

— Dual Major in Optical Engineering —

2017–18 Assessment Report

Scott Prahl

Electrical Engineering & Renewable Energy Department

Dec 12, 2018

Contents

1	Introduction	3
1.1	Program Location	3
1.2	Program Goals and Design	3
1.3	Program Brief History	4
2	Program Mission, Educational Objectives, and Outcomes	4
2.1	Program Mission	4
2.2	Program Educational Objectives	4
2.3	Relationship of Program Educational Objectives to Institutional Objectives	5
2.4	Program Outcomes	5
3	Cycle of Assessment for Program Outcomes	5
3.1	Introduction and Methodology	5
3.2	Summary of Assessment Activities & Evidence of Student Learning	6
3.3	Methodology for Assessment of Program Outcomes	6
3.4	Targeted Assessment for Outcome A: Demonstrate the ability to design and build optical systems	8
3.4.1	Assessment in EE/PHY 449	8
3.4.2	Assessment in EE/PHY 452	8
3.5	Indirect Assessment	8
4	Changes Resulting From Assessment	9

1 Introduction

1.1 Program Location

The Dual Major in Optical Engineering (DMOE) is offered at the Oregon Tech Wilsonville Campus on the south side of the Portland metropolitan area. The DMOE is only available to students completing another ABET-accredited engineering major at Oregon Tech.

The Oregon Tech Wilsonville Campus is situated in a wooded business park setting among several technology companies including FLIR, Rockwell-Collins, and Coherent. 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.

1.2 Program Goals and Design

The Optical Engineering program is designed as a dual major option for students with an ABET-accredited primary major in an engineering discipline offered at Oregon Tech. Students first choose a primary ABET-accredited major (e.g., Electrical Engineering, Renewable Energy Engineering, Mechanical Engineering), and complete additional specialized coursework to earn a second major in Optical Engineering. The program is designed so that both majors in the degree can be completed in 4 years by taking summer courses. ABET ETAC degree students may also pursue the dual major with departmental approval.

The purpose of the Dual Major in Optical Engineering is to prepare graduates who are able to design and build devices using optical devices. Such devices often require production, modification, detection, and interpretation of an optical signal. Optical engineers know how to select, design and produce light using a wide variety of sources (from incandescent bulbs to lasers). Modification of the optical signal is done using a different passive optical elements (lens, polarizers, wave plates) as well as diverse active elements (e.g., spatial light modulators, variable retarders, acoustic optic modulators). Optical engineers understand and specify devices to collect optical signals according to optical wavelength, information bandwidth, and noise. Optical Engineering includes the skills needed to incorporate optical components in systems serving diverse areas such as metrology, photovoltaics, computing, robotics, and optical testing.

Graduates of the dual degree program are technically competent in an engineering discipline, but also have optical engineering knowledge. This provides a competitive advantage for graduates entering the workforce because incorporating optical subsystems is common in many engineering applications. For example, a student seeking to become an optomechanical engineer might combine with mechanical engineering; an optoelectronics engineer would combine with electrical engineering; a solar energy engineer with renewable energy engineering.

The Dual Major in Optical Engineering is offered at the Oregon Tech Wilsonville campus.

1.3 Program Brief History

The Dual Major in Optical Engineering was developed in response to requests from local industry. The need for optical engineering instruction in Oregon was established at an optics roundtable discussion at FLIR in 2010 attended by various companies, academics, and legislators. The outcome was that more than 80 companies in Oregon need recruit from outside Oregon to meet their optics needs. In response the Engineering and Technology Industry Council (ETIC) committed \$268,279 for Oregon Tech to develop and launch a dual major in this technical field. The program was approved by the Curriculum Planning Commission in February 2014 and was first offered in the 2014–15 catalog.

The DMOE program also has strong relationships with industry, particularly through its Industry Advisory Board and alumni from the Laser Electro-Optics Technology (LEOT) and the Laser Optical Engineering Technology (LOET) B.S. programs. These relationships keep the DMOE program current and ensure that it continues to meet the needs of the industry.

2 Program Mission, Educational Objectives, and Outcomes

2.1 Program Mission

The mission of the DMOE is to provide a comprehensive program of instruction that will enable graduates to obtain the knowledge and skills necessary for immediate employment and continued advancement in the field of optical engineering. The department will be a leader in providing career ready candidates for various photonics-related technology fields. Faculty and students will engage in applied research in emerging technologies and provide professional services to their communities.

2.2 Program Educational Objectives

The Dual Major in Optical Engineering requires students to complete an ABET-accredited engineering major as a primary major (e.g., BSEE, BSREE, etc). In addition to the Program Educational Objectives of the primary major, the additional Program Educational Objectives for the Optical Engineering program are:

- Graduates of the program will demonstrate an ability to analyze and design optical systems.

2.3 Relationship of Program Educational Objectives to Institutional Objectives

The DMOE PEO maps strongly to the mission and core themes for the university. Specifically, the program objective expects students to have a working knowledge of optical systems is tightly linked to the mission of offering “rigorous applied degree programs” in a “hands-on learning environment, focusing on application of theory to practice.”

2.4 Program Outcomes

The Dual Major Optical Engineering requires students to complete an ABET-accredited engineering major (e.g., BSEE, BSREE, etc.). In addition to the ABET-EAC (a) through (k) Student Outcomes (assessed in the primary major), students pursuing the Dual Major in Optical Engineering must meet one additional Optical Engineering specific Student Outcome:

- A. Demonstrate the ability to design and build optical systems.

This student outcome has three performance criteria

- A1. (Sources): Ability to design and build using coherent and incoherent optical sources.
- A2. (Manipulation): Ability to manipulate light using active and passive elements.
- A3. (Detection): Ability to design and build using a variety of optical detection systems..

3 Cycle of Assessment for Program Outcomes

3.1 Introduction and Methodology

The Optical Engineering major is only offered as a dual major. Consequently, the overall assessment is a combination of the assessment cycles for the Primary Engineering major and Optical Engineering major. For the three-year cycle of the Primary Engineering Major discipline, please refer to the assessment report for that discipline.

The Optical Engineering specific Student Outcome is part of all courses in the Optical Engineering program. However, the Student Outcome is only assessed in juniors (EE449) and seniors (EE452).

Table 1 shows how the Optical Engineering Student Outcome is integrated into the three-year assessment cycle. Because the Dual Major in Optical Engineering was launched in Fall 2014, year 2 in the table corresponds to the 2017–18 assessment period.

Table 1: Dual Major in Optical Engineering Assessment Cycle

	Year 1			Year 2			Year 3		
	F	W	S	F	W	S	F	W	S
ABET (a) - (k)	<i>As needed by primary engineering major</i>								
EE 448 Geometric Optics									
EE 449 Radiometry & Detection		x			x			x	
EE 450 Physical Optics									
EE 451 Lasers									
EE 452 Waveguides & Fiber Optics		x			x			x	
EE 453 Optical Metrology									

3.2 Summary of Assessment Activities & Evidence of Student Learning

The Optical Engineering faculty conducted formal assessment of the Student Outcome during the 2017–18 academic year using design projects as direct measures. These projects were specially designed by Oregon Tech DMOE faculty to go beyond the traditional assessment found a course; the projects were created so that program-level outcomes could be assessed. Additionally, indirect assessment the Student Outcomes was conducted through a senior exit survey.

3.3 Methodology for Assessment of Program Outcomes

At the beginning of the assessment cycle, an assessment plan was generated by the Assessment Coordinator in consultation with the faculty. This plan included the outcome to be assessed during that assessment cycle, as well as the courses and terms in which these outcomes will be assessed.

The DMOE assessment process uses design projects in DMOE courses specifically to assess program outcomes and program educational objectives. These design projects are assessed based on rubrics created by Oregon Tech DMOE faculty. These design projects involve both a written design document, a laboratory component, and a comprehensive report. The design project requires the student to apply knowledge of optical source, light manipulation, and optical detection. 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 used to 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 reflects a 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:

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 meeting are included in the annual DMOE Assessment Report, which is reviewed by the Department Chair and the Director of Assessment for the university. The suggested changes to the curriculum are presented and discussed with all the department faculty at the annual Convocation meeting in Fall of 2017, as well as with the Industry Advisory Board at the following IAB meeting. If approved, these changes are implemented in the curriculum and submitted to the University Curriculum Planning Commission (if catalog changes are required) for the following academic year.

The sections below describe the 2017–18 targeted assessment activities and detail the performance of students for each of the assessed outcomes. 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.

3.4 Targeted Assessment for Outcome A: Demonstrate the ability to design and build optical systems

This outcome was assessed in two classes EE/PHY 449 and EE/PHY 452.

3.4.1 Assessment in EE/PHY 449

EE/PHY 449 (Radiometry and Optical Detection) was assessed in EE/PHY 449/549 in winter term of 2017 by evaluating one project for parts A1, A2 and A3.

The project was to design an optical system for a spectrometer using lenses, a diffraction grating, and a photodiode array. The students were expected to select (and position) a lens to illuminate the grating and then to arrange the optical system to illuminate a photodiode array to produce a signal that could be interpreted as an optical spectrum. The students were expected to fully document their building process and gather data using diode lasers and a low pressure mercury lamp.

Seven undergraduate students were assessed in Winter 2017 using the performance criteria listed in the table below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria.

Performance Criterion	1-Developing	2-Accomplished	3-Exemplary	%Students \geq 2
A1 — Source	1	0	6	85.7%
A2 — Manipulation	1	2	4	85.7%
A3 — Detection	1	1	5	85.7%

3.4.2 Assessment in EE/PHY 452

EE/PHY 452 (Fiber Optics and Optical Waveguides) would have been assessed in Winter 2017 but the class was not offered.

3.5 Indirect Assessment

In addition to direct assessment measures, the Student Outcome was indirectly assessed through a senior exit survey in the Spring term of 2017. The survey asked students “Below are the student outcomes for the Dual Major in Optical Engineering program. Please indicate how well the DMOE program prepared you in each of the following areas.” *Unfortunately, no students graduated in 2017 with a dual major in optical engineering.* Consequently Table 2 below shows no results for the indirect assessment of the DMOE student outcomes for the 2017–18 graduating class.

This was the fourth year of the DMOE program and the number of students who enrolled or graduated is small. In the future, more students will participate and therefore will provide a more stable sample size for assessment purposes.

4 Changes Resulting From Assessment

This section describes the changes resulting from the assessment activities carried out during the year 2017–18. It includes any changes that have been implemented based on assessment in previous assessment cycles, from this or last year, as well as considerations for the next assessment cycle. No changes were made in the previous year because 80% of the students preformed at the accomplished or exemplary levels.

The DMOE faculty met on November 8, 2017 to review the assessment results and determine whether any changes are needed to the DMOE curriculum or assessment methodology based on the results presented in this document. The objective set by the DMOE faculty was to have at least 80% of the students perform at the level of accomplished or exemplary in all performance criteria of the assessed outcomes.

The results of the 2017–18 Assessment indicate that the minimum acceptable performance level of 80% was met on all performance criteria for all assessed outcomes.

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

Table 2: Indirect Student Outcome Assessment

Outcome	Inadequately Prepared		
	Inadequately Prepared	Prepared	Highly Prepared
A. an ability to design and build optical systems	0	0	0