

# Physics and Engineering Core Competencies

2024-25

## Physics and Engineering

**Learning Outcome:** ABET #1: Students will demonstrate an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (CC: CT)

**Outcome Measures and Criteria for Success:**

Course	Outcome Assessed	Assessment Method	Threshold	Frequency
EGR2014 EGR2014L	Students will be able to set up a problem with the appropriate variables and solve the problem. (ME and EE)	Exam Question	At least 80% of the students will score 2.5 or higher on the associated rubric	Annually
EGR2024 EGR2024L	Students will be able to set up a problem with the appropriate variables and solve the problem. (all)	Exam Question	At least 80% of the students will score 2.5 or higher on the associated rubric	Annually
EGR3034 EGR3034L	Students will be able to apply a theoretical model to calculate a solution to a problem using appropriate computational techniques/software. (ME)	Exam Question	At least 80% of the students will score 2.5 or higher on the associated rubric	Alternating Year
EGR4103 (replaced EGR4013)	Students will be able to apply a theoretical model to calculate a solution to a problem using appropriate computational techniques/software. (EE and CSE)	Exam Question	At least 80% of the students will score 2.5 or higher on the associated rubric	Alternating Year
EGR4082	Students will demonstrate an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (all)	Faculty/Review Team Assessment of Final Project	At least 80% of the teams will score 2.5 or higher on the associated rubric	Annually
EGR4082	Student reflection on preparation to solve problems using engineering, science and mathematics. (all)	Senior Survey (Indirect Method)	80% of the respondents will say that they are satisfied or higher	Annually

**Longitudinal Data:**

Note that the PHE department changed assessment processes to align with ABET expectations for engineering curriculum. The data shown is all that we are expected to collect for ABET, both formative and summative data. The italicized data is from our previous assessment system.

EGR2014 (Formative)	Percent of Students Above 2.5					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Identify necessary information given in the problem to arrive at a solution.	100%	67%	77%	67%	73%	79%
Formulate appropriate equations with corresponding variables.	100%	67%	100%	67%	64%	79%
Solve the problem by applying the principles identified.	100%	67%	100%	67%	64%	79%

EGR2024 (Formative)	Percent of Students Above 2.5					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Identify necessary information given in the problem to arrive at a solution.	100%	82%	90%	100%	57%	77%
Formulate appropriate equations with corresponding variables.	100%	73%	90%	100%	71%	77%
Solve the problem by applying the principles identified.	100%	73%	90%	88%	64%	38%

EGR3034 (Summative)	Percent of Students Above 2.5					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Identify necessary information given in the problem to arrive at a solution.		81%		100%		100%
Formulate appropriate equations with corresponding variables.		81%		100%		82%
Solve the problem by applying the principles identified.		94%		100%		64%

EGR4013 - Old System (Summative)	Percent of Students Above 2.5			
	2019-20	2020-21	2021-22	2022-23
Identify necessary information given in the problem to arrive at a solution.	63%		87%	
Formulate appropriate equations with corresponding variables.	56%		87%	
Solve the problem by applying the principles identified.	63%		73%	

EGR4103 - New System (Summative)	Percent of Students Above 2.5					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25*
Can identify a theoretical model to calculate a solution to a problem (EE and CSE)				100%		
Can apply appropriate computational techniques/software (EE and CSE)				100%		
Identify necessary information given in the problem to arrive at a solution.						100%
Formulate appropriate equations with corresponding variables.						82%
Solve the problem by applying the principles identified.						6%

\* Used different rubric for 2024-25.

EGR4082 (Summative)	Percent of Students Above 2.5					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Students will demonstrate an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (all).	64%	40%	67%	100%	100%	100%

EGR4082 (Student Survey)	Percentage of Students Indicating Satisfied or Higher		
	2022-23	2023-24	2024-25
How well do you feel that you have been prepared to: [Apply the principles of knowledge of engineering, science, and mathematics to solve problems?]	100%	90%	71%

*Previous Learning Outcome: Students will apply physical principles, mathematical reasoning, and computational techniques to solve real-world problems.*

*Previous Outcome Measure: Embedded final exam questions given in upper division mastery class on a rotating basis (EGR/PHY3063, EGR/PHY3043 and PHY4053).*

*Previous Criteria for Success (how do you judge if the students have met your standards): At least 75% of students will achieve an average score of 2.5 or higher on criteria described in application rubric.*

*Previous Data:*

	Percentage Over 2.5									
	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
	PHY431	PHY361	PHY431	PHY361	PHY431	PHY361	PHY431	PHY3063	PHY/EGR3043	PHY/EGR3063
Application Rubric	84%	88%	82%	80%	71%	96%	81%	92%	100%	53%

*\* Note the courses were renumbered in the 2019-20 academic year. PHY361 became PHY3063. PHY431 became PHY4053. At that time some courses were cross listed as both engineering and physics.*

**Conclusions Drawn from Data:**

The students are generally meeting our expectations in this area except in the area of “solving problems by principles identified.” The most significant shortfall was in EGR4103 and it appears that the assignment was not aligned with the rubric used. We need to review assignments and continue to help students make connections between specific principles and problem solving techniques. As part of the senior project (advisory board assessment) the students did meet the benchmark. Note that the survey data asking the students to self-assess their abilities is near our benchmark. The sample size was small, and we had two students who negatively assessed all aspects of the program. This will be seen throughout the data in this report.

**Changes to be Made Based on Data:**

Review the assignments being used for the formative assessments to see what curricular insights can be gained from the students not hitting the benchmark. We are revising the curriculum map and assessment plan to be sure that we are assessing this skill in the right locations.

**Rubric:**

- EGR2014 – Attached
- EGR2024 – Attached
- EGR3034 – Attached
- EGR4013 – Attached
- EGR4103 – Attached
- EGR4082 – There is no rubric since it comes from the review sheet of the faculty and external

professional review committee.

Senior Survey – No rubric for this since they are survey results.

### Engineering and Physics Rubric

PLO1: Student will demonstrate an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (CC: CT)

Courses evaluated: EGR 2014/2014L, EGR 2024/2024L, EGR 3034/3034L, EGR 4013

<b>Criteria</b>	<b>4 – Excellent</b>	<b>3 – Good</b>	<b>2 – Fair</b>	<b>1 – Poor</b>
Identify necessary information given in the problem to arrive at a solution	No mistakes	Few mistakes, mostly correct	Some mistakes, some understanding	Many mistakes, not interpreting information
Formulate appropriate equations with corresponding variables	No mistakes	Few mistakes, mostly correct	Some mistakes, some understanding	Many mistakes, not interpreting information
Solve the problem by applying the principles identified	No mistakes	Few mistakes, mostly correct	Some mistakes, some understanding	Many mistakes, not interpreting information

### EGR4103 Rubric

PLO1: Students will demonstrate an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (CC: CT)

Outcome Assessed	Excellent (4)	Good (3)	Satisfactory (2)	Unsatisfactory (1)	Excellent (4)
Can identify a theoretical model to calculate a solution to a problem. (EE and CSE)	No mistakes	Few mistakes, mostly correct	Some mistakes, some understanding	Many mistakes, not interpreting information	No mistakes
Can apply appropriate computational techniques/software. (EE and CSE)	No mistakes	Few mistakes, mostly correct	Some mistakes, some understanding	Many mistakes, not interpreting information	No mistakes

## Physics and Engineering

**Learning Outcome:** ABET #3: Students will demonstrate an ability to communicate effectively with a range of audiences.

- Students will be able to speak about their work with precision, clarity and organization. (CC: OC)
- Students will be able to write about their work with precision, clarity and organization. (CC: WC)
- Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand. (CC: IL)

### Outcome Measures and Criteria for Success:

Course	Outcome Assessed	Assessment Method	Threshold	Frequency
EGR2024L	Students will be able to write a lab report that accurately summarizes the experiment and the results.	Lab Report	At least 80% of the students will score 2.5 or higher on the associated rubric	Annually
PHY3004L	Students will be able to write a lab report that accurately summarizes the experiment and the results.	Lab Report	At least 80% of the students will score 2.5 or higher on the associated rubric	Alternating Year
EGR3093L	Students will be able to write a lab report that accurately summarizes the experiment and the results.	Lab Report	At least 80% of the students will score 2.5 or higher on the associated rubric	Alternating Year
EGR4082	Students will be able to speak about their work with precision, clarity and organization.	Faculty Team Assessment of Final Project Presentation	At least 80% of the teams will score 2.5 or higher on the associated rubric	Annually
EGR4082	Students will be able to write about their work with precision, clarity and organization.	Faculty Team Assessment of Final Project Report	At least 80% of the teams will score 2.5 or higher on the associated rubric	Annually
EGR4082	Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand.	Faculty Team Assessment of Final Project Report	At least 80% of the teams will score 2.5 or higher on the associated rubric	Annually
EGR4082	Student reflection on preparation to communicate effectively	Senior Survey (Indirect Method)	80% of the respondents will say that they are satisfied or higher	Annually

### Longitudinal Data:

Note that the PHE department changed assessment processes to align with ABET expectations for engineering curriculum. The data shown is all that we are expected to collect for ABET, both formative and summative data, so some formative data has been added as well as some additional data gathered from laboratory reports.

EGR2024 (Formative)	Percent of Students Above 2.5					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25*
Students will be able to write a lab report that accurately summarizes the experiment and the results	0%	33%	56%			100%
Writing is precise, clear, and organized				100%	100%	
Writing accurately summarizes the experiment				100%	100%	
Writing accurately summarizes the main results of the experiment				100%	100%	

\* The wrong rubric was used in 2024-25.

PHY3004 (Summative)	Percent of Students Above 2.5					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Students will be able to write a lab report that accurately summarizes the experiment and the results	60%	100%	63%	100%	100%	100%

EGR3093 (Summative)	Percent of Students Above 2.5					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Students will be able to write a lab report that accurately summarizes the experiment and the results	100%	N/A	100%	N/A	60%	N/A

EGR4082 - Speaking (Summative)	Percentage of Students at 2.5 or Higher						
	2018-19	2019-20*	2020-21*	2021-22	2022-23	2023-24	2024-25
Students will be able to speak about their work with precision, clarity and organization. (CC: OC)	75%	100%	88%	100%	100%	100%	100%

EGR4082 - Writing (Summative)	Percentage of Students at 2.5 or Higher						
	2018-19	2019-20*	2020-21*	2021-22	2022-23	2023-24	2024-25
Students will be able to write about their work with precision, clarity and organization. (CC: WC)	100%	No Data	80%	67%	100%	100%	0%

EGR4082 - Information Literacy (Summative)	Percentage of Students at 2.5 or Higher						
	2018-19	2019-20*	2020-21*	2021-22	2022-23	2023-24	2024-25
Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand. (CC: IL)	44%	No Data	80%	100%	83%	0%	0%

\* Indicates a COVID year

EGR4082 (Student Survey)	Percentage of Students Indicating Satisfied or Higher		
	2022-23	2023-24	2025-25
How well do you feel that you have been prepared to: [Communicate truthfully and effectively?]	100%	90%	71%
How well do you feel that you have been prepared to: [Communicate orally?]	83%	100%	71%
How well do you feel that you have been prepared to: [Communicate in writing?]	100%	100%	71%

**Conclusions Drawn from Data:**

The students are generally meeting our benchmarks. We have seen improvement in the results with the lab reports as we have made our expectations clearer. The drop in the 2023-24 lab assessment for EGR3093 was a matter of a single student missing the benchmark. We are seeing mixed results with information literacy. In 2024-25 all of the students missed the benchmark in both writing and information literacy. These scores were based on a single team report. If we had set the benchmark at scores of 2 or higher, 100% of the students would have met the benchmark. As with other data from the senior survey, if a single student had scored communication areas one point higher, we would have met the benchmark.

**Changes to be Made Based on Data:**

Continue to monitor progress and emphasize the components of a thorough lab report. Revisit the proper citation of reference material in reports. We are also revising how we handle writing in EGR4082 so that we can collect samples of individual students' writing.

**Rubrics:**

EGR2024 - attached

PHY3004 - attached

EGR3093 - attached

Oral Presentation - attached

Writing - attached

Information Literacy – This is a subset of the writing rubric.

The senior data comes from a survey and thus has no rubric.

**EGR 2024 Assessment Method: Lab Report (Current)**

PLO3: Students will demonstrate an ability to communicate effectively with a range of audiences.

- Students will be able to speak about their work with precision, clarity, and organization. (CC: OC)
- Students will be able to write about their work with precision, clarity and organization. (CC: WC)
- Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand. (CC: IL)

<b>Criteria</b>	<b>4 – Excellent</b>	<b>3 – Good</b>	<b>2 – Fair</b>	<b>1 – Poor</b>
Writing is precise, clear, and organized	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized
Writing accurately summarizes the experiment	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized
Writing accurately summarizes the main results of the experiment	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized

**EGR 2024L Assessment Method: Lab Report (Past)**

PLO3: Students will demonstrate an ability to communicate effectively with a range of audiences.

- Students will be able to speak about their work with precision, clarity, and organization. (CC: OC)
- Students will be able to write about their work with precision, clarity and organization. (CC: WC)
- Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand. (CC: IL)

PLO6: Students will demonstrate an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (CC: QR)

<b>Criteria</b>	<b>4 – Excellent</b>	<b>3 – Good</b>	<b>2 – Fair</b>	<b>1 – Poor</b>
<b>3.</b> Students will be able to write a lab report that accurately summarizes the experiment and the results.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized
<b>6.</b> Students will be able to carry out an experiment based on instructions and accurately record data.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized
<b>6.</b> Students will be able to analyze experimental data and draw conclusions.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized

**PHY 3004L Assessment Method: Lab Report**

PLO3: Students will demonstrate an ability to communicate effectively with a range of audiences.

- Students will be able to speak about their work with precision, clarity, and organization. (CC: OC)
- Students will be able to write about their work with precision, clarity and organization. (CC: WC)
- Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand. (CC: IL)

PLO6: Students will demonstrate an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (CC: QR)

<b>Criteria</b>	<b>4 – Excellent</b>	<b>3 – Good</b>	<b>2 – Fair</b>	<b>1 – Poor</b>
<b>3.</b> Students will be able to write a lab report that accurately summarizes the experiment and the results.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized
<b>6.</b> Students will be able to compare experimental results to appropriate theoretical models and explain differences, including quantifying sources of error.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized

**EGR 3093L Assessment Method: Lab Report**

PLO3: Students will demonstrate an ability to communicate effectively with a range of audiences.

- Students will be able to speak about their work with precision, clarity, and organization. (CC: OC)
- Students will be able to write about their work with precision, clarity and organization. (CC: WC)
- Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand. (CC: IL)

PLO6: Students will demonstrate an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (CC: QR)

<b>Criteria</b>	<b>4 – Excellent</b>	<b>3 – Good</b>	<b>2 – Fair</b>	<b>1 – Poor</b>
<b>3.</b> Students will be able to write a lab report that accurately summarizes the experiment and the results.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized
<b>6.</b> Students will be able to compare experimental results to appropriate theoretical models and explain differences, including quantifying sources of error.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized

### PHY-ENG Oral Presentation Rubric Update

Criteria	Outstanding	High Satisfactory	Low Satisfactory	Unsatisfactory
<b>Command of material</b>	<input type="checkbox"/> Clearly knows material	<input type="checkbox"/> Knows most key facts	<input type="checkbox"/> Reads some, knows some	<input type="checkbox"/> Reads many sentences from slides
	<input type="checkbox"/> Expands on PowerPoint slides	<input type="checkbox"/> Some expansion on slides	<input type="checkbox"/> No expansion on slides	<input type="checkbox"/> Dependent on notes
	<input type="checkbox"/> Content appropriate for audience	<input type="checkbox"/> Partial adaptation for audience	<input type="checkbox"/> Little adaptation of content for audience	<input type="checkbox"/> Lacks adaptation of content to audience
<b>Organization</b>	<input type="checkbox"/> Clear and concise outline	<input type="checkbox"/> Clear outline	<input type="checkbox"/> Some sense of outline	<input type="checkbox"/> No clear sense of outline
	<input type="checkbox"/> Relevant graphics and key text items on slides	<input type="checkbox"/> Too much information on slides (not concise)	<input type="checkbox"/> Too much information and detail	<input type="checkbox"/> Slides are in paragraphs; too much detailed information on one slide
	<input type="checkbox"/> Plus/minus 30 seconds of time limit	<input type="checkbox"/> Plus/minus 60 seconds of time limit	<input type="checkbox"/> Plus/minus 1.5 minutes of time limit	<input type="checkbox"/> Plus/minus 2 minutes of time limit
<b>Presentation skills</b>	<input type="checkbox"/> Clearly has practiced several times; smooth transitions	<input type="checkbox"/> Practiced, but transitions are not smooth	<input type="checkbox"/> Practiced, but no transitions between slides	<input type="checkbox"/> Not practiced, doesn't anticipate content of next slide
	<input type="checkbox"/> Free of uhms and the like	<input type="checkbox"/> Few uhms and the like	<input type="checkbox"/> Many uhms and the like	<input type="checkbox"/> Uhms and the like detract from the presentation
	<input type="checkbox"/> Clearly heard and used inflection for emphasis	<input type="checkbox"/> Understood much of the time and some inflection	<input type="checkbox"/> Some difficulty hearing and little inflection	<input type="checkbox"/> Cannot be heard and/or speaks in a monotone
	<input type="checkbox"/> Engages audience with eye contact	<input type="checkbox"/> Some engagement with eye contact	<input type="checkbox"/> Infrequent eye contact	<input type="checkbox"/> No eye contact
	<input type="checkbox"/> Engages audience with gestures	<input type="checkbox"/> Some engagement with gestures	<input type="checkbox"/> Some distracting gestures	<input type="checkbox"/> Frequent distracting gestures
<b>Presentation tools</b>	<input type="checkbox"/> PPT background is matched to content, legible font, graphics, seamless transitions	<input type="checkbox"/> Appropriate background, font, transitions	<input type="checkbox"/> Distracting backgrounds, transitions, fonts hard to read	<input type="checkbox"/> No attention to backgrounds, transitions, fonts very hard to read
	<input type="checkbox"/> Appropriate graphics used	<input type="checkbox"/> Some graphics used to enhance presentation	<input type="checkbox"/> Graphics do not enhance presentation	<input type="checkbox"/> Distracting use of graphics

### PHY-ENG Written Presentation Rubric

Criteria	Outstanding	High Satisfactory	Low Satisfactory	Unsatisfactory
<b>Structural pieces</b>	<input type="checkbox"/> Abstract is a clear and concise summary of all relevant results and descriptions in the order emphasized in the paper	<input type="checkbox"/> Abstract could be made clear and/or concise with minor changes	<input type="checkbox"/> Abstract is missing some information and/or contains unnecessary information	<input type="checkbox"/> Abstract does not contain necessary information
	<input type="checkbox"/> Introduction indicates precise subject, scope, and purpose	<input type="checkbox"/> Introduction is missing one of the following: precise subject, scope or purpose	<input type="checkbox"/> Introduction is missing two of the following: precise subject, scope or purpose	<input type="checkbox"/> Introduction does not give precise subject, scope and purpose
	<input type="checkbox"/> Main body is well organized, logical and contains all necessary information without extra information	<input type="checkbox"/> Main body lacks some organization	<input type="checkbox"/> Main body is missing some important pieces and/or is not well organized	<input type="checkbox"/> Main body is not well organized, lacks logical arguments and relevant data
	<input type="checkbox"/> Conclusion appropriately sums up, gives conclusions, and recommendations	<input type="checkbox"/> Conclusion does two of the following: sums up, gives conclusions, and recommendations	<input type="checkbox"/> Conclusion does one of the following: sums up, gives conclusions, and recommendations	<input type="checkbox"/> Conclusion does not provide any summation, conclusions, or recommendations
	<input type="checkbox"/> Multiple references from reputable sources	<input type="checkbox"/> Most references from distinct reputable sources	<input type="checkbox"/> Some references from reputable sources	<input type="checkbox"/> No bibliography or all references from untrusted sources
	<input type="checkbox"/> References cited in the body of the document	<input type="checkbox"/> Some citations of reference in the body	<input type="checkbox"/> Limited citation references	<input type="checkbox"/> No citation of references
<b>Data</b>	<input type="checkbox"/> Data is clearly presented in properly formatted tables, figures and graphs where appropriate	<input type="checkbox"/> Some data could be presented more clearly	<input type="checkbox"/> Data is poorly presented and some key data is missing	<input type="checkbox"/> Several pieces of key data are missing
	<input type="checkbox"/> All uncertainties are shown and error propagation is carried out where appropriate	<input type="checkbox"/> Most uncertainties are shown and propagation of error carried out	<input type="checkbox"/> Many uncertainties are missing and/or propagation or error not carried out correctly	<input type="checkbox"/> No uncertainties of measurements are shown
<b>Grammar, spelling and style</b>	<input type="checkbox"/> No grammatical or spelling errors	<input type="checkbox"/> Few grammatical and spelling errors	<input type="checkbox"/> Some grammatical and spelling errors	<input type="checkbox"/> Many grammatical and spelling errors
	<input type="checkbox"/> Equations well formatted and variables introduced as needed	<input type="checkbox"/> A few errors in formatting equations	<input type="checkbox"/> Poorly formatted equations	<input type="checkbox"/> Incorrect equations
	<input type="checkbox"/> Appropriate style (no first-person, past tense when reporting was done)	<input type="checkbox"/> A few informal statements and/or tense	<input type="checkbox"/> Several areas which are too informal and tense errors	<input type="checkbox"/> Very informal and/or use of future tense where not appropriate
	<input type="checkbox"/> Clear sentences and ideas are presented in a way that won't be misunderstood	<input type="checkbox"/> A few unclear sentences	<input type="checkbox"/> Many complex and unclear sentences	<input type="checkbox"/> Many sentences are unclear and have overly complex construction
	<input type="checkbox"/> Concise and quantitative as subject matter permits	<input type="checkbox"/> A few unnecessary words and ideas	<input type="checkbox"/> Frequent extra and inexact words	<input type="checkbox"/> Many vague, inexact, and/or idle words
	<input type="checkbox"/> Arguments are complete and logical	<input type="checkbox"/> Most arguments are complete	<input type="checkbox"/> Several arguments are difficult to follow	<input type="checkbox"/> Arguments are incomplete, illogical, and may contain unnecessary information and specialized jargon

## Physics and Engineering

**Learning Outcome:** ABET #6: Students will demonstrate an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (CC: QR)

### Outcome Measures and Criteria for Success:

Course	Outcome Assessed	Assessment Method	Threshold	Frequency
EGR2024 EGR2024L	Students will be able to carry out an experiment based on instructions and accurately record data.	Lab Report	At least 80% of the students will score 2.5 or higher on the associated rubric	Annually
EGR2024 EGR2024L	Students will be able to analyze experimental data and draw conclusions.	Lab Report	At least 80% of the students will score 2.5 or higher on the associated rubric	Annually
PHY3004 PHY3004L	Students will be able to compare experimental results to appropriate theoretical models and explain differences, including quantifying sources or error.	Lab Report	At least 80% of the students will score 2.5 or higher on the associated rubric	Annually
EGR3053# EGR3053L (2023 and beyond) EGR3093 EGR3093L (old)	Students will be able to compare experimental results to appropriate theoretical models and explain differences, including quantifying sources or error.	Lab Report	At least 80% of the students will score 2.5 or higher on the associated rubric	Alternating Year
EGR4082	Student reflection on preparation to conduct experiments and interpret data.	Senior Survey (Indirect Method)	80% of the respondents will say that they are satisfied or higher	Annually

### Longitudinal Data:

Note that the PHE department changed assessment processes to align with ABET expectations for engineering curriculum. This includes both formative and summative data. As can be seen in the data, the measurement/rubric has changed over time.

EGR2024 (Formative)	Percent of Students at 2.5 or Higher					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Students will be able to carry out an experiment based on instructions and accurately record data	0%	27%	100%			
Students are able to carry out the experiment from instructions				100%	100%	100%
Students will be able to analyze experimental data and draw conclusions	0%	45%	60%	100%	79%	100%

PHY3004 (Summative)	Percent of Students at 2.5 or Higher					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Students will be able to compare experimental results to appropriate theoretical models and explain differences, including quantifying sources of error	40%	100%	63%	100%	50%	75%

EGR3053 (Summative)	Percent of Students at 2.5 or Higher					
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Students are able to follow instructions					100%	N/A
Students are able to carry out the experiment from instructions					100%	N/A
Data is accurately recorded					100%	N/A
Students will be able to compare experimental results to appropriate theoretical models and explain differences, including quantifying sources of error	100%		100%			

\*changed to EGR3053 in 2023-24 and rubric modified - previously it was EGR3093

EGR4082 (Student Survey)	Percentage of Students Indicating Satisfied or Higher		
	2022-23	2023-24	2024-25
How well do you feel that you have been prepared to: [Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions?]	83%	100%	57%

**Conclusions Drawn from Data:**

The students are generally meeting our benchmarks at the summative level. The drop in PHY3004 in 2023-24 and 2024-25 is due to 1-2 teams writing sub-par reports. One of the things that we have identified this year is that students are struggling with designing testing plans for their senior projects. This seems to be reflected in the student survey data.

**Changes to be Made Based on Data:**

Continue to monitor student progress and review the lab results for PHY3004. We are also making changes in when students are required to take statistics in the program and will make it a pre-requisite for the senior project classes. We are also going to incorporate the design of testing plan into student projects earlier in the curriculum and we are considering creating a statistics for engineers course that we will be able to populate as the program grows.

**Rubrics:**

EGR2024: The rubrics for both assessments are attached (the two current rubrics as well as the historical one are included).

PHY3004: Rubric is attached.

EGR3093: Rubric is attached.

EGR4082: This is data from a survey given to seniors.

**EGR 2024 and 2024L Assessment Method: Lab Report (Current)**

PLO6: Students will demonstrate an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (CC: QR)

<b>Criteria</b>	<b>4 – Excellent</b>	<b>3 – Good</b>	<b>2 – Fair</b>	<b>1 – Poor</b>
Students are able to follow instructions	No mistakes	Few mistakes, mostly follows instructions	Some mistakes, some confusion following instructions	Many mistakes, clearly does not follow instructions
Students are able to carry out the experiment from instructions	No mistakes	Few mistakes, mostly correct experimental setup	Some mistakes, some confusion with experimental setup	Many mistakes, wrong experimental setup
Data is accurately recorded	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some confusion with data	Many mistakes, data is not organized or labeled properly

**EGR 2024 and 2024L Assessment Method: Lab Report (Current)**

PLO6: Students will demonstrate an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (CC: QR)

<b>Criteria</b>	<b>4 – Excellent</b>	<b>3 – Good</b>	<b>2 – Fair</b>	<b>1 – Poor</b>
Analyze experimental data	Arrives at significant results of the experiment from data and identifies key features in data	Arrives at significant results of the experiment from data	Arrives at some of the significant results of the experiment from data	Does not analyze data or incorrectly analyzes data
Draw conclusions from data	Significant conclusions of the experiment are stated and further inferences are made from data	Significant conclusions of the experiment are stated	Some Significant conclusions of the experiment are stated	No conclusions stated or inaccurate conclusions from data

**EGR 2024L Assessment Method: Lab Report (Past)**

PLO3: Students will demonstrate an ability to communicate effectively with a range of audiences.

- Students will be able to speak about their work with precision, clarity, and organization. (CC: OC)
- Students will be able to write about their work with precision, clarity and organization. (CC: WC)
- Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand. (CC: IL)

PLO6: Students will demonstrate an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (CC: QR)

<b>Criteria</b>	<b>4 – Excellent</b>	<b>3 – Good</b>	<b>2 – Fair</b>	<b>1 – Poor</b>
<b>3.</b> Students will be able to write a lab report that accurately summarizes the experiment and the results.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized
<b>6.</b> Students will be able to carry out an experiment based on instructions and accurately record data.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized
<b>6.</b> Students will be able to analyze experimental data and draw conclusions.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized

**PHY 3004L Assessment Method: Lab Report**

PLO3: Students will demonstrate an ability to communicate effectively with a range of audiences.

- Students will be able to speak about their work with precision, clarity, and organization. (CC: OC)
- Students will be able to write about their work with precision, clarity and organization. (CC: WC)
- Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand. (CC: IL)

PLO6: Students will demonstrate an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (CC: QR)

<b>Criteria</b>	<b>4 – Excellent</b>	<b>3 – Good</b>	<b>2 – Fair</b>	<b>1 – Poor</b>
<b>3.</b> Students will be able to write a lab report that accurately summarizes the experiment and the results.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized
<b>6.</b> Students will be able to compare experimental results to appropriate theoretical models and explain differences, including quantifying sources of error.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized

**EGR 3053L Assessment Method: Lab Report**

PLO3: Students will demonstrate an ability to communicate effectively with a range of audiences

- Students will be able to speak about their work with precision, clarity, and organization. (CC: OC)
- Students will be able to write about their work with precision, clarity and organization. (CC: WC)
- Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand. (CC: IL)

PLO6: Students will demonstrate an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (CC: QR)

<b>Criteria</b>	<b>4 – Excellent</b>	<b>3 – Good</b>	<b>2 – Fair</b>	<b>1 – Poor</b>
<b>6.</b> Students will be able to compare experimental results to appropriate theoretical models and explain differences, including quantifying sources of error.	No mistakes	Few mistakes, mostly clear and organized	Some mistakes, some ambiguity	Many mistakes, writing is ambiguous and not organized