{ Master of Science in Engineering (MSE) {
2018-19 Assessment Report

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1 Program Mission and Educational Objectives

1.1 Program Mission

The mission of the Master of Science in Engineering (MSE) program at Oregon Institute of Technology is to prepare engineering professionals with advanced knowledge and skills in high-demand multi-disciplinary engineering fields who are ready to assume a broad range of technical and leadership roles.

The MSE program supports the university mission of offering "innovative, professionally-focused undergraduate and graduate degree programs" and providing "a hands-on, project-based learning environment," with an emphasis on "innovation, scholarship, and applied research." It is an applied professional MS program in engineering, designed to allow maximum flexibility while maintaining academic rigor. The flexibility in the MSE degree ensures a relevant, up-to-date educational experience, and the ability to meet emergent industry needs in multidisciplinary technical fields. The program also aligns with the university core themes (applied degree programs, student and graduate success, statewide educational opportunities, and public service).

1.2 Program Educational Objectives

The following program educational objectives (PEO) reflect what graduates from the MSE program should be able to acomplish within a few years of graduation, and stem directly from the program mission.

PEO1: Graduates of the program will excel as professionals in a broad range of technical and leadership roles within the various fields of engineering.

PEO2: Graduates of the program will demonstrate an ability to apply advanced engineering methods to the solution of complex problems involving one or more engineering disciplines.

PEO3: Graduates of the program will demonstrate an ability to acquire emerging knowledge and remain current within their field.

2 Program Description

2.1 Program Description

The MSE program is designed as a highly customizable and modular MS engineering degree, which enables students to choose coursework from multiple disciplines to design specialties typically not available in the classical engineering MS degrees. MSE students have the ability to customize the MSE to be highly relevant to their professional interests. The flexibility to design a specialized or multidisciplinary degree program, while maintaining practical focus and academic rigor, is the defining element of the program and is what makes it such a close match to the interdisciplinary environment in today's fast changing industries. This ensures a relevant, up-to-date educational experience, and the ability to meet urgent industry needs in multidisciplinary technical fields.

The MSE program offers several tracks or specialties (see Table 1) in differentiated areas that the faculty, in consultation with the Industry Advisory Board, have identified as high-demand fields. Depending on their interest and career goals, students can choose to complete a multidisciplinary, specialized, or a more classical MSE program. All of the tracks offer some degree of customization and they all have a mutidisciplinary element, with the track labeled Multidisciplinary/No Specialty being the most flexible.

Table 1: MSE Tracks/Specializations

Multidisciplinary
MSE (Multidisciplinary)
MSE in Systems Engineering
Specialized
MSE in Robotics, Autonomous Systems and Control
MSE in Embedded Systems Engineering
MSE in Optical Engineering
MSE in Power Systems Engineering
Classical
MSE in Electrical Engineering

2.2 Program Location

The Master of Science in Engineering (MSE) is offered at the Oregon Tech Portland Metro (PM) Campus, located in Wilsonville, on the south side of the Portland metropolitan area. The campus is situated in a wooded business park setting among several technology companies including Mentor Graphics, Rockwell Collins, and Xerox. The campus is conveniently

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4 Curriculum Map

The MSE curriculum map supports the development and attainments of the program outcomes. Table 3 provides a mapping of the courses in the MSE curriculum to each program outcome. The table identifies how each program outcome appears within the curriculum at the Foundation (Introduction), Practice (Reinforcement and Application) and Capstone (Synthesis) levels.

Table 3: MSE Curriculum to Outcome Mapping

Course	Outcome A	Outcome B
Graduate Research, Development & Innovation (Required for all MSE Tracks)		
ENGR 511 Research Methods I	F, P	{
ENGR 512 Research Methods II	F, P	{
ENGR 513 Research Methods III	F, P	{
ENGR 59X Graduate R&D/Project/Thesis	C	C
ENGR 59X Graduate R&D/Project/Thesis	C	C
ENGR 59X Graduate R&D/Project/Thesis	C	C
MSE in Electrical Engineering		
EE 5XX EE Specialty Course I	{	F
EE 5XX EE Specialty Course II	{	F, P
EE 5XX EE Specialty Course III	{	P
Engineering Electives (12 cr)	Varies	
MSE in Automation, Robotics & Control Engineering		
ENGR 520 Engr. Modeling	{	F
ENGR 524 Adv. Control Engr.	{	F, P
ENGR 523 Motion Control	{	F, P
ENGR 521 Automation for Robotics	{	P
EE 530 Linear Systems & DSP	{	F, P
Engineering Electives (4 cr)	Varies	
MSE in Embedded Systems Engineering		
EE 535 Embedded Systems I	{	F
EE 555 Embedded Systems II	{	F, P
EE 565 Sensors & Instrumentation	{	P
Engineering Electives (12 cr)	Varies	
MSE in Optical Engineering		
EE 548 Geometric Optics	{	F
EE 549 Optical Detection & Radiometry	{	F
EE 550 Physical Optics	{	F
EE 551 Lasers	{	P
EE 552 Waveguides & Fiber Optics	{	P
EE 553 Optical Metrology	{	P
MSE in Power Systems Engineering		
REE 529 Power Systems Analysis	{	F F
REE 549 Power Systems Protection & Cntrl	{	F, P
REE 569 Grid Integration of Renewables	P {	

EE 552 Wavl0 1 143.885 299.596 cm []0 d 0ing

F, P

5 Assessment

The MSE student outcomes are assessed on an annual basis.

Direct assessment is performed according to Table 4. Outcome A is assessed in a core course required in all MSE tracks. Outcome B is assessed in a core course for each one of the MSE tracks. Both outcomes are also assessed in the graduate thesis or project, which is the culminating experience bringing together the different knowledge and skills acquired in the program.

Indirect assessment is conducted via a survey of graduating students, where the students rate their level of attainment for each of the program outcomes.

Table 4: MSE Annual Assessment of Student Outcomes

MSE Track	Course with Direct Assessment	Outcomes A	B
All			

6 Assessment

6.1 Methods for Assessing Program Outcomes

Faculty in the MSE program perform direct assessment of program outcomes in their courses from Fall through Spring terms, according to Table 4. This assessment is performed using specific assignments or exam questions that target the particular outcome. A systematic, rubric-based process is then used to assess student attainment of the outcome based on a set of performance criteria. The rubrics are included in the Appendix. The results of all the assessment activities are then summarized in an annual assessment report. At the end of each academic year, the program faculty meet to review the assessment data at the annual Closing-The-Loop meeting.

Additionally, all graduating students are asked to fill out an anonymous exit survey. As part of the survey, students are asked to rate their level of attainment of the program outcomes. This provides an indirect assessment measure. The results of this indirect assessment are also included in the assessment report, and evaluated at the Closing-The-Loop meeting

The Closing-The-Loop meetings provide an opportunity to evaluate and compare assessment results, and discuss whether any changes are needed to the curriculum or to the assessment methodology in order to improve attainment of the outcomes or to improve effectiveness, objectivity, and consistency in the assessment methodology. By comparing assessment results over multiple years, faculty can also ascertain the effect of previous changes to curriculum or assessment methodology on outcome attainment or assessment results.

6.2 Summary of Data Collected AY 2018-19

The sections below describe the assessment activity and performance of students for each of the assessed program outcomes. The tables report the number of students performing at a 1-developing, 2-accomplished, and 3-exemplary level for each performance criteria, as well as the percentage of students performing at an accomplished level or above. The departmentally established objective is to have at least 80% of students performing at an accomplished level or better. If a smaller percentage of students is meeting this threshold in any of the performance criteria, this would be flagged as an area of concern and further action would be discussed at the Closing-The-Loop meeting.

6.2.1 Direct Assessment for Outcome a: an ability to conduct research and development involving one or more engineering disciplines.

This outcome was assessed in ENGR 512 Research Methods II and ENGR 597 Graduate Project, according to the performance criteria indicated in the Outcome (a) rubric, included in the Appendix.

Outcome (a) : ENGR 512, Winter 2019, Dr. Mateo Aboy

6.2.2 Direct Assessment for Outcome b: an ability to apply advanced engineering concepts, methods and principles to solve complex technical problems.

This outcome was assessed in one of the required courses for each track of the MSE program, as well as ENGR 597 Graduate Project, according to.the performance criteria indicated in the Outcome (b) rubric, included in the Appendix.

Outcome (b) : EE 501, Spring 2019, Dr. Scher

Both the problem set and lab simulation consisted of problems that required the application of series calculus, stability concepts from control system engineering, di erential equations, and Matlab programming.

Students were expected to apply their conceptual knowledge of di erential equations, series calculus, classical control systems, and Matlab programming to solve and simulate a small variety of complex transformations, as well as understanding how to use Matlab to plot a discrete impulse response h(n) of a discrete system suitable for implementation in a control system.Table 8 summarizes the results of this assessment.

Table 8: Outcome (b) : ENGR 524, Winter 2019, Dr. Robert Melendy (N = 5)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% Students	2
b.1 - De nition	1	{	4	80.0%	

There were no students enrolled in EE 552 this year and therefore this assessment was not conducted, as Table 10 indicates.

Table 10: Outcome (b) : EE 552, Winter 2019, Dr. Scott Prahl (N = 0)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% Students	2
b.1 - De nition	{	{	{	N/A	
b.2 - Design	{	{	{	N/A	
b.3 - Evaluation	{	{	{	N/A	

Outcome (b) : REE 549, Winter 2019, Dr. Venugopal

This outcome was assessed in REE 549 - Power Systems Protection and Control during the Winter 2019 term. Students were given a design project to assess this outcome. There were totally 4 assignments to carry on the project stage by stage.

In the rst assignment students were asked to design a single line diagram of given power system transmission loop. The purpose of the assignment was to develop the basic understanding of the given speci cation and to develop power ow diagram accordingly. The second assignment of this project was to develop voltage control methods, including use of generator excitation control, tap changing and regulating transformers, static capacitors, static var systems and parallel transmission lines. The purpose of this assignment was to prepare an engineering design according to the constraints speci ed. The third assignment speci es the types of faults under which the performance of the designed project need to be tested. Using this assignment, the performance of the designed project under di erent fault conditions were tested. The fourth assignment was used to test the ability of students in selecting the breaker and fuse characteristics to handle the fault currents tested in assignment 3.

All the assignments were intended to test the understanding of the given problem, design an engineering project according to the speci cation, test the design performance for various real time fault situations and provide acceptable solution to handle the fault conditions. The results were submitted as an executive summary and detailed report for each case along with the data les. Table 11 summarizes the results of this assessment.

Table 11: Outcome (b) : REE 549, Winter 2019, Dr. Chitra Venugopal (N = 2)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% Students	2
b.1 - De nition	{	2	{	100%	
b.2 - Design	{	1	1	100%	
b.3 - Evaluation	{	1	1	100%	

Outcome (b) : SEM 522, Winter 2019, Prof. Eastham

This outcome was assessed in SEM522 - Advanced Systems Engineering in Winter 2019 by means of a homework assignment. The homework assignment required students to create a linear program (LP) model aimed at nding the optimum solution for a product mix problem. The model was created with assigned goal(s) and constraints. A mathematical representation of the model was developed along with the software model. A sensitivity analysis was conducted. Students consider how sensitive their model's solution was to changes or estimation errors which may occur in the objective function and constraint co-e cients.

One student was considered \developing" for outcome b.1. A detailed mathematical model was not included in the assignment. However, the LP model was properly designed with acceptable goals, constraints, and results. Evaluation of the solution and sensitivity results were considered \accomplished". Table 12 summarizes the results of this assessment.

Table 12: Outcome (b) : SEM 522, Winter 2019, Prof. Eastham (N = 2)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% Students	2
b.1 - De nition	1	1	{	50.0%	
b.2 - Design	{	1	1	100%	
b.3 - Evaluation	{	1	1	100%	

Outcome (b) : ENGR 597, Spring 2019, Prof. Allan Douglas

This outcome was assessed in ENGR 597 - Graduate Project, in Spring 2019. The Graduate Project is a year-long (three-term) project that students typically complete in their nal

Table 13: Outcome (b) : ENGR 597, Spring 2019, Prof. Allan Douglas (N = 5)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% Students	2
b.1 - De nition	{	{	5	100%	
b.2 - Design	{	3	2	100%	
b.3 - Evaluation	{	1	4	100%	

6.3 [illegible] 2018-19

In addition to direct assessment measures, the program outcomes are indirectly assessed through an exit survey of graduating students.

The survey includes the following questions for all students graduating with a MSE degree:

Q MSE 1 - Program Student Learning Outcomes for M.S. Engineering. Please rate your pro ciency in the following areas:
(Limited Pro ciency / Pro ciency / High Pro ciency)

- { (1.a) An ability to conduct research and development involving one or more engineering disciplines.
- { (1.b) An ability to apply advanced engineering concepts, methods and principles to solve complex technical problems.

Q MSE 2 - Program Student Learning Outcomes for M.S. Engineering. How much has yhh conribuitedto yhl-e
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- { *1.a) An ability to conduct research and development involving one or more engineering disciplines.
- { *1.b) An ability to apply advanced engineering concepts, methods and principles

7 Changes Made as a Result of Assessment

This section describes the changes resulting from the assessment activities carried out during AY2018-19.

The MSE faculty met on October 3, 2019 to review the assessment results and determine whether any changes are needed to the MSE curriculum or assessment methodology based on the results presented in this document. The objective set for all programs in the EERE department is to have at least 80% of the students perform at the level of accomplished or exemplary in all performance criteria of the assessed outcomes. Results below this attainment level would prompt a closer look and further discussion to determine appropriate course of action.

Tables 14 and 15 provide a summary of the 2018-19 direct assessment results for outcomes (a) and (b), respectively.

Table 14: Summary of MSE direct assessment for outcome (a) during AY2018-19.

Outcome (a): An ability to conduct research and development involving one or more engineering disciplines.				
	Students	2	% Students	2
ENGR 512, Winter 2019, Dr. Mateo Aboy (N = 13)				
1 - Research	12		92.3%	
2 - Planning	12		92.3%	
3 - Implementation	{		{	
ENGR 597, Spring 2019, Prof. Allan Douglas (N = 5)				
1 - Research	5		100%	
2 - Planning	4		100%	
3 - Implementation	5		100%	

Table 15: Summary of MSE direct assessment for outcome (b) during AY2018-19.

Outcome (b): An ability to apply advanced engineering concepts, methods and principles to solve complex technical problems.				
	Students	2	% Students	2
EE 501, Spring 2019, Dr. Scher (N = 2)				
1 - De nition	2		100%	
2 - Design	2		100%	
3 - Evaluation	2		100%	
ENGR 524, Winter 2019, Dr. Melendy (N = 5)				
1 - De nition	4		80%	
2 - Design	4		80%	
3 - Evaluation	4		80%	
EE 555, Winter 2019, Prof. Douglas (N = 9)				
1 - De nition	9		100%	
2 - Design	8		88.9%	
3 - Evaluation	9		100%	
EE 552, Winter 2019, Dr. Prahl (N = 0)				
1 - De nition	{		{	
2 - Design	{		{	
3 - Evaluation	{		{	
REE 549, Winter 2019, Dr. Venugopal (N = 2)				
1 - De nition	2		100%	
2 - Design	2		100%	
3 - Evaluation	2		100%	

9 APPENDIX: MS [illegible]

9.1 [illegible] A[illegible] O[illegible] (a): A[illegible]
[illegible]

9.2 [illegible] A[illegible] O[illegible] (b): A[illegible]
[illegible]

9.3 [illegible] MS[illegible] P[illegible] E[illegible]

MSENGINEERING - RUBRICFORSTUDENTOUTCOME(B)

OUTCOME (B): AN ABILITY TO APPLY A DVANCED ENGINEERING CONCEPTS, METHODS AND PRINCIP LES TO SOLVE COMPLEX TECHNICAL PROBLEMS .

PERFORMANCE CRITERIA	1-DEVELOPING	2ÐACCOMPLISHED	3 - EXEMPLARY
B.1 Problem definition Student is able to identify the technical problem to be solved in its proper context and define it in engineering terms through the use o appropriate language, criteria, specifications, and constraints.	¥! Problem vaguely identified. Relevance or context not addressed or unclear. ¥! Weak problem definition. Criteria are vague, subjective, or not relevant. Specifications and constraints are insufficient or unclear.	¥! Problem is identified, its relevance and context are minimally explained ¥! Problem is adequately defined engineering terms. Appropriate objective criteria are u166 1820	

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3. Strong Methodology
Presents a systematic approach (including testing and evaluation) to the overall research or design problem. The methodology followed is sound and adequate for the particular project/topic
Design decisions are adequately justified based on the application or sound design principles

! Developing ! Accomplished ! Exemplary

4. Solid Understanding of the Discipline
Shows accuracy and rigor in the theoretical, design, and experimental aspects of the work evidences sophisticated understanding of all relevant materials (sources, methods, theory, past results, etc.)

! Developing ! Accomplished ! Exemplary

5.

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6. Comprehensive
Adequate coverage and discussion of the key issues, sources, results (answers the research questic
or R&D specification) Demonstrated a

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