

**Docket Item:**

University Program Approval: Oregon State University, Bachelor of Science (B.S.) in Engineering Science.

**Summary:**

Oregon State University proposes a new degree program leading to a B.S. in Engineering Science. The statewide Provosts' Council has unanimously recommended approval. Higher Education Coordinating Commission (HECC) staff completed a review of the proposed program. After Analysis, HECC staff recommends approval of the program as proposed.

**Staff Recommendation:**

The HECC recommends the adoption of the following resolution:

RESOLVED, that the Higher Education Coordinating Commission approve the following program:

B.S. in Engineering Science at Oregon State University.



## **Proposal for a New Academic Program**

**Institution: Oregon State University (Cascades Campus)**

**College/School: College of Engineering**

**Department/Program Name: Engineering Science**

**Degree and Program Title: BSES, Bachelor of Science in Engineering Science**

### **Program Description**

Proposed Classification of Instructional Programs (CIP) number. 14.1301

Brief overview of proposed program

An engineering program must prepare students for not only today's technological and societal challenges but also those of the future. These challenges are becoming more and more complex as well as multidisciplinary in nature. An Engineering Science program that provides students with a strong, broad foundation in engineering fundamentals rather than in a specific engineering discipline is proposed for this reason. The objective of this program is to prepare students to be engineers, but without pigeonhole-ing them into a single discipline. This approach addresses the emerging need for dynamic, agile, and flexible engineers [1].

The disciplinary foundation of the Engineering Science degree program is engineering, and the degree awarded upon completion of the program is a Bachelor of Science in Engineering Science. The curriculum has a common core built from select courses across several engineering disciplines (industrial, electrical, and mechanical) as well as the science and mathematics courses required by all these programs. Technical electives in these different disciplines will be offered, allowing a student to either gain exposure to several different fields by taking an assortment of those courses or to specialize in a particular area by taking technical electives focused in one of the concentration areas. An investigation of similar programs at peer and aspirational peer institutions was performed and their curricula used as models. It should be noted that some of the top engineering schools in the country (e.g., Harvey Mudd College and Olin College) offer similar programs. In addition, Pennsylvania State University—also a land, space, sun, and sea grant institution—offers an Engineering Science program as part of its honor college.

### **Program Delivery**

The Engineering Science program will be housed in the College of Engineering. The program will be offered face-to-face at the OSU-Cascades campus in Bend.

## **Relationship to Mission and Goals**

*Manner in which the proposed program supports the institution's mission, signature areas of focus, and strategic priorities.*

The addition of the Engineering Science program will be in strong alignment with the mission of Oregon State University. An Engineering Science program provides the people of Oregon and beyond, through education and research, the skills needed to improve economic and environmental progress directly and social and cultural progress indirectly. For example, consider Amar Bose and the company he founded in 1964, the Bose Corporation. In 2015, Bose had 3.5 billion in sales. The Bose product line includes an energy efficient series that uses 50% less energy than comparable sound systems. Like many products today, Bose headphones and speakers are an excellent example of engineering growing economic and environmental progress. Bose products indirectly improve social and cultural progress as well through the delivery of music of all types to people of all types. There are a multitude of examples of this kind. A student with a broad engineering background steeped in fundamentals, like that provided by this program, will be well poised to continue this tradition. It should also be noted that some schools advertise Engineering Science programs as a launching off point for law and medical degrees. This only further emphasizes the alignment of such a program with OSU's mission.

Today's technological and societal challenges are becoming more and more complex and multidisciplinary in nature, and this program will provide students with a strong, broad foundation in engineering fundamentals rather than in a specific engineering discipline. A comprehensive program of this nature will provide students with the solid background required to contribute to any of the three signature areas identified in OSU's strategic plan. For example, through training in electrical fundamentals, electronics, and energy distribution, a student in the Engineering Science program could work as a power engineer for a wind turbine company, thereby helping to "advance science in sustainable earth ecosystems" (a signature area). A student taking engineering graphics, material science, and capstone design could be employed in the medical device field, thereby helping to "improve human health and wellness." Historically, engineers have been "promoting economic growth and social progress," and students of this program would be well-positioned to continue doing so.

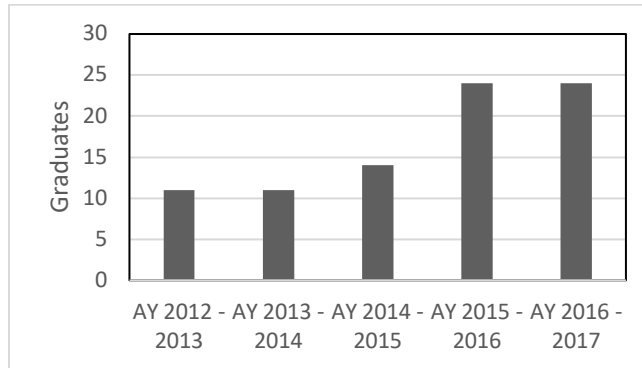
It is stated on the Oregon State University – Cascades website that the campus strives to be a "major contributor to the vitality of the unique Central Oregon community and environment." The population change of Deschutes County, where OSU-Cascades is located, from April 1, 2010 to July 1, 2016 was reported by the US Census to be 14.9% [2]. Additionally, the Bend-Redmond metropolitan area was the third-fastest-growing area of this kind from July 2015 to July 2016 [3]. Therefore, providing a second strong engineering program to the rapidly growing Central Oregon region is directly in line with this campus goal. Additionally, Cascades has stated that "it will be a destination of choice for students, faculty and staff seeking teaching and research excellence within a dynamic, inclusive and student-centered campus community." The Engineering Science program, by definition, is dynamic. Its inherent flexibility will allow both students and faculty to essentially "choose their own adventure." Studies indicate that the current generation of college-age students highly value both feeling valued and adventure. This program directly addresses these

values, making the program and OSU-Cascades a destination of choice.

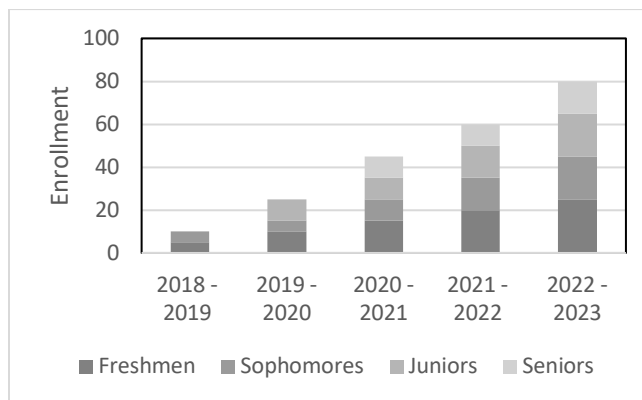
## Need

*Anticipated fall term headcount and FTE enrollment over each of the next five years.*

The OSU-Cascades Energy Systems Engineering (ESE) program was established in 2010. It is the only engineering program of its kind offered in the state of Oregon and one of five accredited programs in the country. The program has had strong enrollment growth as demonstrated by the graduation numbers shown in Figure 1. The Engineering Science program will also be the only one in Oregon. In addition, there are only eleven ABET accredited Engineering Science programs in the nation. Just over half of these programs are offered at public institutions, with the closest housed at Colorado State University. Enrollment trends comparable to that of the Energy Systems Engineering program are expected for the Engineering Science program due to these similarities. Projected enrollment for the next five years is shown in Figure 2. Note, each year five transfer students are expected to enter the program during their junior year. This is based on trends experienced in the ESE program.



**Figure 1:** Number of graduates from the Energy Systems Engineering program in the past five years.



**Figure 2:** Engineering Science enrollment projections.

*Expected degrees/certificates produced over the next five years.*

It is anticipated that 10 Engineering Science baccalaureate degrees will be awarded in spring 2022. In the five years that follow, trends similar to that shown in Figure 1 are expected. The only degree conferred by the program will be a Bachelor of Science in Engineering Science.

*Characteristics of students to be served (resident/nonresident/international; traditional/nontraditional; full-time/part-time, etc.).*

This program will serve resident, nonresident, and international students. It will be composed of traditional and nontraditional as well as full-time and part-time students.

*Evidence of market demand.*

Only three of the seven public institutions of higher education in Oregon offer engineering programs. None of those institutions currently offer an Engineering Science (or similar) program. The flexibility of this program will appeal to today's student as it directly addresses many of the values attributed to millennials [4]. An Engineering Science program would provide an additional program for the large engineering student body at OSU. Although the program is broad, the opportunity for areas of concentration in more traditional engineering disciplines would attract students interested in but not eligible for the OSU-Corvallis programs.

*If the program's location is shared with another similar Oregon public university program, the proposal should provide externally validated evidence of need (e.g., surveys, focus groups, documented requests, occupational/employment statistics and forecasts).*

This program's location will not be shared with similar programs. Additionally, this will be the only program of its kind offered at a public institution in Oregon.

*Estimate the prospects for success of program graduates (employment or graduate school) and consideration of licensure, if appropriate. What are the expected career paths for students in this program?*

The Engineering Science program will provide students with a strong, broad foundation in engineering fundamentals rather than a deeper focus on a specific engineering discipline. The students completing this program will be dynamic, agile, and flexible engineers capable of doing a variety of modern engineering jobs. Some of the many areas students graduating from this program will be ready to work in are industrial, electrical, mechanical, design, and process engineering. Additionally, they will be well-prepared for graduate studies in any of these fields as well as law or medical school.

Two national databases indicate a 6% employment growth rate in general engineering. Central Oregon business community members were asked if they felt a student with an Engineering Science degree would be employable. Those polled were from a variety of different areas including biotech, venture capital, aerospace engineering, and the Oregon Department of Energy. The response was an overwhelmingly yes! The professional engineer (PE) licensure is often earned by engineers (but is not necessary). The license requires a Bachelor's degree in Engineering from an ABET accredited school, demonstrable engineering experience under the supervision of another licensed engineer, as well as

successful completion of two tests. The first exam, the fundamentals of engineering (FE) test is offered in seven different disciplines. It is anticipated that students from this program will take FE Other Disciplines. The topics covered by this FE exam include: math; probability and statistics; chemistry; instrumentation and data acquisition; ethics and professional practice; safety, health, and environment; engineering economics; statics; dynamics; strength of materials; materials science; fluid mechanics; electricity, power, and magnetism; heat, mass, and energy transfer. Those topics are mapped to the proposed curriculum in Table 1. In general, each topic is covered in multiple courses. In addition, the Central Oregon Professional Engineers of Oregon indicated they felt the Engineering Science program will prepare students to successfully obtain their PE.

| Course No | Course Title                             | FE Topic  |
|-----------|--|---|
| CH 231    | General Chemistry                        | Chemistry   |
| CH 261    | Laboratory for Chemistry 231             | Chemistry   |
| MTH 251   | Differential Calculus                    | Mathematics and Advanced Engineering Mathematics                        |
| ESC 111   | Introduction to Engineering              | Ethics and Professional Practice; Safety, Health, and Environment       |
| CH 232    | General Chemistry                        | Chemistry   |
| MTH 252   | Integral Calculus                        | Mathematics and Advanced Engineering Mathematics                        |
| CS 161    | Introduction to Computer Science I       | Instrumentation and Data Acquisition                                    |
| MTH 254   | Vector Calculus I                        | Mathematics and Advanced Engineering Mathematics                        |
| MTH 256   | Applied Differential Equations           | Mathematics and Advanced Engineering Mathematics                        |
| PH 211    | General Physics with Calculus            | Dynamics  |
| ENGR 201  | Electrical Fundamentals I                | Electricity, Power, and Magnetism; Instrumentation and Data Acquisition |
| ENGR 211  | Statics                                  | Statics; Strength of Materials  |
| MTH 306   | Matrix and Power Series Methods          | Mathematics and Advanced Engineering Mathematics                        |
| PH 212    | General Physics with Calculus            | Dynamics  |
| ENGR 212  | Dynamics                                 | Dynamics  |
| ENGR 202  | Electrical Fundamentals II               | Electricity, Power, and Magnetism; Instrumentation and Data Acquisition |
| ST 314    | Introduction to Statistics for Engineers | Probability and Statistics  |
| PH 213    | General Physics with Calculus            | Electricity, Power, and Magnetism                                       |
| ENGR 203  | Electrical Fundamentals III              | Electricity, Power, and Magnetism                                       |
| ME 311    | Introduction to Thermal - Fluid Sciences | Fluid Mechanics and Dynamics of Gases, Heat, Mass, and Energy Transfer  |
| IE 415    | Simulation and Decision Support Systems  | Probability and Statistics  |
| ESC 340   | Introduction to Experimentation          | Instrumentation and Data Acquisition                                    |
| ESC 350   | Engineering Materials                    | Materials Science; Strength of Materials                                |
| ESC 497   | ESC Capstone Design                      | Ethics and Professional Practice  |
| ME 331    | Introductory Fluid Mechanics             | Fluid Mechanics and Dynamics of Liquids                                 |
| ESC 440   | Computational Methods for Engineers      | Mathematics and Advanced Engineering Mathematics                        |
| ENGR 390  | Engineering Economy                      | Engineering Economics   |

**Table 1:** Courses in the proposed curriculum mapped to FE topics

### Program Integration and Collaboration

*Closely related programs in this or other Oregon colleges and universities.*

Of the seven public higher education institutions in Oregon, three have engineering programs. Two private schools in Oregon offer engineering programs. Closely related programs within all of these programs include:

1. Oregon Institute of Technology:

- a. Electrical Engineering
  - b. Mechanical Engineering
- 1. Renewable Energy Engineering
- 2. Portland State University:
  - a. Electrical Engineering
  - b. Mechanical and Materials Engineering
- 3. Oregon State University:
  - a. Electrical Engineering
  - b. Mechanical Engineering
  - c. Industrial Engineering
- 4. George Fox University
  - a. Bachelor of Science in Engineering with four concentrations (civil, computer, electrical, and mechanical)
- 5. University of Portland
  - a. Electrical Engineering
  - b. Mechanical Engineering

*Ways in which the program complements other similar programs in other Oregon institutions and other related programs at this institution. Proposal should identify the potential for collaboration.*

This will be the only program of this kind in Oregon.

*If applicable, proposal should state why this program may not be collaborating with existing similar programs.*

N/A

*Potential impacts on other programs.*

From 2014 to 2015 the number of bachelor's of science degrees awarded from an engineering program grew by 7.5%. An upward trend that started in 2007. The Bureau of Labor Statistics projects employment of mechanical engineers will grow by 5% from 2014 to 2024 while that of electrical and industrial engineers will hold steady. Anecdotal evidence indicates technology companies are bracing for the "silver tsunami." They indicate a large portion of their workforce is preparing to retire and the supply for replacements is low, especially in engineering. All these facts indicate strong demand for engineers and that an additional engineering program would not negatively impact any of the current programs.



## HECC Docket Submission

Oregon State University seeks the Oregon Higher Education Coordinating Commission approval to offer an instructional program leading to a Bachelor of Science (BS) in Engineering Science.

### Program Description and Justification

1. Identify the institution, degree, and title of the program.

Oregon State University is proposing to offer a new Bachelor of Science degree program in Engineering Science beginning summer 2020. The program will be located in the College of Engineering. The proposed program will be delivered face-to-face on the OSU-Cascades.

2. Describe the purpose and relationship of the proposed program to the institution's mission and strategic plan.

The Engineering Science (ESC) program is designed to provide students with a strong foundation in engineering fundamentals. The base of the T-shaped curriculum is a common core built from select courses across several engineering disciplines (industrial, electrical, and mechanical) as well as the science and mathematics courses required by those programs. The depth of the curriculum is provided by technical electives. Electives from a variety of different engineering disciplines will be offered, and students can specialize by taking courses focused in a single area. The degree awarded will be a Bachelor of Science in Engineering Science. Some of the many fields students graduating from this program will be ready to work in are industrial, electrical, mechanical, design, and process engineering.

A comprehensive program of this nature would provide students with the solid background required to contribute to any of the three Signature Areas identified in the OSU mission statement. A graduate of the proposed Engineering Science program could work as a power engineer for a wind turbine company, addressing Advancing Science in Sustainable Earth Ecosystems. A graduate who pursued engineering graphics and material science could be employed in the medical device field, addressing Improving Human Health and Wellness. Historically engineers have been Promoting Economic Growth and Social Progress and graduates of this program would be well-positioned to continue that tradition.



3. What evidence of need does the institution have for the program?

The BS in Engineering Science would also be the only program of its kind in Oregon. Additionally, there are only eleven ABET accredited engineering science programs in the nation. Just over half of these programs are offered at public institutions, with the closest housed at Colorado State University.

4. Are there similar programs in the state? If so, how does the proposed program supplement, complement, or collaborate with those programs?

Only three of the seven public institutions of higher education in Oregon offer engineering programs. None of those institutions currently offer an engineering science (or similar) program.

All appropriate University committees and the Statewide Provosts Council have approved the proposed program. The Oregon State University Board of Trustees approved the program on January 23, 2020.

**Recommendation to the Commission**

The Statewide Provosts Council recommends that the Oregon Higher Education Coordinating Commission authorize Oregon State University to establish an instructional program leading to a Bachelor of Science (BS) in Engineering Science effective summer 2020.

*Revised May 2016*

**Institution: Oregon State University**

**Program: Bachelor of Science in Engineering Science**

**Action:** At the **March 5, 2020** meeting, the Statewide Provosts Council approved a new program for **OSU, BS in Engineering Science** to move forward to the Oregon Higher Education Coordinating Commission for its review and approval. The **OSU** Board of Trustees approved the **BS in Engineering Science** program at its **January 23, 2020** meeting.

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**Eastern Oregon University**

Sarah Witte, provost

Approved

Opposed

Abstained



**Oregon Health & Science University**

Elena Andresen, interim provost

Approved

Opposed

Abstained



**Oregon State University**

Ed Feser, provost

Approved

Opposed

Abstained



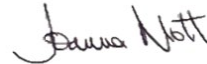
**Oregon Tech**

Joanna Mott, provost

Approved

Opposed

Abstained



**Portland State University**

Susan Jeffords, provost

Approved

Opposed

Abstained



**Southern Oregon University**

Susan Walsh, provost

Approved

Opposed

Abstained



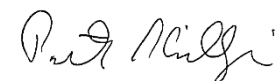
**University of Oregon**

Patrick Phillips, provost

Approved

Opposed

Abstained



**Western Oregon University**

Rob Winningham, provost

Approved

Opposed

Abstained

