– Master of Science in Engineering (MSE) – 2022–23 Assessment Report

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Contents

1 Introduction

1.1 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

1.2 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 located off Interstate 5 and a short walk away from the Wilsonville Station on the Westside Express Service (WES) commuter rail line that connects to Beaverton and the MAX Light Rail. Several core and elective courses are available in an online modality to provide increased flexibility and adapt to students' needs.

1.3 Program History

The MS Engineering program originated in response to the increasing demand in technology companies within the state of Oregon for specific programs of study that do not fit 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.) offered by OUS universities.

In 2014, the Engineering and Technology Industry Council (ETIC) provided startup funding to develop the MSE program. The ETIC council included top leadership of key technology companies in Oregon. ETIC identified an increasing market demand for this type of flexible 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. As part of this review, a site visit was conducted on the Wilsonville Campus of OIT on April 24, 2015. The results of the external review were positive, with the report concluding that *"[...] the faculty and staff at the OIT Wilsonville campus are more than capable to launch the defined Masters of Science in Engineering program immediately. The program seems well suited to the student population, builds off existing expertise, and responds directly to industry's needs in the greater Portland area."*

The launch of a new program for Oregon Tech, M.S. in Engineering (with Specialties) was approved by the Statewide Provosts Council (May 2015), the Oregon State Board of Higher Education (June 2015), and the Higher Education Coordinating Commission (HECC) on August 13, 2015. The MSE program was subsequently launched in Fall 2017, with the first cohort of students graduating from the program in 2019.

1.4 Program Enrollment and Graduation Data

Table 2 provides the enrollment and graduation numbers for the last 5 years.

Table 2: MSE Enrollment and Graduation History

Academic Year	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**2022-23**
Enrolment (HC)	25	34	25	20	17
Graduates	–	2	13	7	8

2 Program Mission, PEOs and SOs

2.1 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*).

2.2 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 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.

2.3 Program Student Outcomes

Consistent with the program mission and objectives, the MSE program possesses specific measurable outcomes. The outcomes state specific 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 student learning outcomes (ISLOs). Information about these outcomes can be found in the corresponding report for the undergraduate program, and the ISLO university reports, available on the Oregon Tech's institutional assessment website (https://www.oit.edu/academic-excellence/institutional-assessment).

3 Mapping of MSE Curriculum to Student Outcomes

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	

4 Cycle of Assessment of Student Outcomes

4.1 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 indirect measures. Direct measures are collected by teaching faculty in core courses in the curriculum, typically via assignments or assessments that are integral to the course. Direct measures of attainment of all program outcomes is also collected in the MS thesis or project, as this represents the culminating product of the students' learning. Indirect assessment of outcomes is also performed annually by means of an exit survey that is distributed to all graduating students. As part of the survey, graduating students perform a self-assessment of their level of attainment of the different program outcomes.

The assessment results are compiled by the MSE Assessment Coordinator into a single document by the end of spring term. During the following fall term, faculty meet to review and discuss the assessment results of the previous academic year, in the annual Closing-the-Loop meeting. In these meetings, the faculty may identify particular results that fall below the expected level of attainment, or trends in assessment data that merit special attention. At this time, faculty may propose or discuss programmatic changes or changes to the assessment methodology as needed in order to increase the level of attainment beyond the set threshold, or to improve the quality of the assessment data.

4.2 Assessment Cycle

The MSE student outcomes are assessed on an annual basis.

Direct assessment is performed according to Table 4[1]. 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

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

[1]Tracks in Embedded Systems Engineering, Optical Engineering and Autonomous Systems, Robotics and Control Engineering not offered in AY2022-23

5 Assessment Data

5.1 Direct Assessment

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.

5.1.1 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 the final Graduate Project/Thesis/R&D sequence, according to the performance criteria indicated in the Outcome (a) rubric, included in the Appendix.

Outcome (a) : ENGR 512, Winter 2023, Dr. Mateo Aboy

This outcome was assessed in a project where students needed to select a MS R&D topic, define the problem and its significance, 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 criterion (a.3) cannot be assessed at this point, since students do not get to implement their projects until the subsequent completion of their graduate project/thesis.

In total 6 students were assessed and all performed at an accomplished level or above in the assessed performance criteria. The results are summarized in Table 5.

Table 5: Outcome (a) : ENGR 512, Winter 2023, Dr. Mateo Aboy (N = 6)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% Students ≥ 2
a.1 - Research	-	3	3	100%
a.2 - Planning	-	3	3	100%
a.3 - Implementation	–	–	–	–

Outcome (a) : EE/ENGR 596/597/598, Spring 2023, Multiple faculty

This outcome was assessed in Spring 2023 in the courses EE/ENGR 596 - Graduate Research & Development, EE/ENGR 597 - Graduate Project, and EE/ENGR 598 - Graduate Thesis. These consist of a year-long (three-term) project or thesis, which consists of a major design or research experience encompassing knowledge and skills gained throughout the

MSE program.

Depending on their specialization track within the MSE program and their career objectives, students may select a faculty advisor to supervise one of three available sequences (EE/ENGR 596 - Graduate Research & Development, EE/ENGR 597 - Graduate Project, or EE/ENGR 598 - Graduate Thesis). The sequence selected depends on the type of work the student will be completing. A graduate thesis requires a contribution with an element of novelty to the domain knowledge, and can be either basic research (directed toward fuller knowledge or understanding of the fundamental aspects of phenomena), or applied research (directed to greater understanding necessary to achieve a specific practical outcome). A graduate project requires an element of original design and implementation, where the finished product must meet a predetermined set of specifications (design objectives and constraints). Graduate Research and Development is focused on the systematic research and application of existing knowledge towards the production of new useful materials, devices, systems, or methods, which may involve the design, development or improvement of prototypes.

The faculty advisor assists the student in defining and scoping a project that will be of interest to the student and meet the MSE requirements for the particular course track selected (EE/ENGR 596, 597 or 598), and acts in a supervisory capacity for the duration of the project. Students may work individually or in a group depending on the project specifics. Students completing a Graduate Project or Thesis have the additional requirement to do an oral defence of their work in front of a committee of 3 or more faculty, each of whom provides an independent evaluation of the student's work, and may provide a positive evaluation of the work presented or recommend further changes or improvements.

A total of 5 students were assessed in AY2022-23 by Professors M. Aboy (1), J. Eastham (1), S. Petrovic (1) and S. Prahl (2). The results of this assessment are presented in Table 6.

Table 6: Outcome (a) : EE/ENGR 596/597/598, Spring 2023, Multiple faculty (N = 5)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% Students ≥ 2
a.1 - Research	–	2	3	100%
a.2 - Planning	1	1	3	80%
a.3 - Implementation	–	3	2	100%

5.1.2 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 the final Graduate Project/Thesis/R&D sequence, according to the performance criteria indicated in the Outcome (b) rubric, included in the Appendix.

Outcome (b) : EE 501, Spring 2023, Dr. Scher

This outcome was assessed in EE 501 - Communication Systems in Spring 2023 by a project in which students build and test a receiver circuit for detecting and demodulating ASK communication signals for a Qi wireless charger.

Students construct a passive magnetic field probe and place the probe near the stationary Qi charging pad. If a smartphone is placed on the charging pad, the phone communicates with the charging pad via backscatter modulation during the power transfer phase. These signals are picked up by the probe, and students are asked demodulate the signals. Students build their receivers on a breadboard which is expected to contain the following front-end components: rectifier, voltage divider, buffer, filters, amplifier, comparator, and voltage divider. In addition, students consult the published Qi wireless power transfer specifications to manually decode the demodulated waveform and analyze sent packets. Students present their design and findings to the instructor.

This assignment relates to the outcome because it requires students to apply engineering concepts, methods, and principles learned in class to solve a technical problem. The results of this targeted assessment are shown in Table 7.

Table 7: Outcome (b) : EE 501, Spring 2023, Dr. Aaron Scher (N = 1)

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

Outcome (b) : REE 549, Winter 2023, Dr. Chitra Venugopal

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 first section is to design the given power system using power world software according to the given specifications and run the flow 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 specification, 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 file was submitted. as shown in Table 8.

Table 8: Outcome (b) : REE 549, Winter 2023, Dr. Venugopal (N = 1)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% Students ≥ 2
b.1 - Definition	–	–	1	100%
b.2 - Design	–	–	1	100%
b.3 - Evaluation	–	–	1	100%

Outcome (b) : SEM 522, Winter 2023, Prof. Eastham

This outcome was assessed in SEM 522 Advanced Systems Engineering in Winter 2022 by means of a homework assignment. The homework assignment required students to create a linear program (LP) model aimed at finding 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 solution was to changes or estimation errors which may occur in the objective function and constraint coefficients.

Two students were assessed (N=2). The results are presented in Table 9.

Table 9: Outcome (b) : SEM 522, Winter 2023, Prof. Eastham (N = 2)

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

Outcome (b) : EE/ENGR 596/597/598, Spring 2023, Multiple faculty

This outcome was assessed in Spring 2020 in a variety of courses, namely: EE/ENGR 596 - Graduate Research & Development, EE/ENGR 597 - Graduate Project, and EE/ENGR 598 - Graduate Thesis. The MSE program culminates with a year-long (three-term) project or thesis, which consists of a major design or research experience encompassing knowledge and skills gained throughout the program.

A full description of the courses and how they fit into the different MSE options was previously included in section 6.2.1, subsection *Outcome (a) : EE/ENGR 596/597/598, Spring 2020, Multiple Faculty* of this document.

A total of 5 students were assessed in AY2022-23 by Professors M. Aboy (1), J. Eastham (1), S. Petrovic (1) and S. Prahl (2). The results of this assessment are presented in Table 10

Table 10: Outcome (b) : EE/ENGR 596/597/598, Spring 2023, Multiple faculty (N = 5)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% Students ≥ 2
b.1 - Definition	–	2	3	100%
b.2 - Design	1	1	3	80%
b.3 - Evaluation	1	3	1	80%

5.2 Indirect Assessment

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 proficiency in the following areas:**
  (Limited Proficiency / Proficiency / High Proficiency)
  - (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 8 students who graduated in AY2022-23, 4 (50%) 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 proficiency 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 and 2.

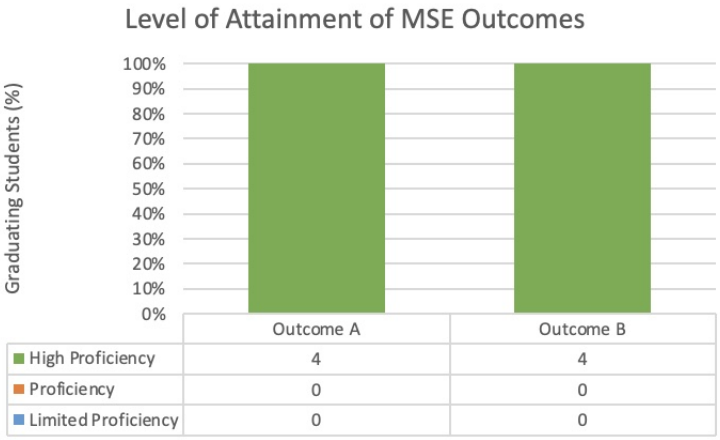

Figure 1: Results of the indirect assessment for attainment of the MSE student outcomes as reported in the exit survey (AY 2022-23)

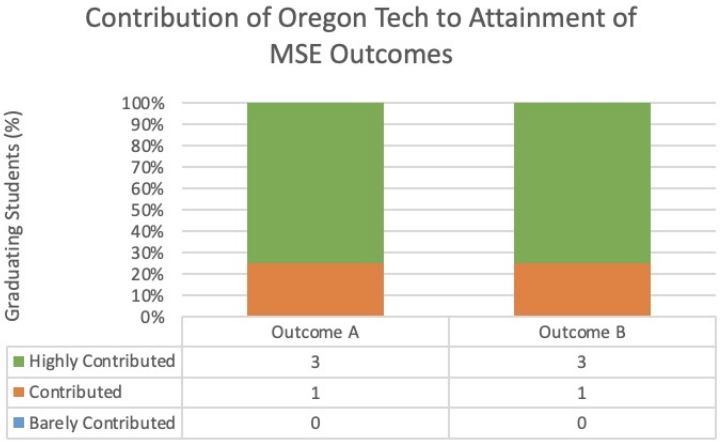

Figure 2: Results of the indirect assessment for contribution of Oregon Tech to the attainment of the MSE student outcomes as reported in the exit survey (AY 2022-23)

5.3 Degree Completion, Retention and Equity Data

In AY2022-23, the university created new dashboards so that programs can track graduation and retention rates, as well as identify equity gaps in these success metrics. Table 11 shows the 6-year graduation and 4th-term retention rate for MSE students.

The 6-Year graduation rate data is not available, as the program was launched less than 6 years ago. We expect this data to become available from next year. Out of 9 students who enrolled in the MSE program in AY2021-22, 7 were continuing in the program 4 terms

later (77.8%). Due to low populations numbers, it is not possible to identify equity gaps (i.e., most equity categories have less than 3 students).

Table 11: Degree Completion, Retention and Equity data for MSE students

Performance Criteria	Performance target	Result	Target met?	Equity gap?
6-Year Graduation*	75%	–	–	–
Retention	75%	77.8%	Yes	–

**Note: 6-year graduation data not available until AY2023-24*

6 Continuous Improvement and Closing The Loop

The MSE faculty met in Fall 2023 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 12 and 13 provide a summary of the direct assessment results for outcomes (a) and (b), respectively. Results showing attainment of outcomes below the target 80% appear in boldface. Given the small class sizes, the tables show the percent of students assessed at a level of *2–Accomplished* or above in each outcome for the current year, as well as the last 5 years. By combining multiple years, we are essentially assessing a larger sample of students, so that the results are more statistically meaningful. This is specially true in track specific courses (which understandably have lower enrollment numbers than the core courses). As we continue to collect data over a larger time window, we should be able to detect issues and trends, and avoid the signal to noise problems associated with small sample sizes.

Table 12: Summary of MSE direct assessment for outcome (a) during AY2022-23.

Outcome (a): An ability to conduct research and development involving one or more engineering disciplines.		
	AY2022-23 (N1) %Students ≥ 2	Last 5 years (N2) % Students ≥ 2
ENGR 512, Dr. Mateo Aboy (N1 = 6, N2 = 36)		
1 - Research	100%	97.2%
2 - Planning	100%	94.4%
3 - Implementation	–	–
ENGR 597, Multiple faculty (N1 = 5, N2 = 36)		
1 - Research	100%	91.7%
2 - Planning	100%	88.9%
3 - Implementation	100%	94.4%

Table 13: Summary of MSE direct assessment for outcome (b) during AY2022-23.

Outcome (b): An ability to apply advanced engineering concepts, methods and principles to solve complex technical problems.		
	AY2022-23 (N1) %Students ≥ 2	Last 5 years (N2) % Students ≥ 2
EE 501, Dr. Scher (N1 = 1, N2 = 8)		
1 - Definition	100%	100%
2 - Design	100%	100%
3 - Evaluation	100%	100%
REE 549, Dr. Venogupal (N1 = 1, N2 = 5)		
1 - Definition	100%	100%
2 - Design	100%	100%
3 - Evaluation	100%	100%
SEM 522, Prof. Eastham (N1 = 2, N2 = 13)		
1 - Definition	100%	92.3%
2 - Design	100%	100%
3 - Evaluation	100%	100%
ENGR 597, Multiple Faculty (N1 = 5, N2 =36)		
1 - Definition	100%	94.4%
2 - Design	80%	91.7%
3 - Evaluation	80%	88.9%

6.1 Evaluation of Assessment Results and Data Driven Action Plans

Below is a summary of the discussions and recommendations made by MSE faculty at the Closing-The-Loop meeting, which took place on October 12th, 2023. The issues discussed and associated action plans are summarized in Table 14.

a **Assessment of Program Outcomes**
Outcomes (a) and (b)) were attained to the desired level, which is consistent with historical trends. No action required at this point.

b **Indirect Assessment**
In AY2022-23, the university changed its reporting system from FAST to a new reporting application Edify. Due to a clerical error when linking the Student Exit Survey to the new system, only students who graduated in Fall term were able to complete the student exit survey, and therefore the sample size for the indirect assessment this year is too small to be meaningful. Carrie Dickson is working on this and expects this issue to be resolved by Fall 2023. Indirect assessment data collected from previous years shows generally a positive level of attainment of student outcomes. The Executive Assessment Committee is currently working with departments on a revision of the Student Exit Survey in order to simplify the survey and increase consistency institution-wide.

c **Program Challenges**
In the last two years, the EERE department has lost three faculty members associated with the MSE program, and three of the MSE tracks have had to be discontinued. Due to the small number of graduate students at Oregon Tech, a number of graduate courses have been cancelled due to low enrollment, some of them core courses within particular tracks. This has led to having to make course substitutions that compromise the quality of the program, and in some cases has impacted students'

graduation plans. At the present time, the department is not offering enough courses to meet the requirements for some of the MSE tracks, leading students to having to complete courses outside OIT (e.g., ETM courses at PSU for the Systems Engineering track). This increases student dissatisfaction and impacts retention and graduation rates negatively. In order to ensure the continuity of the MSE program we must provide enough courses or alternatives for students to be able to complete the program. MSE Program Director and department chair will meet to discuss potential solutions.

d **Admissions Committee**
The Admissions Committee has been historically slow to review MSE applications. We should set an objective for review of applications (2 weeks). Also, the committee needs more clarity on how to process conditional admissions (should they processed as Admit or Deny?), since the Admissions Office does not have a process for Conditional Admissions. MSE Program Director to contact members in Admissions committee to resolve these issues.

e **Graduate Assistantships**
There is currently little clarity on the process for approval of graduate assistantships. The Provost Office decided to abandon the former system that tied number of GAs approved to program enrollment numbers, but has not published new guidelines for approval of GAships. This was discussed at Graduate Council last year. A committee was put together in AY2022-23 to propose a Graduate Assistant funding model. The Provost Office limited the charter of the committee to compiling a list of responsibilities for graduate assistants to be reviewed and approved by the Provost, but the committee did not get much traction.

The Provost Office has hinted at potential models where GAs are used to perform teaching activities and be assigned some of the workload for those. Concerns have been raised that in most engineering programs, MS students are 4+1s so they do not have a BS or MS degree yet. It is also contrary to the benefits of an OIT education advertised by the university, which emphasize the emphasis of hands-on learning and specifically indicates that professors are teaching the labs in marketing materials.

The graduate programs were originally launched without the provision of additional resources, and the GAs were used as an incentive for faculty to develop the graduate courses and programs. Without a clear GA funding model or approval process, the planning and assignment of GAships has been difficult and performed in a very ad hoc manner on a term by term basis. This has made it difficult to recruit and retain competent GAs in MSE, as they have opted for more secure jobs rather than a GAship that is typically offered on a term-by-term basis.

MSE Program Director and Department Chair will participate in discussions related to GA responsibilities and funding model through Graduate Council and Academic Council, respectively, throughout AY2023-24. We expect some progress will be made this year regarding a new funding model and process for GAs.

Table 14: Summary of data-driven action plans

Item	Action	Person In Charge	Due Date
Outcome (a) - Outcome met	None.	N/A	N/A
Outcome (b) - Outcome met	None.	N/A	N/A
Indirect Assessment - Low participation	Address and correct institutional issues with Student Exit Survey distribution.	C. Dickson	Fall 2023
Program Challenges - Loss of faculty, courses cancelled and tracks discontinued impacting student retention and completion.	Plan to offer minimum number of courses to be able to complete MSE in the tracks currently available. Add new cross-listed courses 4xx-5xx as needed. Explore other courses at OIT or PSU that can be transferred into the program (engineering or technology management)	C. Crespo, N. Korivi	Fall 2024
Admissions Committee - Slow response time may contribute to loss of candidates	Set objective for Admissions Committee response time (2 weeks)	C. Crespo, M. Aboy, J. Eastham	Fall 2023
Graduate Assistantships - Unclear approval process makes it difficult to plan for and recruit GAs	Work with Graduate Council and university administration to continue to work towards a GA funding model and approval process	C. Crespo, N. Korivi	Fall 2024

6.2 Review of Previous Year Action Plans

The faculty reviewed the progress made on the implementation of changes suggested in the prior assessment cycle, shown in Table 15.

Table 15: Status of action plans from prior assessments.

Item	Action	Person In Charge	Status
Direct Assessment: Small sample sizes	Include data for 5-year window in assessment reports to increase the sample size.	C. Crespo	Completed

Table 15: Status of action plans from prior assessments.

Item	Action	Person In Charge	Status
Indirect Assessment - Low participation	Send reminder regarding exit survey to graduating students. Generate graduation checklist that includes completion of exit survey.	C. Crespo	In progress (exit survey being reviewed at the institutional level this year)

7 Closing the Loop: Evidence of Improvement in Student Learning

At present, the MSE program seems to have stable enrollment and graduation trends, and both the direct and indirect assessment results suggest adequate attainment of student outcomes. Some of the tracks have been temporarily discontinued due to enrollment trends and faculty availability. The department should work to fill some of the faculty vacancies. As enrollment and faculty numbers go back to normal levels, we expect some of the discontinued tracks will be offered again. Some of the issues identified

As previosuly detailed, the changes made so far as a result of assessment activities seem to have properly addressed the issues raised in previous years. Faculty in the MSE program will implement the changes suggested at the 2023 CTL meeting, and will continue to monitor the impact to the assessment results over time.

8 APPENDIX: MSE Program Rubrics

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

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

8.3 Rubric for MS Thesis/Project Evaluation

8.4 Document detailing MSE Options

MS ENGINEERING - RUBRIC FOR STUDENT OUTCOME (A)

OUTCOME (A): AN ABILITY TO CONDUCT RESEARCH AND DEVELOPMENT INVOLVING ONE OR MORE ENGINEERING DISCIPLINES

PERFORMANCE CRITERIA	1-DEVELOPING	2 – ACCOMPLISHED	3 - EXEMPLARY
A.1 Research and Information Gathering Student is able to identify adequate sources, effectively gather relevant information, and critically evaluate it.	• Limited or inadequate sources of information. • Information gathered is insufficient or lacks relevance, does not provide a solid understanding of the topic under study. • Critical evaluation of information gathered not provided or very limited.	• Adequate and sufficient sources of information. • Information gathered is relevant and sufficient to provide a solid understanding of the topic under study. • Some critical evaluation of information gathered and its applicability.	• Sources of information are adequate and thoroughly cover all relevant aspects of the topic under study. • Information gathered is extensive and relevant, providing an in-depth understanding of the topic under study. • Thorough critical evaluation of information gathered and its applicability to the particular context.
A.2 Planning Student is able to define a technical project in terms of objective outcomes, and to generate a plan outlining the time, resources, and methodologies needed to achieve those outcomes.	• No clear definition of objective outcomes. • Plan lacks detail or is inadequate for accomplishing the project outcomes.	• Objective outcomes clearly defined. • Plan has sufficient level of detail, including time, resources, and methodological steps, and is adequate for accomplishing the project outcomes.	• Objective outcomes clearly defined. • Plan is extremely well developed, including time, resources, and methodological steps, is adequate for accomplishing the project outcomes, and accounts for potential setbacks.
A.3 Implementation Student is able to develop or implement a creative solution to a technical problem involving one or more engineering disciplines.	• Does not follow a robust methodological approach to project implementation. • Does not adhere to project plan (outcomes, deadlines, resources, methods). • Shows limited creativity in the implementation of a solution to a technical problem.	• Follows a robust, methodological approach to project implementation. • Adheres reasonably well to project plan (outcomes, deadlines, resources, methods). • Shows a reasonable level of creativity in the implementation of a solution to a technical problem.	• Follows a robust, methodological approach to project implementation, and is able to adapt the methodology as needed to enhance the quality of the project implementation. • Adheres exceptionally well to project plan (outcomes, deadlines, resources, methods). • Shows an exceptional level of creativity in the implementation of a solution to a technical problem.

MS ENGINEERING - RUBRIC FOR STUDENT OUTCOME (B)

OUTCOME (B): AN ABILITY TO APPLY ADVANCED ENGINEERING CONCEPTS, METHODS AND PRINCIPLES TO SOLVE COMPLEX TECHNICAL PROBLEMS.

PERFORMANCE CRITERIA	1-DEVELOPING	2 – ACCOMPLISHED	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 of 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 in engineering terms. Appropriate objective criteria are used. Specifications and constraints are clear and sufficient.	• Problem is clearly identified; its relevance and context are explained thoroughly and effectively. • Problem is clearly defined in engineering terms. Criteria are objective, relevant and adequately prioritized based on context. Specifications and constraints are clear and allow to thoroughly evaluate the effectiveness of the proposed solution in solving the problem.
B.2 Engineering Design Student is able to use engineering concepts, methods and principles in a creative and methodical way to devise an optimal solution that addresses the technical problem.	• Selects preliminary design based on criteria that are not well aligned with design specifications and constraints. • Describes design solution without articulated scientific or engineering principles. • Does not use iterative modifications in a systematic way to improve design. • Rudimentary use of engineering tools and methods in the design process. • Design meets some but not all specs/constraints.	• Provides subjective justification for preliminary design which aligns with design specifications and constraints. • Describes design solution using scientific or engineering concepts and principles. • Uses iterative modifications in a systematic way to improve design. • Uses engineering tools and methods effectively in the design process. • Design meets most or all specs/constraints.	• Provides objective justification for preliminary design which aligns with design specifications and constraints. • Describes design solution using scientific or engineering concepts and principles with great precision. • Uses iterative modifications in a systematic and effective way to improve design. • Shows mastery of engineering tools and methods in the design process. • Design meets or exceeds all specs/constraints.

MS ENGINEERING - RUBRIC FOR STUDENT OUTCOME (B)

B.3 Evaluation of Solution Student is able to characterize the performance of the design solution and discuss advantages, disadvantages, tradeoffs, and/or ideas for further improvement.	• Provides limited characterization of performance of the design solution. • Does not effectively communicate the advantages and limitations of the design solution. • Provides no or insufficient discussion of the design tradeoffs (i.e., how different design choices affect performance). • Provides no or vague suggestions for further improvement.	• Provides adequate characterization of performance of the design solution. • Briefly mentions the advantages and limitations of the design solution. • Provides brief discussion of the design tradeoffs (i.e., how different design choices affect performance). • Provides some reasonable suggestions for further improvement at a high level of generality.	• Provides thorough characterization of performance of the design solution. • Discusses the advantages and limitations of the design solution in detail. • Clearly articulates and discusses design tradeoffs (i.e., how different design choices affect performance). • Provides specific and detailed suggestions for further improvement.

MS ENGINEERING
GRADUATE THESIS/PROJECT EVALUATION RUBRIC

Student Name: _____

Type of Work: ❒ **MS Thesis** ❒ **MS Project**

Degree: ❒ **BS/MSE** ❒ **MSE** **Specialization:** _____

Evaluator's Name: _____

Date of Evaluation: _____

EVALUATION OF KEY AREAS:
(Please evaluate each one of the key areas according to how well the work produced by the candidate satisfies the descriptions provided. You may add any comments or observations to support or complement your assessment in each key area.)

1. Well Chosen Topic
Focuses narrowly on a specific research question or engineering design contribution; right scale and level of difficulty, relevant to the discipline, significant, makes an adequate contribution.

❒ Developing ❒ Accomplished ❒ Exemplary

Evaluator's Comments

2. Builds on Previous Research
The literature review shows awareness of wide range of relevant work and leading experts. The work motivates the chosen approach by citing appropriate published works and explains why alternate methods were not chosen.

❒ Developing ❒ Accomplished ❒ Exemplary

Evaluator's Comments

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

Evaluator's Comments

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

Evaluator's Comments

5. Adequate Use of Evidence
Accurate and critical use of data to interpret results; results are sufficient to assess the performance of the proposed solution and support conclusions.

❒ Developing ❒ Accomplished ❒ Exemplary

Evaluator's Comments

6. Comprehensive
Adequate coverage and discussion of the key issues, sources, results (answers the research question or R&D specification). Demonstrated ability to critically evaluate the validity and reliability of the work done.

❒ Developing ❒ Accomplished ❒ Exemplary

Evaluator's Comments

7. Conclusion and Future Work
Conclusion or summary succintly addresses the R&D problem, provides the key contributions made, and facilitates or guides future work on the topic.

❒ Developing ❒ Accomplished ❒ Exemplary

Evaluator's Comments

8. Communication
Clear and appropriate language throughout, excellent synthesis, awareness of limitations/ambiguity/nuance/complexity; clarity of expression, proper use of specialist vocabulary and figures.

❒ Developing ❒ Accomplished ❒ Exemplary

Evaluator's Comments

9. Satisfies Formal Criteria
Meets all the formal requirements in terms of format, style, length, formalities, etc.

❒ Developing ❒ Accomplished ❒ Exemplary

Evaluator's Comments

10. Overall Quality
Overall, the work is of appropriate quality in terms of content and format for a MS thesis or project.

❒ Developing ❒ Accomplished ❒ Exemplary

Evaluator's Comments

ASSESSMENT OF MSE PROGRAM OUTCOMES:
(Please evaluate each one of the following outcomes according to the degree to which the work produced by the candidate evidences achievement of the particular outcome. You may add any comments or observations to support or complement your assessment in each outcome.)

(a) An ability to conduct advanced research and development involving one or more engineering disciplines.

❒ Developing ❒ Accomplished ❒ Exemplary

Evaluator's Comments

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

❒ Developing ❒ Accomplished ❒ Exemplary

Evaluator's Comments

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.

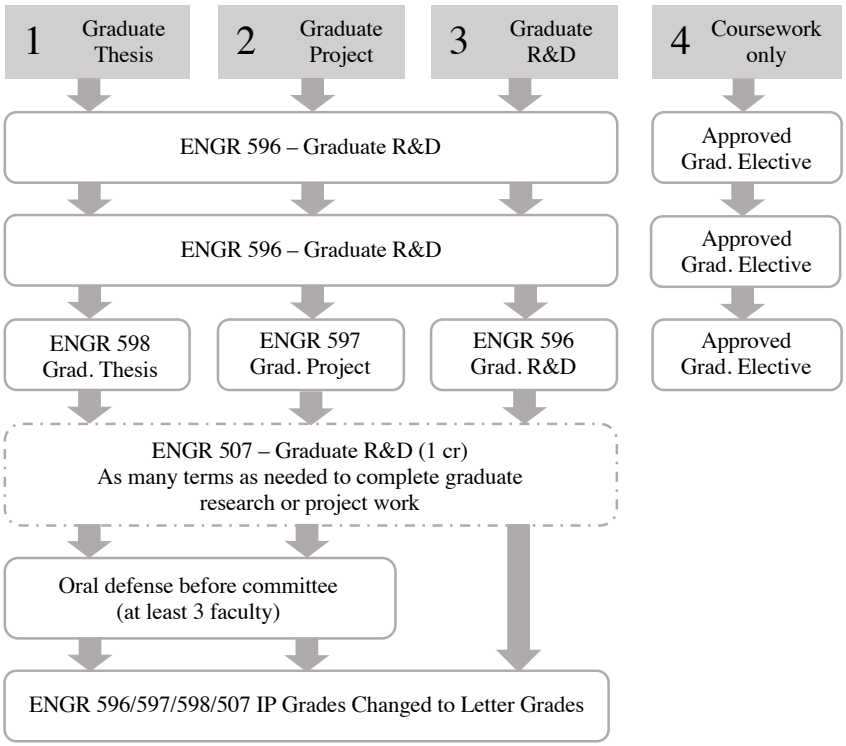

Fig. 1 Flowchart of MS Engineering Degree Options.

Below is a more detailed description of the type of work and requirements associated with each of the four degree options:

1) **Graduate Thesis (ENGR 598)**
   The Graduate Thesis option involves working on original research under the supervision of a faculty member who acts as the thesis advisor. The student selects a topic, conducts an extensive literature review, develops research questions, and works on finding answers to those research questions. This work typically requires design of experiments, collection of data, and testing of hypotheses, among other things. This option requires the student to write a formal MS Thesis summarizing all aspects of their endeavour, followed by an oral defense before a committee of at least 3 faculty members, one of which must be the thesis advisor. This process is not straightforward, it is time-consuming in nature, and may require several iterations. Because of this, students intending to go this route are encouraged to start thinking about potential thesis topics early in their study program (second term). Students should select a faculty committee around the time they register for the last term of Graduate Thesis (ENGR 598).

2) **Graduate Project (ENGR 597)**
   This option entails solving a problem or issue of significance in the chosen field by means of a project involving some original design and development. The student selects a topic, conducts a state-of-the-art review, develops a specification which may consist of improving an existing design or taking a new

approach to solving the problem at hand. Depending on the nature of the project, it may require the development of a prototype or similar deliverable demonstrating that the proposed design solves the problem and meets the specifications. The graduate project option requires the student to write a formal Graduate Project report summarizing all aspects of their work, followed by an oral defense before a committee of at least 3 faculty members, one of which must be the graduate project advisor. The design process is iterative and time-consuming in nature. To avoid unnecessary delays, students are encouraged to start thinking about project definition early in their program of study (second term0. Students should select a faculty committee around the time they register for the last term of graduate project (ENGR 597).

3) **Graduate Research & Development (ENGR 596)**
   This option involves conducting research and/or developing a project in a chosen topic. The scope of the research or project must meet the standards for graduate work, similar to the graduate thesis and graduate project options. In the case of students following the accelerated BS/MSE path who have not completed an undergraduate capstone project, the scope of the project must also meet the requirements for the undergraduate capstone project. However, the requirements of review for this option are lower. Under this option, an oral defense before a faculty committee is not required. The work is graded exclusively by the faculty advisor supervising the work, who will also determine the particular deliverables appropriate to the nature of the work performed by the student (e.g., project report, oral presentation, live demonstration, etc.).

4) **Coursework-only MSE**
   In this option, the student completes an additional set of graduate course (9 credits) in lieu of a graduate thesis or project. Students should get approval for the courses from their academic advisor or MSE Program Director ahead of registering.

Students should consider the following items when selecting an option:

(a) Eligibility: Students in the accelerated BS/MSE track who have not completed an undergraduate capstone project are only allowed to complete options 2 or 3, in order to satisfy their undergraduate capstone project requirements.

(b) Approval: Students interested in options 1 or 2 must complete two terms of ENGR 596. Based on their progress thereof, they can request approval from their faculty thesis/project advisor to register for ENGR 597 or ENGR 598 in their third term of the graduate thesis. Students interested in option 4 should get approval from their advisor or MSE Program Director for the courses to satisfy this option ahead of registering.

(c) Continuous Enrollment: Students who do not complete the requirements for the graduate thesis/project/R&D courses in three terms, but who will continue to use faculty and university resources for work related to graduate thesis/project/R&D must continue to register for at least 1 credit per term in an independent study course ENGR 507 – Graduate R&D.

(d) Grading: Grading for thesis, project, or graduate R&D courses will be IP (in progress) every term, until the student has completed the work. At that time, the faculty member will replace the IP grade with a letter grade (A-D). If not cleared within 5 years of issuance, IP grades will automatically revert to a F.

(e) Paperwork: Students pursuing the coursework-only option must submit a course substitution form approving the courses selected to replace the Graduate R&D sequence. Students completing the graduate thesis or Graduate Project options must submit a Final Approval Form after successful completion of the oral defense. These forms can be downloaded from the Registrar's Office website (www.oit.edu/registrar).