

## **Outcome 1**

**Graduates have an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.**

### **Measure 1.1**

A passing student must be able to formulate and solve a complex or multistep problem based on relevant parameters.

**Assessment item:** Instructor created scenarios in which students are given parameters and students formulate a model or solution.

**Target:** 80% of passing students meet or exceed expectations, as determined by an assessment review committee.

**Course(s):** OSE 3052, 4520

<b>Proficient</b>	<b>Minimally proficient</b>	<b>Not proficient</b>
Student uses the correct parameters to <b>formulate</b> a valid approach to solve the problem, with information organized in a clear coherent manner that can be easily followed.	Student uses the correct parameters to <b>formulate</b> a valid approach to solve the problem, but organization is lacking and difficult to follow.	Student is unable to <b>formulate</b> a valid approach.
Student correctly <b>solves</b> problem with information organized in a clear coherent manner that can be easily followed.	Student correctly <b>solves</b> problem but organization is lacking and difficult to follow.	Student is unable to <b>solve</b> most steps of the problem.

**Exceeds Expectation:** 2 proficient **or** 1 proficient and 1 minimally proficient.

**Meets Expectations:** No “not proficient”

**Does Not Meet Expectations:** 1 or more “not proficient”

### **Measure 1.2**

A passing student must be able to identify a photonics engineering problem out of a complex, context-rich statement or scenario.

**Assessment item:** Instructor created problem(s) on the final exam in which students are asked to identify key aspects of a problem

**Target:** 80% of passing students are proficient or minimally proficient, as determined by an assessment review committee.

**Course(s):** OSE 3052, 4520

<b>Proficient</b>	<b>Minimally proficient</b>	<b>Not proficient</b>
Student clearly identifies the key aspects of the problem.	Student is able to identify some key aspects of the problem.	Unable to identify most or all the key aspects of the problem.

## Outcome 2

**Graduates have an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.**

### Measure 2.1

A passing student must be able to design and produce a system that is safe and, where applicable, incorporates components to protect users from identified hazards and correctly identify those hazards.

**Assessment item:** Student project final report. Instructor reports data based on their own evaluation and feedback from the review panel.

**Target:** 100% of students will be proficient or minimally proficient and 80% of students will be ranked as proficient.

**Course(s):** OSE 4952

Proficient	Minimally proficient	Not proficient
Project design fully takes into account safety issues, and potential hazards are correctly identified and mitigated.	Safety issues are correctly identified but not adequately mitigated in final design  OR  No safety issues with final design but discussion of potential safety issues is inadequate	Safety issues are neither identified fully nor adequately mitigated in final design

## Measure 2.2

A passing student must be able to identify how their designed project incorporates the following factors, as may be appropriate to their specific design: global, cultural and social, and environmental.

**Assessment item:** Student project final report

**Target:** 80% of students will meet or exceed expectations.

**Course(s):** OSE 4952

Proficient	Not proficient
Student is able to identify the ways in which their project was designed for a global marketplace.  OR  Addressing the global marketplace is not relevant for this project.	Student did not address how project was designed for a global marketplace although there were obvious ways it could be achieved.
Student is able to identify the ways in which their project is designed for various cultures and societies.  OR  Addressing use in various cultures or societies is not relevant for this project.	Student did not address how the project was designed for various cultures and societies although there are aspects which should have been addressed.
Student is able to identify the ways in which project is designed to take into account sustainability and impact on the environment.  OR  Addressing the impact on the environment is not relevant for this project.	Student did not address how the project was designed to take into account sustainability and impact on the environment although this should have been addressed.

**Exceed Expectations:** 3 proficient

**Meets Expectations:** 2 out 3 proficient

**Does Not Meet Expectations:** 2 or more “not proficient”

## Measure 2.3

A passing student must be able to provide a budget and budget narrative.

**Assessment item:** Student project final report.

**Target:** 80% of students will be ranked as proficient or minimally proficient.

**Course(s):** OSE 4952

Proficient	Minimally Proficient	Not proficient
Includes a realistic budget and a budget narrative; project can be manufactured at a realistic cost.	Budget is included but lacks narrative; project can be manufactured at a realistic cost.	Poor or inaccurate budget; project has unrealistic manufacturing cost.

### **Outcome 3**

**Graduates have an ability to communicate effectively with a range of audiences.**

#### **Measure 3.1**

A passing student must be able to demonstrate effective written communication for specified audiences using technical written communication modes, such as reports, publication, patents, or proposals.

**Assessment item:** Final version of instructor assigned writing sample

**Target:** 90% of passing students are proficient or minimally proficient.

**Course(s):** OSE 4930

<b>Proficient</b>	<b>Minimally proficient</b>	<b>Not proficient</b>
Student is able to clearly write ideas, taking into account target audience and type of communication mode.	Minor deficiencies in length, spelling, grammar or structure. Targeted to proper audience and uses proper format.	Major deficiencies. Not targeted to appropriate audience or format; writing may be verbose; multiple errors in structure, grammar, spelling, etc.

#### **Measure 3.2**

A passing student must be able to demonstrate effective oral communication techniques for specified audiences, using conference presentations, posters, seminars, “elevator speeches”, or presentations without visual aids.

**Assessment item:** Instructor assigned oral presentation

**Target:** 90% of passing students are proficient or minimally proficient.

**Course(s):** OSE 4930

<b>Proficient</b>	<b>Minimally proficient</b>	<b>Not proficient</b>
Student is able to give presentation to various audiences and communicate their ideas, taking into account target audience and situation. Remains on topic or point.	Presentation lacks some clarity in communicating ideas; may vary slightly from topic; vocabulary used may be slightly simple or complex, dependent on audience; minor improvements are needed.	Does not take into account the situation or audience; presentation is unorganized, not of proper time duration, or not on topic.

## **Outcome 4**

**Graduates have an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.**

### **Measure 4.1**

A passing student must be able to demonstrate knowledge of the ethical issues regarding publications and the peer review process, work credit sharing allocations, data management and reporting, citations and plagiarism.

**Assessment item:** Instructor provided assessment in the form of questions or scenarios.

**Target:** 100% of passing students are proficient or minimally proficient.

**Course(s):** OSE 4930

<b>Proficient</b>	<b>Minimally proficient</b>	<b>Not proficient</b>
Student correctly identifies and differentiates ethical from unethical practices in all or most situations or scenarios and can explain the ethical issues.	Student has difficulty differentiating ethical from unethical practices in nuanced situations or scenarios but can differentiate in less complex ones with explanation.	Student is unable to differentiate ethical from unethical practices in a variety of situations or scenarios.

### **Measure 4.2**

A passing student must be able to recognize ethical and professional conduct by being well informed about global, economic, environmental and societal issues as an engineering solution is realized.

**Assessment item:** Case Studies or Scenarios

**Target:** 100% of passing students are proficient or minimally proficient.

**Course(s):** OSE 4930

<b>Proficient</b>	<b>Minimally proficient</b>	<b>Not proficient</b>
Student can differentiate ethical/professional conduct from unethical/unprofessional conduct and provide reasoning in the context of global, economic, environmental and societal factors.	Student can differentiate ethical/professional conduct from unethical/unprofessional conduct but have difficulty providing reasoning in context of the stated factors.	Student cannot differentiate ethical/professional conduct from unethical/unprofessional conduct nor provide reasoning in the context of stated factors.

## **Outcome 5**

**Graduates have an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.**

### **Measure 5.1**

Passing students must be able to demonstrate that they worked effectively on a team. This includes the ability to collaborate, plan tasks and establish and meet specifications.

**Assessment item:** Review panel rubric

**Target:** 80% of teams will be proficient or minimally proficient.

**Course(s):** OSE 4952

<b>Proficient</b>	<b>Minimally proficient</b>	<b>Not proficient</b>
Team receives high ranks in all the following categories: Collaboration, planning tasks, establish and meeting specifications.	Team did not receive all high ranks, but there were no low ranks.	Team receives 1 or more low ranks in one or more of the categories.

### **Measure 5.2**

A passing student must be able to work effectively on a team that includes the ability to collaborate, plan tasks, and establish and meet specifications as measured by an instructor evaluation.

**Assessment item:** Instructor evaluation

**Target:** 80% of students will be proficient or minimally proficient.

**Course(s):** OSE 4952

<b>Proficient</b>	<b>Minimally proficient</b>	<b>Not proficient</b>
Student receives high ranks in all the following categories from the instructor: Collaboration, plan tasks, establish and meet specifications.	Student did not receive all high ranks from the instructor, but there were no low ranks.	Student receives 1 or more low ranks in one or more of the categories.

## Outcome 6

**Graduates have an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.**

### Measure 6.1

A passing student must be able to conduct directed experimentation, collect data, analyze and interpret results.

**Assessment item:** One experiment from lab workbook near the end of the semester.

**Target:** 90% of passing students meet or exceed expectations

**Course(s):** OSE 3200L, OSE 3052L, OSE 4410L, OSE 4520L, OSE 4470L, OSE 4830L

Proficient	Minimally proficient	Not proficient
Student followed procedures.	Student deviated in small ways from the procedures.	Student did not follow procedures.
Accurate data is collected. Data is displayed in tables.	Students have collected data but the organization of the information is lacking.	Data is missing or unintelligible.
Calculations are organized with formulas, variables, and units and are correctly written.	Calculations may be missing a few units or there may be mistakes in the calculations.	Calculations are inaccurate, no units used or incorrect formulas are used.
Analysis and interpretation of the results are accurate and concise, with no extraneous information provided.	Analysis and interpretation arrives at an accurate conclusion but there is extra irrelevant information provided.	Inaccurate analysis of data or there is a tremendous amount of irrelevant information provided.

**Exceeds Expectations:** At least 3 Proficient with no “not proficient”

**Meets Expectations:** At least 2 proficient with no “not proficient”

**Does Not Meet Expectations:** Any other combination

## Measure 6.2

A passing student must be able to develop and conduct appropriate experimentation to characterize the properties of an optical or photonic component or system.

**Assessment item:** Instructor provided problem to solve experimentally.

**Target:** 90% of passing students meet or exceed expectations

**Course(s):** OSE 3200L, OSE 3052L

Proficient	Minimally proficient	Not proficient
Student develops and presents a clear set of efficient procedures and can accurately collect data to solve the experimental question.	Student has a set of procedures, but there missing or redundant steps or steps which may not clearly lead to accurate data.	Procedures are poor or inaccurate. Established procedures do not lead to intended data. They may also be missing.
Accurate data is collected. Data is displayed in tables.	Students have collected data but the organization of the information is lacking.	Data is missing or unintelligible.
Analysis and interpretation of the results are accurate and concise, with no extraneous information provided.	Analysis and interpretation arrives at an accurate conclusion but there is extra irrelevant information provided.	Inaccurate analysis of data or there is a tremendous amount of irrelevant information provided.
Student correctly self-assesses the validity of the experiment in light of the results.	Student provide a self-assessment of the validity, however it may omit key factors.	Student is unable to assess the validity of the experiment.

**Exceeds Expectations:** At least 3 Proficient with no “not proficient”

**Meets Expectations:** At least 2 proficient with no “not proficient”

**Does Not Meet Expectations:** Any other combination

## **Outcome 7**

**Graduates have an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.**

### **Measure 7.1**

A passing student must be able to demonstrate the ability to conduct background research to develop approaches for their senior design project.

**Assessment item:** Student project final report

**Target:** 100% of students be proficient or minimally proficient.

**Course(s):** OSE 4952

<b>Proficient</b>	<b>Minimally proficient</b>	<b>Not proficient</b>
Final report contains a detailed and well-cited description of the background research performed in order to develop the project design and engineering and market requirements	Final report contains a brief description of the background research, with citations performed in order to develop the project design and engineering and market requirements	Final report contains a brief or no description of the background research, with few, no, or inaccurate citations performed in order to develop the project design and engineering and market requirements

### **Measure 7.2**

A passing student must be able to demonstrate the ability to self-learn content beyond that taught in classroom instruction.

**Assessment item:** Instructor provided assignment.

**Target:** 80% of students are proficient or minimally proficient.

**Course(s):** OSE 4930

<b>Proficient</b>	<b>Minimally proficient</b>	<b>Not proficient</b>
Is able to demonstrate all the characteristics of a self-learner: identify their own learning needs, create learning goals, find resources for learning, select and put into practice suitable learning strategies, and assess learning outcomes.	Student can identify their own learning needs, create learning goals and find resources. May be able to select and put into practice suitable learning strategies. Does not assess their own learning outcomes.	Student is unable to identify their own learning needs or create learning goals.

## **Outcome 8**

**Retain students in the Photonic Science and Engineering Bachelor of Science program.**

### **Measure 8.1**

Students will complete photonics pending requirements and be accepted into the Photonic Science and Engineering Degree.

**Assessment item:** IKM Data

**Target:** 75% of photonics pending students will complete pending requirements and be accepted into the major within two years of declaring photonics pending.

**Additional Assessment Data (s):** Student survey annually for those students who did not move from pending into the major.

### **Measure 8.2**

Students will graduate with a bachelor's degree in Photonic Science and Engineering.

**Assessment item:** IKM Graduation Data and Change of Major Data.

**Target:** 75% of students who are accepted in the major will complete the major within six years.

**Additional Assessment Data (s):** Student survey annually for those students who did not complete major and track student progress and retention in courses related to the major.