BS Renewable Energy Engineering

2019-20 Assessment Report

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1 Introduction

1.1 Program Design and Goals

The Bachelor of Science in Renewable Energy Engineering (BSREE) program at Oregon Institute of Technology (Oregon Tech) has been designed to provide interdisciplinary education in mechanical, electrical, and chemical engineering topics as they apply to renewable energy. Students take coursework in communications, natural sciences, mathematics, and the humanities and social sciences to support their engineering coursework.

The BSREE program goal is to provide graduates for careers in areas of renewable energy engineering including but not limited to: solar, solar thermal, wind power, wave power, geothermal energy, transportation, energy storage, hydroelectric and traditional energy fields such as power systems, smart grid, energy management, energy auditing, energy systems planning, energy economics, energy policy and development, carbon accounting and reduction, and controls and instrumentation. BSREE graduates will enter renewable energy engineering careers as design, site analysis, product, application, test, quality control, and sales engineers.

1.2 Program History

In 2005, the Oregon Institute of Technology (Oregon Tech) began offering its new Bachelor of Science degree in Renewable Energy Systems (BSRES) program at its satellite campus in Portland, Oregon. The BSRES degree was the first of its kind in North America, and it was created to prepare graduates for careers in various fields associated with renewable energy. These included, but were not limited to, energy management, energy auditing, energy systems planning, energy economics, energy policy and development, carbon accounting and reduction, and energy-related research, as stated in Oregon Tech's 2005-06 catalogue.

In 2008, however, the BSRES degree was discontinued and replaced by the Bachelor of Science degree in Renewable Energy Engineering (BSREE). Analysis of the market place and observed growth in career options across the renewable energy fields revealed significant opportunities for graduates with a solid energy engineering education. By design, the original BSRES program was built atop a firm engineering foundation, and the curriculum could generally be described as near engineering-level. But the title of the degree, Renewable Energy Systems, a dearth of 300-level mathematics coursework and the absence of several key engineering fundamentals courses prevented the degree from being considered a full engineering degree program, particularly one that could be accredited as by the Engineering Accreditation Commission of ABET, Inc. By stating engineering as a principle programmatic focus, the career potential for graduates expanded beyond those

careers or they would not find employment in these fields to begin with. Our survey of the renewable energy industry cluster in the Pacific Northwest convinced us that an engineering degree, the BSREE degree, was the only suitable option for our students.

1.3 Industry Relationships

<u>Table 1: Rubric for EAC-1- An ability to identify, formulate, and solve complex engineering problems</u> by applying principles of engineering, science, and mathematics

Students must demonstrate the following Program Outcome

EAC-1). an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

Criteria	1-Developing	2-Accomplished	3-Exemplary	Score
IDENTIFY AND DEFINE PROBLEMS BY COLLECTING DATA AND INFORMATION	Identify the known/unknown for a problem and indicates where information is needed (comprehension). Describe a problem to be solved and define resources needed (know).	Identifies where and improvement can be made after analyzing variable limits for a basic model (analysis.) Develops, conducts and uses resources to collect information. (application) Develops possible alternative solutions to a given solution (application)	Combines data, facts and engg. knowledge to build variables, resources and limits into a problem statement and new solution (synthesis) Evaluate resources and information to assess problem statement with regard to objectivity, relevance and validity and the effectiveness of solution (evaluation)	
Model and Design the Experiment by Applying Knowledge of Mathematics/sci Ence	Explains the role of mathematics/science and understands the importance of experiments as a tool in modeling a system or process (comprehension). Discuss the types of applicable model (knowledge) Determines the appropriate experimental methods for the problem (comprehension)	Applies mathematical/scientific principles to formulate a model with the appropriate level and scope (application) Designs and conducts an experiment to obtain problem information (application) Investigates functional relationships of a model for validity and analyzes the result to draw conclusions for the problem (analysis)	Identifies math/physical assumptions that allow models to be developed and determine if model data supports hypothesized relationships (analysis.) Combines principles to formulate models for a system/process in an area of concentration and to extend knowledge of the problem (synthesis). Evaluate validity of engg. models by comparing solutions to known results (evaluation).	
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IMPLEMENT SOLUTION	process and documentation and define the performance of a system or process (comprehension).	Analyzes modeling results of a system or process using sci/eng principles (analysis.) Reveiws/critiques documentation by others to problem at hand (analysis.)	draw and support conclusion (synthesis.) Interprets the sci/eng significance of model predictions with respect to impact factors (evaluation)	
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Table 2. Rubric for EAC-2- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

Students must demonstrate the following Program Outcome

EAC-

EVALUATES RELATIVE VALUE OF A FEASIBLE SOLUTION AND IMPLEMENT THE BEST DESIGN	Describes evaluation methods and makes choice given a set of alternatives (comprehension.). Names methods and applicability (knowledge)	Selects and applies the best method to evaluate a solution (application). Analyzes results of an evaluation with other alternatives (analysis.).	Ranks results of an evaluation, select appropriate alternative and proceed with the design (synthesis). Judges quality of the evaluation (evaluation).	
Communication and documentation	Describes methods available (DR, reports), (knowledge).	Prepares proper documentation for a review as needed in design process (app). Analyzes results from presentation methods and adjusts designs (analysis.)	Performs effective reviews and evaluates potential quality (eval).	

Table 3: Rubric for EAC-3- An ability to communicate effectively with a range of audiences

Students must demonstrate the following Program Outcomes

EAC-3: an ability to communicate effectively with a range of audiences

Criteria 1-Developing

2-Accomplished

3-Exemplary

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summary. effectively.

Table 4: Rubric for EAC-4- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Students must demonstrate the following Program Outcome

EAC-4). An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which m consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Criteria

1-Developing

2-Accomplished

Knowledge of contemporary issues	List and discuss socio- econ, political and environment issues (knowledge) Summarizes the focus of issues and list harmful effects of technology on the environment (comprehension.)	Interprets specific scenarios relative to contemporary issues (comprehension.) Defend the impact of a particular group or party (environmental/political/societal/e conomic) (knowledge)	Analyze issue at the system level by breaking down an issue (analysis.) Design performs experiments with models to draw conclusions about an issue decisions (application) Evaluate solution in regards to contemporary issues, and device alternate solutions to mitigate impact (evaluation)	
IDENTIFYING SOCIAL AND GLOBAL IMPACT OF ENGINEERING SOLUTION	List basic impacts and describe key features of individual and universal perspective (knowledge)	Can describe the role of science and technology from different perspective (Can interpret the potential impacts of a given engg. solution and failure (knowledge State and classify the societal, global, along with environmental, economic and political impact a solution could have (comprehension		

<u>Table 5:</u> Rubric for EAC-5- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

Students must demonstrate the following program outcome.

EAC 5: an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

Criteria	1— DEVELOPING	2—Accomplished	3— Exemplary	Score
TEAM	Can describe what an			
PARTICIPATION	individual does to			
and communication	contribute to a team (comprehension).			
COMMUNICATION	(comprenension).			
	Understands active			
	listening and			
	constructive feedback			
	(knowledge).			

DEVELOPS A GROUP CONSENSUS

CONDUCTING AN EXPERIMENT	Understands the use of equipment and models in an experiment (knowledge). Recognizes appropriate safety procedures (knowledge). Selects the appropriate test equipment/models to use in an exp. (comprehension)	Aware of measurement errors and uncertainty in an exp. (comprehension). Explains the operation test equip/models for an experiment (comprehension.). Uses appropriate measurement techniques to collect data (Application). Document collection procedures use for exp. Repeatability	Anticipates and minimizes data errors (Application). Develop alternative approaches to an exp (Application).
Analyzing experimental data	Select and explain different methods of data analysis (comprehension). Uses appropriate tools to analyze data (Application).	(application). Explain the level of analysis required (comprehension	

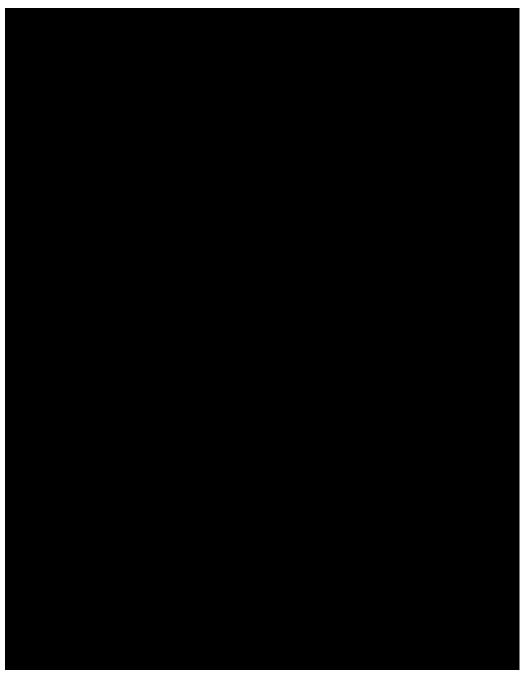


Figure 1: Scorecard for Outcome (1) containing 3 performance criteria

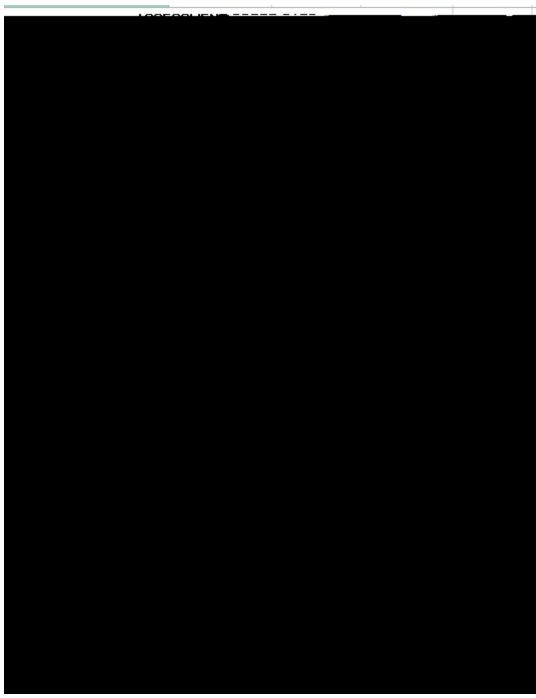


Figure 3: Scorecard for Outcome (3) containing 3 performance criteria

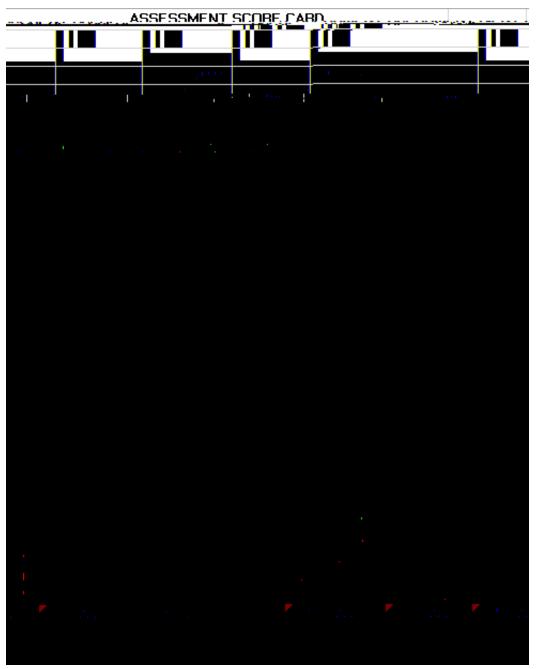


Figure 4: Scorecard for Outcome (4) containing 4 performance criteria



Figure 5: Scorecard for Outcome (5) containing 3 performance criteria

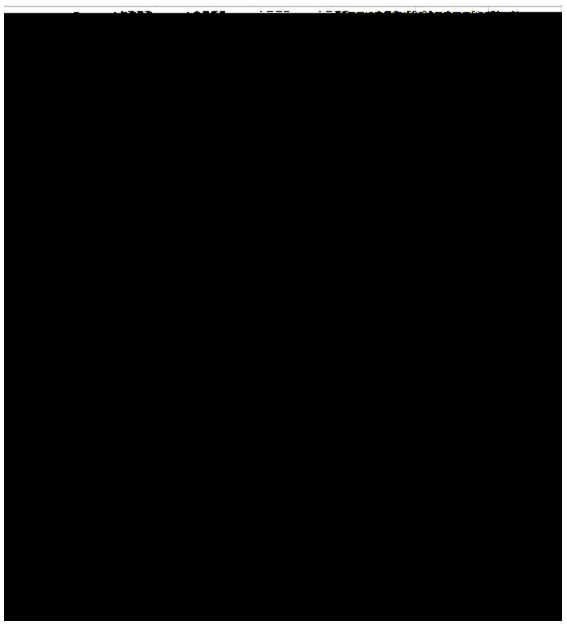


Figure 6: Scorecard for Outcome (6) containing 5 performance criteria

The mapping process aims to systemize the assessment of engineering coursework, and to provide a mechanism that facilitates the design of engineering assignments that meet the relevant outcomes, particularly those that are more distant from traditional engineering coursework. Rather than considering how the outcomes match the assignment, the assignment is designed to map to the program outcomes.

A systematic, rubric-based process is then used to quickly assess the level of attainment of a given program outcome, based on a set of performance criteria. The work produced by each student is evaluated according to the different performance criteria, and assigned a level of 1-developing, 2-accomplished, or 3-exemplary. The results for each outcome are then summarized in a table, and reviewed by the faculty at the annual Closing-the-Loop meeting.

The acceptable performance level is to have at least 80% of the students obtain a level of accomplished or exemplary in each of the performance criteria for any given program outcome.

If any of the direct assessment methods indicates performance below the established level, that triggers the continuous improvement process, where all the direct and indirect assessment measures associated with that outcome are evaluated by the faculty, and based on the evidence, the faculty decides the adequate course of action. The possible courses of action are these:

Collect more data (if there is insufficient data to reach a conclusion as to whether the outcome is being attained or not); this may be the appropriate course of action when assessment was conducted on a class with low enrollment, and it is recommendable to re-assess the outcome on the following year, even if it is out-of-cycle, in order to obtain more data.

Make changes to the assessment methodology (if the faculty believe that missing the performance target on a specific outcome may be a result of the way the assessment is being conducted, and a more proper assessment methodology may lead to more accurate numbers); for example, this could be the suggested course of action if an outcome was assessed in a lower-level course, and the faculty decide that the outcome should be assessed in a higher-level course before determining whether curriculum changes are truly needed.

Implement changes to the curriculum (if the faculty conclude that a curriculum change is needed to improve attainment of a particular outcome). A curriculum change will be the course of action taken when the performance on a given outcome is below the target level, and the evidence indicates that there is sufficient data and an adequate assessment methodology already in place, and therefore there is no reason to question the results obtained.

If the faculty decide to take this last course of action and implement curriculum changes, the data from the direct assessments is analyzed and the faculty come up with a plan for continuous improvement, which specifies what changes will be implemented to the curriculum to improve outcome performance.

In addition to direct assessment measures, indirect assessment of the student outcomes is performed on an annual basis through a senior exit survey.

The results of the direct and indirect assessment, as well as the conclusions of the faculty discussion at the Closing-the-Loop me3(ia)5(tt6(f)-2(a) 0 61205u0 g0120y5e)54(w)d0 g012 the ts and t46 Tm0 TwtheSETE is suf(la)5(s)-4(t)-6

are presented and discussed with all the department faculty at the annual Convocation meeting in Fall, as well as with the Industry Advisory Council (IAC) at the following IAC meeting. If approved, these changes are implemented in the curriculum and submitted to the Curriculum Planning Commission (if catalog changes are required) for the following academic year.

3.3.3 2019-20 Targeted Direct Assessment Activities

The sections below describe the 2019-20 targeted assessment activities and detail the performance of students for each of the assessed outcomes. Unless otherwise noted, the tables report the number of students performing at a developing level, accomplished level, and exemplary level for each performance criteria, as well as the percentage of students performing at an accomplished level or above.

Performance Criteria	Criteria 1-Developing 2-Accomplished		3-Exemplary	% student >1				
1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics								
Identify and Define Problems by collecting data and information	1	3	4	87.50%				
Model and design the experiment by applying knowledge of mathematics/science	0	3	5	100%				
Applying knowledge of scientific and engineering principles to interpret result and implement solution	1	3	4	87.50%				

3.3.5 Targeted Assessment for Outcome (1) an ability to identify, formulate, and solve complex
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students' ability to apply knowledge of scientific and engineering principles to interpret results and implement a solution.

Outcome (3

6. A

	environmental, and societal contexts									
5	5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	41.67%	5	50.00%	6	8.33%	1	0.00%	0	12
6	6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	27.27%	3	63.63%	7	9.09%	1	0.00%	0	11
7	 An ability to acquire and apply new knowledge as needed, 									

1.	Identify and Define Problems by collecting data and information	8	7	87.50%
2.	Model and design the experiment by applying knowledge of mathematics/science	8	8	100%
3.	Applying knowledge of scientific and engineering principles to interpret result			
	and implement solution	8	7	87.50%
OL	itcome (1): (REE 377, Fall 2019, Dr. Cla	udia Torres Gariba	ay)	
1.	Identify and Define Problems by collecting data and information			
2.	Model and design the experiment by applying knowledge of mathematics/science			
3.	Applying knowledge of scientific and engineering principles to interpret result and implement solution			

- Recommendation: The faculty identified no problem with this outcome, and therefore recommended no changes at this time.

Outcome (6): - Results: