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COLLEGE OF ENGINEERING ACCREDITATION REPORT AT THE UNIVERSITY OF IOWA

Action Requested: Receive the accreditation report from the College of Engineering at the University of Iowa.

Executive Summary: The College of Engineering Programs in Biomedical Engineering, Chemical and Biochemical Engineering, Civil and Environmental Engineering, Electrical and Computer Engineering, and Mechanical and Industrial Engineering (1) underwent a self-study that addressed the standards defined by the accrediting body; and (2) had an on-site visit by peer evaluators.

In August 2015, the College of Engineering was informed that the engineering programs were accredited for the maximum period of six years without further reporting required. The review by the Academic and Student Affairs Committee is to discuss the results of the accreditation review, the program improvements resulting from the accreditation visit, and future plans for the program/College.

This report, which addresses the Board of Regents Strategic Plan priorities to "ensure access to education and student success; to promote and support innovation in teaching, research, and economic development; and to promote effective use of resources to meet institutional missions," was submitted to the Board of Regents in January 2017. It also complies with Board policy on accreditation reporting.

Background:

- Description of programs. The mission of the College of Engineering is to graduate broadly educated engineers, conduct high quality research, develop breakthrough technologies, and disseminate and preserve technical knowledge.
- **Biomedical Engineering (BME)**. The BME curriculum provides an in-depth, rigorous undergraduate education in the fundamentals of engineering and engineering science. The curriculum requires the students to select a track, consisting of four track requisites and seven track elective courses that enable the student to specialize in one of several focus areas, including bioimaging; bioinformatics/biocomputational biology; biomaterials; cardiovascular biomechanics; cellular engineering; musculoskeletal biomechanics; and pre-medicine.
- **Chemical Engineering.** The core curriculum is designed to give students a strong foundation in chemical engineering. The elective focus area courses complement the core and allow the students to develop an area of specialization consistent with their career goals. The available options are biochemical engineering; business; energy and environment; entrepreneurial; pharmaceutics; polymers; pre-medicine; process engineering; sustainability; and custom.

- ⇨ **Civil Engineering (CEE)**. The CEE program delivers its curriculum in two sub-tracks – civil and environmental with one common core. Students can choose among eight elective focus areas that are intended for the student to achieve exposure and depth of study in an area that is complementary to their degree in CEE. The current elective focus areas are civil practice; environmental structures; structures, mechanics, and materials; transportation; hydraulics and water resources; management; urban and regional planning; and student tailored.

- ⇨ **Electrical Engineering (EE)**. This program offers a track-based curriculum. There are two curricular track designated as the Computer Track and the Electrical Track, both leading to the degree designation – Bachelor of Science in Engineering with a major in Electrical Engineering. The Computer Track is intended for students preparing for careers of advanced studies in the areas of computer software engineering; the Electrical Track is intended for students who are preparing for a traditional EE careers or who desire broad-based background for graduate or professional studies.

- ⇨ **Industrial Engineering (IE)**. Students choose an area of concentration which proves them an opportunity to acquire advanced education in an area of their choice – design and manufacturing; computer and information systems; entrepreneurship, human factors and ergonomics; management, pre-Med Track; Wind Energy; and student tailored. The student tailored areas are individualized and career-specific programs designed by the student and approved by the program. They allow students with unusual interests to explore various educational opportunities and aspirations to be an "Engineer and Something More."

- ⇨ **Mechanical Engineering (ME)**. The curriculum provides a rigorous and contemporary undergraduate education in the fundamentals of engineering and engineering science. The student is required to specialize in one elective focus area by selecting a minimum of seven courses in the chosen area – design; energy and environment; manufacturing and materials processing; and student tailored.

- ⇨ Purpose of Accreditation. An accredited educational program is recognized by its peers as having met national standards for its development and evaluation. To employers, graduate schools, and licensure, certification, and registration boards, graduation from an accredited program signifies adequate preparation for entry into the profession. In fact, many of these groups require graduation from an accredited program as a minimum qualification. Accreditation is also intended to protect the interests of students, benefit the public, and improve the quality of teaching, learning, research, and professional practice. Accreditation is also critical for recruitment of new students.

- ⇨ Accrediting Agency. The accrediting body is the Engineering Accreditation Commission of ABET. A program's accreditation is based upon the findings of the Visiting Team. The findings may include *deficiencies*, which indicate that the program is not in compliance with the criterion; *weaknesses*, which indicate that the program lacks the strength of compliance with the criterion to ensure that the quality of the program will not be compromised; *concerns*, which indicate that the program currently satisfies the criterion but the potential exists for the situation to change such that the criterion may not be satisfied; or *observations*, which are comments or suggestions that do not relate directly to the accreditation action but are offered to assist the institution to improve its programs.

- Review Process. The self-study prepared by the engineering programs contained the responses to the standards required by the accrediting body. ABET, through its Engineering Accreditation Commission, has established the accreditation standards for the six programs. The eight areas considered in the accreditation standards include the following – students; program educational objectives; student outcomes; continuous improvement; curriculum; faculty; facilities; and institutional support.
  - *Students*. This criterion includes information about requirements for student admission; process for evaluating student performance; systems and process for accepting transfer students and transfer courses; process for advising and providing career guidance to students; requirements and process for awarding credit for work in lieu of courses; and graduation requirements.
  - *Program Educational Objectives*. This criterion focuses on the mission (institutional, departmental, and program), program educational objectives, and their consistency with the mission of the institution. Programs are required to identify their constituencies and the process for review of the program educational objectives.
  - *Student Outcomes*. This criterion requires a list of the student outcomes for the program and where the outcomes are documented; programs must also establish the link between student outcomes and program educational objectives.
  - *Continuous Improvement*. Programs must document the process for regularly assessing and evaluating the extent to which the student outcomes are being attained. Programs must also document how the results of these processes are used to effect continuous improvement of the program.
  - *Curriculum*. Programs must describe the plan of study, including information on course offerings and curricular paths available. Programs must also describe how the curriculum aligns with the program educational objectives; how the curriculum and its associated prerequisite structure supports the attainment of the student outcomes; how the program meets the requirements in terms of hours and depth of study for each subject area; and describe the major design experience that prepares students for engineering practice.
  - *Faculty*. Programs must describe the qualifications of the faculty and how they are adequate to cover all the curricular areas of the program; faculty workload and size; opportunity for professional development; and faculty's role in course creation, modification, and evaluation; their role in the definition and revision of program educational objectives and student outcomes; and faculty's role in the attainment of the students outcomes.
  - *Facilities*. Programs must summarize each of the program's facilities in terms of their ability to support the attainment of the student outcomes and to provide an atmosphere conducive to learning.
  - *Institutional Support*. Programs must describe the leadership of the program and discuss its adequacy to ensure the quality and continuity of the program; describe the process used to establish the programs' budget; how teaching is supported by the institution; how resources are provided to acquire, maintain, and upgrade the infrastructure, facilities, and equipment used in the program; describe the adequacy of the staff; faculty hiring and retention; and support of faculty professional development.

- On-Site Team Report. In September 2014, the visiting team identified strengths, weaknesses, and concerns of the program. The team also determined that the engineering programs were in compliance with Engineering Accreditation Commissions' standards. The team offered a number of suggestions to enhance the programs; suggestions offered by the Visiting Team do not constitute accreditation or compliance requirements. There were no deficiencies identified by the Visiting Team.

- Sample Strengths Identified by the Visiting Team.
  - "Many students earned engineering credits prior to entering the university, with 33% of first-year students indicating they earned credits associated with Project Lead The Way. Through these experiences, incoming students already have an understanding of the engineering profession and curriculum, which may help in-major retention.
  - Over 80% of undergraduate engineering students are involved in experiential learning, such as internships or undergraduate research, with nearly a quarter of seniors participating in paid research positions at the time of the visit.
  - The College uses Elective Focus Areas which allow students to acquire advanced education in a specific area related to their major or in an area outside of common engineering curriculum. This additional depth or breadth makes students more attractive to potential employers. The College uses a broad view of the engineering field and promote a holistic approach to engineering career development.
  - The Biomedical Engineering program advisory board is directly and heavily involved in the senior design experience and other aspects of the curriculum.
  - The Chemical Engineering program emphasizes safety and knowledge of hazardous materials and conditions.
  - The Civil Engineering program's continuous improvement activities use well-thought-out rubrics to assess student performance."

- Program Weaknesses Identified by the Visiting Team.
  - **Electrical Engineering Program.**
    - ☑ Criterion 5 – Curriculum. Many student project reports lack multiple realistic constraints and do not clearly demonstrate the knowledge and skills acquired in earlier course work. It was also not evident that safety and design standards were adequately addressed in all design projects. Without clear ties to the knowledge and skills acquired in earlier coursework and adequate exposure to multiple realistic constraints and appropriate standards in the major design experience, student preparation for engineering practice is uncertain. *The Commission acknowledged receipt of spring 2015 student work from Electrical Engineering Senior Design demonstrating the inclusion of real-world constraints and engineering standards, along with background on the earlier coursework in which students acquired the knowledge and skill necessary for their design projects. The weakness was resolved.*

⇨ **Industrial Engineering Program.**

☑ Criterion 1 – Students. This criterion requires that student progress be monitored to foster success in attaining student outcomes. The team findings indicate that the program's system for monitoring student progress does not sufficiently address prerequisites. *The Commission acknowledge receipt of documentation describing the college's implementation of an automated pre-requisite checking process adopted by the university in fall 2014. This new system removes students who lack necessary faculty permissions from courses for which they are not prepared. The program also provided satisfactory background for students cited as not having met pre- or co-requisite requirements. The weakness was resolved.*

☑ Criterion 4 – Continuous Improvement. Course materials, including the syllabus, course outcomes, student project reports, and an assessment rubric, did not demonstrate that consideration of realistic constraints was covered within the course content. Because course content did not address realistic constraints, it was not clear how the program assessed and evaluated attainment of student outcome (c). *The Commission acknowledged receipt of assessment results from fall 2014 and spring 2015 and student-by-student rubric scores from spring 2015 for student outcome (c). The weakness was resolved.*

⇨ **Mechanical Engineering Program.**

☑ Criterion 1 – Students. The potential exists for students to graduate from the program without meeting all graduation requirements, strength of compliance with this criterion is lacking. *The Commission acknowledged receipt of documentation describing the college's implementation of an automated pre-requisite checking process adopted by the university in fall 2014. This new system removes students who lack necessary faculty permissions from courses for which they are not prepared. The weakness was resolved.*

☑ Criterion 5 – Curriculum. A number of the major design reports did not demonstrate sufficient use of appropriate engineering standards and constraints for mechanical engineering projects. Without adequate exposure to multiple realistic constraints and appropriate engineering standards in the major design experience, student preparation for engineering practice is uncertain. *The Commission acknowledged receipt of student work from the Mechanical Engineering Design Project demonstrating the inclusion of engineering standards and multiple constraints. The weakness was resolved.*

◈ Program Concerns Identified by the Visiting Team. (The Commission's responses are included in italics.)

⇨ **Biomedical Engineering Program**.

☑ Criterion 4 – Continuous Improvement. While assessment of student outcomes is conducted, the program does not have clear rubrics defining satisfactory attainment of each outcome. *The Commission acknowledged receipt of plans to address assessment rubrics and documentation of the continuous improvement process at the annual faculty fall semester retreat. Changes to the program's continuous improvement process, however, have not been enacted. The concerns remains unresolved.*

- ☑ Criterion 5 – Curriculum. To remain in compliance with this criterion, at least three of the six credits of 'Track Electives' must be engineering topics. To date, the program has betted each track elective course students have taken to ensure this criterion is met, but the increasing number of students enrolled and increasing number of available elective options could make the vetting process a challenge. *The Commission acknowledged receipt of documentation illustrating modifications to the electronic plan of study forms so that they now clearly label pre-approved engineering topics courses for track electives. The concern was resolved.*

- ☑ Program Criterion. The curriculum must prepare graduates to be able to apply advanced mathematics, including differential equations and statistics, science, and engineering to solve the problems at the interface of engineering and biology. There are currently a few assignments in which students apply statistics to problems at the interface of engineering and biology, but these are in classes that do not require statistics as a pre-requisite. If course assignments change, the curriculum may not prepare students to use statistics in design of experiments to test safety and efficacy of medical products. *The Commission acknowledged receipt of documentation describing the adoption of either a biostatistics course or a statistics course as a co-requisite for core courses and as a pre-requisite for design courses taken in the senior year, effective spring semester 2015. The concern was resolved.*

⇨ **Chemical Engineering Program.**

- ☑ Criterion 7 – Facilities. Alumni and students indicate that training and support for effective student use of the ChemCad tool is insufficient and can delay student learning and timely completion of major assignments. *The Commission acknowledged receipt of documentation illustrating that the program has mandatory training for ChemCad and that the tool is used in numerous courses during the last three years of the program. The concern was resolved.*

⇨ **Civil Engineering Program**.

- ☑ Criterion 8 – Institutional Support. The College's expenditures for civil engineering undergraduate laboratories has significantly decreased in recent years making laboratory maintenance and procurement of new or replacement equipment unsustainable. Sustained reductions in funding may impact the sufficiency of laboratories for providing an environment in which student outcomes can be maintained. *The Commission acknowledged receipt of documentation indicating that the decrease in laboratory expenditures was due to state budget cuts. In anticipation of the cuts, the program made a two-year investment in undergraduate teaching laboratories. During this period, new equipment was purchased and existing equipment upgraded. The laboratories are currently in good condition. While the program expresses confidence that sufficient funding will be available in the future to maintain high quality undergraduate laboratories, there is no evidence that this funding is assured. The concern remains unresolved.*

- Accreditation Status. In August 2015, the Engineering Accreditation Commission of ABET awarded accreditation to the engineering programs at the University of Iowa for the maximum period of six years to September 30, 2021 without reporting requirements. A Self-Study Report must be submitted to ABET by July 1, 2020. The reaccreditation evaluation will be a comprehensive general review.