{ Master of Science in Engineering (MSE) { 2021{22 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 accomplish 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 engi-

2 Program Description and History

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 exibility to design a specialized or multidisciplinary degree program, while maintaining practical focus and academic rigor, is the de ning 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 elds.

The MSE program o ers several tracks or specialties (see Table 1) in di erentiated areas that the faculty, in consultation with the Industry Advisory Board, have identi ed as high-demand elds. 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 o er some degree of customization and they all have a mutidisciplinary element, with the track labeled Multidisciplinary/No Specialty being the most exible.

Table 1: MSE Tracks/Specializations

Multidisciplinary
MSE (Multidisciplinary)

2.3 Program Brief History

The MS Engineering program originated in response to the increasing demand in technology companies within the state of Oregon for speci c programs of study that do not t the traditional engineering disciplines (e.g., electrical, mechanical, chemical, civil) but require a unique combination of coursework from these and other disciplines to address their particular workforce needs at the graduate level. With no similar programs in the Oregon University System (OUS), the program was designed to optimally complement the portfolio of M.S. degree programs in the classical engineering disciplines (electrical, civil, mechanical, etc.) o ered by OUS universities.

In 2014, the Engineering and Technology Industry Council (ETIC) provided startup funding to develop the MSE program. The ETIC council included VP- and C-level leadership of key technology companies in Oregon including Intel, IBM Corporation, Tektronix, FEI, HP, Xerox, and others. ETIC identi ed an increasing market demand for this type of exible multidisciplinary program, the lack of similar programs in the State of Oregon, and the alignment with the ETIC mission (serving urgent critical needs in engineering, upgrading existing talent, and producing new talent).

Following internal review and approval by the university's Graduate Council, an external panel was formed to evaluate the proposed Masters of Science in Engineering at the Oregon Institute of Technology as part of the Oregon University System (OUS) review process. The evaluation was conducted using criteria set forth in the IMD 2.015(2) for review of new academic programs. This review included an evaluation of the proposed program,

3 Program Student Learning Outcomes

3.1 Program Outcomes

Consistent with the program mission and objectives, the MSE program possesses speci c measurable outcomes. The outcomes state speci c knowledge, skills, and experiences that students should have attained by the time of graduation. Graduating students in the MSE program will demonstrate:

a an ability to conduct research and development involving one or more engineering disciplines.

b an ability to apply advanced engineering concepts, methods and principles to solve complex technical problems.

MSE students who are graduating from the accelerated BS+MSE degree program are expected to also meet the program-level outcomes associated with their undergraduate program, as well as the institutional-level essential student learning outcomes (ESLOs). Information about these outcomes can be found in the corresponding report for the undergraduate program, and the ESLO university reports, available on the Oregon Tech's Essential Studies website (https://www.oit.edu/faculty-sta /provost/academic-excellence/ essential{studies).

3.2 Assessment Methodology

The mission, objectives and outcomes for the MSE program are reviewed periodically by the department. This typically happens at the fall department meeting during Convocation. They are also reviewed periodically by the department's Industry Advisory Council (IAC). This periodic review ensures the continued alignment between the MSE program, the university mission, and the evolving industry needs.

Assessment of the program outcomes is conducted annually using both direct and in-

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 Robotics, Autonomous Systems & Control Engineering		
ENGR 561 Modeling & Sim. Dyn. Sys.	{	F
ENGR 562 Control Engr II	{	F, P
ENGR 563 Motion Control & Robotics	{	F, P
ENGR 564 Autonoous Systems	{	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
REE 549 Power Systems Protection & Cntrl	{	F, P
REE 569 Grid Integration of Renewables	{	P
Engineering Electives (16 cr)	Varies	
MSE in Systems Engineering		
SEM 521 Foundations of Systems Engr.	{	F
SEM 522 Advanced Systems Engr.	{	P
SEM 525 Advanced Engr. Mgmt.	{	F, P
Engineering Electives (12 cr)	Varies	

5 Assessment Cycle

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 di erent 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	Outcomes B
All	ENGR 512 Research Methods II	p	
All	ENGR 59X Grad. R&D/Project/Thesis	p	p
MSE in Electrical Engineering	EE 501 Communication Systems		p
MSE in Aut., Robotics & Cntrl Engr.	ENGR 562 Control Engineering II		p
MSE in Embedded Sys. Engr.	EE 555 Embedded Systems II		p
MSE in Optical Engr.	EE 552 Waveguides and Fiber Optics		p
MSE in Power Sys. Engr.	REE 549 Power Sys. Protection/Cntrl		p
MSE in Systems Engr.	SEM 522 Adv. Systems Engr.		p

Outcome (a) : ENGR 512, Winter 2022, Dr. Mateo Aboy

This outcome was assessed in a project where students needed to select a MS R&D topic, de ne the problem and its signi cance, conduct a literature review, evaluate related R&D work, and consider the methods and materials needed to carry out the project. Two performance criteria (a.1 and a.2) were evaluated (research & planning). The last performance

speci cs. Students completing a Graduate Project or Thesis have the additional require-

Table 7: Outcome (b) : EE 501, Summer 2022, Dr. Aaron Scher (N = 3)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% Students	2
b.1 - De nition	0	0	3	100%	
b.2 - Design	0	0	3	100%	
b.3 - Evaluation	0	0	3	100%	

Outcome (b) : ENGR 562, Winter 2022, Dr. Melendy

Assessment data could not be collected in this course in AY2021-22, because the course was not o ered.

Outcome (b) : EE 555, Winter 2022, Prof. Douglas

Assessment data could not be collected in this course in AY2021-22, because the course was not o ered.

Outcome (b) : EE 552, Winter 2022, Dr. Prahl

Assessment data could not be collected in this course in AY2021-22, because the course was not o ered.

Outcome (b) : REE 549, Winter 2022, Dr. Chitra Venogupal

This outcome is assessed annually in REE 549 - Power Systems Protection and Control during the Winter term. The assessment was performed by means of a project. The purpose of the assignment was to develop the basic understanding of the protection and control equipment design calculations in power system applications. The project was divided into two sections. The rst section is to design the given power system using power world software according to the given speci cations and run the ow studies. The second section consisted of running the three-phase fault on all the buses to identify the bus fault current, as well as calculating the fuse and circuit breaker sizing to handle the fault.

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 a presentation le was submitted. as shown in Table 8.

6.3 Summary of Indirect Assessment for AY2021-22

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 your experience at Oregon Tech contributed to your knowledge, skills, and personal development in these areas?
(Barely Contributed/ Contributed / Highly Contributed)

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

Out of the 7 students who graduated in AY2021-22, 4 (57%) responded to the graduate exit survey. The results of the indirect assessment from the limited sample size appear positive, with 100% of respondents assessing their level of pro ciency in the MSE outcomes as very high, as well as the contribution of their experience at Oregon Tech to their assessment of these outcomes, as shown in Figures 1 ad 2.

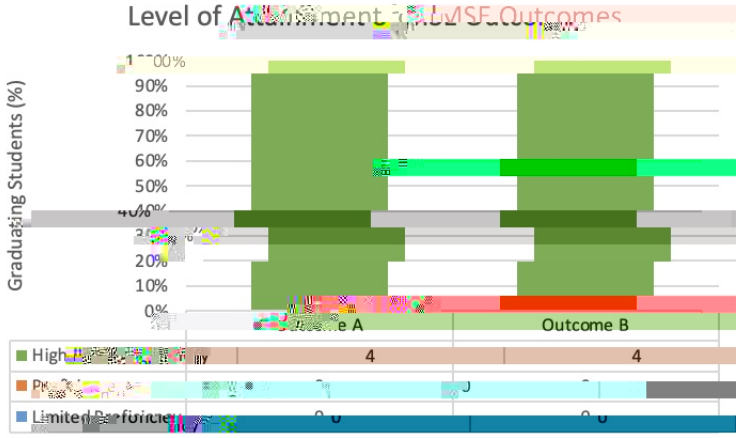

Figure 1: Results of the indirect assessment for attainment of the MSE student outcomes as reported in the exit survey (AY 2021-22)

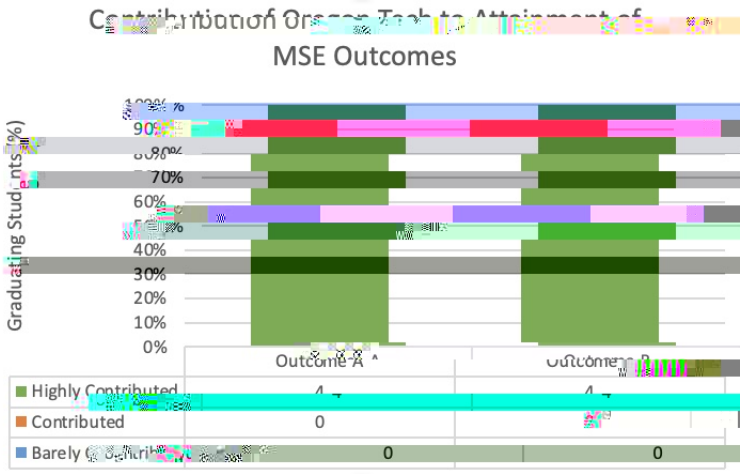

Figure 2: Results of the indirect assessment for contribution of Oregon Tech to the attainment of the MSE student outcomes as reported in the exit survey (AY 2021-22)

7 Review of Assessment Results and Closing The Loop

The MSE faculty met on December 1, 2022 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.

Table 12: Summary of MSE direct assessment for outcome (b) during AY2020-21.

Outcome (b): An ability to apply advanced engineering concepts, methods and

number of graduates in the graduate programs, it would be preferable to increase it further.

7.2 Changes Resulting from the 2021-22 Assessment

Direct Assessment. Results show attainment of both outcomes to satisfactory levels. For track-speci c courses, sample sizes still seem low, even when considering

9 APPENDIX: MSE Program Rubrics

9.1 Rubric for Assessment of Outcome (a): An ability to conduct research and development involving one or more engineering disciplines.

9.2 Rubric for Assessment of Outcome (b): An ability to apply advanced engineering concepts, methods and principles to solve complex technical problems.

9.3 Rubric for MS Thesis/Project Evaluation

9.4 Document detailing MSE Options

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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MS ENGINEERING DEGREE OPTIONS

The MS Engineering (MSE) program provides four different degree options: (1) graduate thesis, (2) graduate project, (3) graduate R&D and (4) coursework-only option. Fig. 1 provides a flowchart outlining the path and requirements for each degree option. Students enrolled in the MSE program must select one of these options and fulfill the corresponding requirements.