, to enjoy enriched lives, and to make contributions to a culturally diverse society."² The proposed program would support this mission as well as the *Strategic Master Plan for Higher Education* policy goal of expanding degree programs in science, technology, engineering, and mathematics (STEM).

Diversity

EWU's campuswide diversity initiative has an excellent track record attracting diverse students, including many first-generation students. The department would supplement campuswide efforts through promotional literature targeted to women, tribal school visits, participation in Chicano Education Program activities, and diversity training for faculty. In addition, the Department would encourage under-represented students to live in a Living Learning Community, in which engineering students live on the same dormitory floor and participate in activities together.

¹ The 70 FTE students figure includes 50 FTE juniors and seniors.

² The EWU mission statement is available at <http://www.ewu.edu/x7780.xml>.

Program Need

Evidence of employer need for the proposed program is mixed. According to the *Statewide Employer Needs Assessment (2009)*, the largest number of engineering job openings between 2011 and 2016 will be for civil engineers, aerospace engineers, and mechanical engineers; however, the current supply of mechanical engineering graduates may be adequate.

The number of mechanical engineering degrees awarded in 2006-07 (322) exceeds the projected number of average annual job openings for 2011 to 2016 (184). These estimates, however, fail to account for the fact that up to 50 percent of mechanical engineering graduates enter other occupations such as business, computer science, or research.³

The Bureau of Labor Statistics' *Occupational Outlook Handbook* projects mechanical engineering job growth from 2008 to 2018 will be slower than the average across occupations, which is consistent with Washington State Employment Security Department projections for 2012 to 2017.

On the other hand, survey statistics from the National Association of Colleges and Employers (NACE) indicate higher employer demand for bachelors-level mechanical engineering graduates than other bachelors-level engineering graduates.⁴ In addition, these graduates command relatively high starting salaries, consistent with high employer need. EWU provided three letters of support from local employers, including Spokane's largest engineering firm.

Although employer need evidence is mixed, student need evidence is more clear. Currently, 33 EWU students are preparing for the proposed program. A survey of students in an existing upper-division mechanical engineering technology class revealed 88 percent would have preferred to major in mechanical engineering.⁵ In spring 2009, a survey of Spokane Falls Community College pre-engineering students found 55 percent of the 29 respondents were considering a mechanical engineering degree, and 75 percent would consider EWU.

Evidence for community need is relatively clear also. For example, Policy ED.7.4 of the Spokane County Comprehensive Plan is "Encourage the development of the region's colleges and universities into a world-class higher-education consortium that prepares students for the highly technical jobs of the information age . . ."⁶

The proposed program would support this goal by providing a pathway for students at local community colleges to obtain a BSME degree in Spokane County. It also would respond to the statewide and national community need to educate engineers. For example, in an April 14, 2009 address on the economy, President Obama called for a recommitment to educating scientists and engineers, people "who are building and making things we can export to other countries."⁷

³ HECB, SBTCC, and WTECB. *A Skilled and Educated Workforce: An assessment of the number and type of higher education and training credentials required to meet employer demand* (2009). Pages 19-20.

⁴ National Association of Colleges and Employers. *Job Outlook 2008*. Page 25.

⁵ When HECB staff asked whether mechanical engineering technology students would be qualified, program planners responded with data indicating a significant number possess sufficient mathematical ability to succeed in a mechanical engineering program.

⁶ Spokane County Comprehensive Plan, Page ED-7, available at: <http://www.spokanecounty.org/BP/data/Documents/CompPlan/Chapter8.pdf>

⁷ The address is available at: www.huffingtonpost.com/2009/04/14/obama-economy-speech-majo_n_186559.html.

The proposed program would meet employer, student, and community needs without unnecessarily duplicating existing programs. Although Gonzaga University offers a BSME program in Spokane County, the proposed program would differ in the emphasis it places on hands-on experience through laboratory work.

According to program planners, the proposed program would include more classes with laboratories than any other four-year program in the state. Although EWU currently offers a BSMET program, the BSME would complement it, rather than duplicate it, as described below.

Program Description

The proposed program is designed to provide a comprehensive education in mechanical engineering using classroom, applied research, experience-based learning, and extensive laboratory work. It could be completed part- or full-time, and would be delivered primarily through face-to-face instruction supplemented by technology. It would complement EWU's BSMET program by offering a curriculum that involves greater theoretical depth and more calculus-based classes.

Program planners expect about 10 BSME graduates per year would be students who otherwise would have enrolled in the BSMET program; however, they believe MET enrollment also would remain relatively high because some students either lack the mathematical background necessary for ME or prefer the stronger "hands on" emphasis of MET.

The proposed program would follow the department's open enrollment policy; so as soon as students express interest, they would be able to declare their major and be guaranteed acceptance. The open enrollment policy supports EWU's mission to serve first-generation and under-represented students. To ensure transfer students have access, the department intends to use the Statewide Engineering AS-T Track 2 Major Related Program (MRP) agreement.

To progress and succeed, students must earn a grade of 2.0 or better in any mathematics course used to satisfy a prerequisite requirement for a subsequent mathematics course, and maintain at least 2.5 cumulative GPA in department courses and a 2.0 cumulative GPA in all other coursework.

Students would graduate after completing a minimum of 187 quarter credits. The curriculum would require 125 credits of STEM-related coursework, 75 of which would be upper-division engineering and technology credits, covering robotics and automation, energy and heat, design and finite element analysis, fluids, and mechanics.

The junior year would provide theoretical background and address basic design criteria. The senior year would emphasize the practical side of the curriculum, including a mandatory team-based senior capstone project.⁸ In addition to the senior capstone project, students would complete an internship or an additional individual or team-based project.

⁸ In the capstone project, seniors would work in a design group to produce a new product.

The proposed program would require development of 14 new courses,⁹ including 13 of the program's 17 upper division courses. It would be taught primarily by full-time, tenured/tenure-track faculty including one new hire in the first year and a second hire in the third year.

Coursework would cover content areas specified by ABET,¹⁰ and EWU would pursue ABET accreditation immediately after the first cohort of students graduate. Students entering as juniors would normally complete the program in two years, achieving all of the following broad learning outcomes:

- Understand industrial concepts and technical and industrial terminology and processes.
- Apply knowledge to practical problems, use design tools efficiently, and experiment and apply experimental results to the design of mechanical and thermal systems.
- Plan and coordinate a project, manage systems, evaluate problems, and apply general design strategies.
- Respect diversity, function effectively on teams, and understand professional, ethical, and social responsibilities.
- Communicate verbally and write clearly and concisely.

Student assessment would include multiple measures such as problem sets, lab reports, examinations, oral presentations, and project reports. The capstone project would include a report presentation and peer evaluation. Internships would be assessed based on a student notebook documenting work and a report from the student's supervisory engineer.

The department would establish a curriculum committee of faculty and an advisory committee including professionals from the engineering community. The department would employ multiple program assessment measures, including student course evaluations, standardized exam results from a commercial Fundamentals of Engineering preparation exam, entry and exit surveys, alumni surveys, employer surveys, and advisory committee input. Data from these measures would be analyzed for themes or patterns and used as feedback for curriculum improvement.

Program Costs

The proposed program would enroll 25 FTE students the first year, growing to 70 FTE students by the fourth year. To implement it, the Department has budgeted for 3.0 FTE faculty (including two new hires at 0.5 FTE each), 0.5 FTE administrative staff (including a 0.25 FTE program coordinator, who is also the department chair), and a 0.25 FTE lab technician. It would use existing office, lab, and library facilities. It would be state-funded, via internal reallocation,¹¹ with limited impact on other departments or programs.

⁹ Of the 14 new courses, 12 would be based on existing BSMET courses.

¹⁰ ABET, Inc. accredits college and university programs in applied science, computing, engineering, and technology. The program proposal included course descriptions with notes showing how course-level learning objectives map to ABET criteria, indicating that program planners are taking a very thoughtful approach to course development.

¹¹ However, program planners have indicated that EWU would apply for high-demand funding if available.

Program planners budgeted \$163,000 (\$6,520 per FTE student) for the first year, increasing to \$346,000 (\$6,920 per FTE student)¹² at full enrollment in the fourth year. The full enrollment cost per FTE student lies at the lower end of the range of statewide averages for engineering students at public institutions. According to the HECB's *2005-06 Education Cost Study (July 2007)*, the direct cost per average annual FTE upper division undergraduate engineering student ranged from \$6,090 at EWU to \$15,976 at University of Washington Tacoma.¹³

External Review

Three external reviewers reviewed the program: Dr. Hugh Currin, P.E., Professor and Program Director, Mechanical Engineering, Oregon Institute of Technology; Dr. Christopher H.M. Jenkins, P.E., Professor and Head, Mechanical Engineering Department, Montana State University; and Dr. Ron Roth, Chair and Professor, Mechanical Engineering Department, California State University Chico.

All three reviewers were supportive. For example, Dr. Roth said the proposal was "very good." Dr. Currin said the program looked "excellent." He also said that the coursework looked very lab intensive, which he saw as a plus for a hands-on program. Dr. Jenkins found the program to be "well crafted and consistent with other ME programs nationwide." He pointed out several noteworthy features, including courses in robotics and finite element analysis and good laboratory facilities.

Each reviewer asked detailed questions, covering topics ranging from specific wording in the proposal to curriculum and staffing. All three asked staffing questions. Dr. Roth questioned whether staffing was sufficient. Program planners responded to Dr. Roth that the proposed faculty number is the number to start the program, the university has capacity to absorb BSME enrollments, and enrollment would be monitored and additional faculty added as warranted by enrollment.¹⁴

Staff Analysis

The proposed program would support the *Strategic Master Plan for Higher Education* and EWU's mission. Students' experience in the program would be enriched through EWU's campuswide and departmental diversity efforts.

Although evidence for employer need is mixed, we know that significant numbers of mechanical engineering graduates will find jobs either in related engineering fields or outside of engineering. Furthermore, the evidence for student and community need is sufficiently strong to justify approving the proposed program.

¹² Full-enrollment cost per FTE student computations are based on 50 FTE students, the projected number of upper-division FTE students at full enrollment.

¹³ Engineering at Washington State University Vancouver was omitted from this analysis because the average cost of instruction, \$17,778 reflects start-up investment in high-demand programs.

¹⁴ HECB staff asked what the Departments enrollment monitoring plan was, and program planners responded that the student-faculty ratio would be monitored every quarter, and additional faculty would be requested if it reached 18 or higher.

Student surveys indicate interest from both community college and EWU students. Spokane County's regional plan indicates that the program would respond to community need. The program would not unnecessarily duplicate existing programs and would be offered at reasonable cost.

Graduates would benefit from the program's emphasis on hands-on lab work, as well as from practical experience gained through its capstone project and internship opportunity. They also would benefit from a program designed for ABET accreditation, which EWU would pursue at the earliest opportunity. Until ABET accredits the program, however, its unaccredited status may have implications for students. For example, accreditation status may affect a person's ability to meet registration requirements to become a licensed professional engineer and when one may sit for the Fundamentals-of-Engineering (FE) exam. Furthermore, engineering job descriptions sometimes indicate a preference for graduates from ABET-accredited programs.

To its credit, EWU obtained more than the minimum number of external reviews. Reviewers were supportive of the proposed program but expressed concerns about adequate staffing. HECB staff shared these concerns, but program planners allayed them by explaining that the student-faculty ratio would be monitored quarterly and additional faculty would be requested if the student-faculty ratio exceeded 18.

Staff Recommendation

After careful review of the proposal and supporting materials, staff recommends conditional approval of the Bachelor of Science in Mechanical Engineering at Eastern Washington University. Approval is subject to the following condition, to be met prior to enrolling students and removed when EWU notifies HECB that the program is ABET accredited:

- EWU must inform prospective students of the implications of the program's ABET accreditation status. This includes ensuring the program's catalog description, Web pages, marketing materials, and advising staff make clear that Eastern Washington University is seeking ABET accreditation but does not have it yet and explain the effect this could have on students.

Program planners indicated EWU is willing to commit to meeting this condition.

The Higher Education Coordinating Board's Education Committee discussed the proposal during its June 23, 2010 meeting and recommended approval by the full Board.

RESOLUTION 10-12

WHEREAS, Eastern Washington University proposes to offer a Bachelor of Science in Mechanical Engineering; and

WHEREAS, The program would support the unique role and mission of the institution by producing technologically proficient and productive graduates; and

WHEREAS, The program would support the *Strategic Master Plan for Higher Education* and respond to student, employer, and community need by expanding access to a STEM degree; and

WHEREAS, The program's students would benefit from the Eastern Washington University's strong diversity efforts, from the institutional level down to the departmental level; and

WHEREAS, The program's students would benefit from a program designed for ABET accreditation, which EWU would pursue at the earliest opportunity; and

WHEREAS, Student and program assessment would employ multiple measures; and

WHEREAS, The program has support from external reviewers; and

WHEREAS, The program's cost would be reasonable;

THEREFORE, BE IT RESOLVED, That the Higher Education Coordinating Board approves the Bachelor of Science in Mechanical Engineering at Eastern Washington University, subject to the following condition to be met prior to enrolling students and removed when Eastern Washington University notifies HECB that the program is ABET accredited:

Eastern Washington University must inform prospective students of the implications of the program's ABET accreditation status. This includes ensuring the program's catalog description, Web pages, marketing materials, and advising staff make clear that Eastern Washington University is seeking ABET accreditation but does not have it yet and explain the effect this could have on students.

Adopted: July 15, 2010

Attest:

Jesús Hernandez, Chair

Roberta Greene, Secretary