# Physics and Engineering

# Core Competencies Assessment

# 2023-24

**Physics and Engineering**
**Core Competencies Assessment, 2023-24**

**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: Critical Thinking)

**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 |
| Identify necessary information given in the problem to arrive at a solution. | 100% | 67% | 77% | 67% | 73% |
| Formulate appropriate equations with corresponding variables. | 100% | 67% | 100% | 67% | 64% |
| Solve the problem by applying the principles identified. | 100% | 67% | 100% | 67% | 64% |

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

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

| 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 |
| 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% | |

| EGR4082 (Summative) | Percent of Students Above 2.5 | | | | |
|---|---|---|---|---|---|
| | 2019-20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 |
| 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% |

| EGR4082 (Student Survey) | Percentage of Students Indicating Satisfied or Higher | |
|---|---|---|
| | 2022-23 | 2023-24 |
| 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% |

*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:**
While not meeting our benchmarks in the formative assessment, the students are in general meeting our benchmarks in the summative assessment. Some of this improvement has come from the department being clearer about the expectations and also refining the tools used to assess the outcomes. As with many areas, we had some challenges during the pandemic because the senior project classes were disrupted but the outcomes seem to be returning to normal.

**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.

**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

| **Criteria** | **4 – Excellent** | **3 – Good** | **2 – Fair** | **1 – Poor** |
|---|---|---|---|---|
| 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**
**Core Competencies Assessment, 2023-24**

**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: Oral Communication)
- Students will be able to write about their work with precision, clarity and organization. (CC: Written Communication)
- Students will be able to identify, locate, evaluate, and effectively and responsibly use and cite information for the task at hand. (CC: Information Literacy)

**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 |
| Students will be able to write a lab report that accurately summarizes the experiment and the results | 0% | 33% | 56% | | |
| 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% |

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

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

| EGR4082 - Speaking (Summative) | Percentage of Students at 2.5 or higher | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20* | 2020-21* | 2021-22 | 2022-23 | 2023-24 |
| Oral Presentation Rubric Scores | 100% | 100% | 100% | 93% | 75% | 100% | 88% | 100% | 100% | 100% |

| EGR4082 - Writing (Summative) | Percentage of Students at 2.5 or higher | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20* | 2020-21* | 2021-22** | 2022-23 | 2023-24 |
| Written Report Rubric | 100% | 100% | 84% | 64% | 100% | No Data | 80% | 67% | 100% | 100% |

| EGR4082 - Information Literacy | Percentage of Students at 2.5 or higher | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (Summative) | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20* | 2020-21* | 2021-22 | 2022-23 | 2023-24 |
| Written Report Rubric IL | 63% | 86% | 53% | 43% | 44% | No Data | 80% | 100% | 83% | 0% |

* Indicates a COVID year

** The students who missed the benchmark scored a 2.46 so this was withing .04 of having 100% of the students meet the benchmark.

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

**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. The 0% result for 2023-24 is because all of the students scored 2 out of 4 so missed the benchmark. We are continuing to work with them to have the accurately cite references.

**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.

**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)

| **Criteria** | **4 – Excellent** | **3 – Good** | **2 – Fair** | **1 – Poor** |
|---|---|---|---|---|
| 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)

| Criteria | 4 – Excellent | 3 – Good | 2 – Fair | 1 – Poor |
|---|---|---|---|---|
| **3.** 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 |
| **6.** 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 |
| **6.** 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)

| **Criteria** | **4 – Excellent** | **3 – Good** | **2 – Fair** | **1 – Poor** |
|---|---|---|---|---|
| **3.** 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 |
| **6.** 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)

| Criteria | 4 – Excellent | 3 – Good | 2 – Fair | 1 – Poor |
|---|---|---|---|---|
| **3.** 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 |
| **6.** 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 |
|---|---|---|---|---|
| **Command of material** | ☐ Clearly knows material | ☐ Knows most key facts | ☐ Reads some, knows some | ☐ Reads many sentences from slides |
| | ☐ Expands on PowerPoint slides | ☐ Some expansion on slides | ☐ No expansion on slides | ☐ Dependent on notes |
| | ☐ Content appropriate for audience | ☐ Partial adaptation for audience | ☐ Little adaptation of content for audience | ☐ Lacks adaptation of content to audience |
| **Organization** | ☐ Clear and concise outline | ☐ Clear outline | ☐ Some sense of outline | ☐ No clear sense of outline |
| | ☐ Relevant graphics and key text items on slides | ☐ Too much information on slides (not concise) | ☐ Too much information and detail | ☐ Slides are in paragraphs; too much detailed information on one slide |
| | ☐ Plus/minus 30 seconds of time limit | ☐ Plus/minus 60 seconds of time limit | ☐ Plus/minus 1.5 minutes of time limit | ☐ Plus/minus 2 minutes of time limit |
| **Presentation skills** | ☐ Clearly has practiced several times; smooth transitions | ☐ Practiced, but transitions are not smooth | ☐ Practiced, but no transitions between slides | ☐ Not practiced, doesn't anticipate content of next slide |
| | ☐ Free of uhms and the like | ☐ Few uhms and the like | ☐ Many uhms and the like | ☐ Uhms and the like detract from the presentation |
| | ☐ Clearly heard and used inflection for emphasis | ☐ Understood much of the time and some inflection | ☐ Some difficulty hearing and little inflection | ☐ Cannot be heard and/or speaks in a monotone |
| | ☐ Engages audience with eye contact | ☐ Some engagement with eye contact | ☐ Infrequent eye contact | ☐ No eye contact |
| | ☐ Engages audience with gestures | ☐ Some engagement with gestures | ☐ Some distracting gestures | ☐ Frequent distracting gestures |
| **Presentation tools** | ☐ PPT background is matched to content, legible font, graphics, seamless transitions | ☐ Appropriate background, font, transitions | ☐ Distracting backgrounds, transitions, fonts hard to read | ☐ No attention to backgrounds, transitions, fonts very hard to read |
| | ☐ Appropriate graphics used | ☐ Some graphics used to enhance presentation | ☐ Graphics do not enhance presentation | ☐ Distracting use of graphics |

## PHY-ENG Written Presentation Rubric

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

**Physics and Engineering**
**Core Competencies Assessment, 2023-24**

**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: Quantitative Reasoning)

**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 |
| 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% |
| Students will be able to analyze experimental data and draw conclusions | 0% | 45% | 60% | 100% | 79% |

| PHY3004 (Summative) | Percent of Students at 2.5 or Higher | | | | |
|---|---|---|---|---|---|
| | 2019-20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 |
| 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% |

| EGR3053 (Summative) | Percent of Students at 2.5 or Higher | | | | |
|---|---|---|---|---|---|
| | 2019-20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 |
| Students are able to follow instructions | | | | | 100% |
| Students are able to carry out the experiment from instructions | | | | | 100% |
| Data is accurately recorded | | | | | 100% |
| 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 |
| 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% |

**Conclusions Drawn from Data:**
The students are generally meeting our benchmarks at the summative level. The drop in PHY3004 in 2023-24 is due to two teams writing sub-par reports (scoring 2 vs. 2.4). Some of the inconsistency in the data is the result of a lack of clarity in expectations for the assignments.

**Changes to be Made Based on Data:**
Continue to monitor student progress and review the lab results for PHY3004.

**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)

| **Criteria** | **4 – Excellent** | **3 – Good** | **2 – Fair** | **1 – Poor** |
|---|---|---|---|---|
| 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)

| Criteria | 4 – Excellent | 3 – Good | 2 – Fair | 1 – Poor |
|---|---|---|---|---|
| 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)

| **Criteria** | **4 – Excellent** | **3 – Good** | **2 – Fair** | **1 – Poor** |
|---|---|---|---|---|
| **3.** 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 |
| **6.** 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 |
| **6.** 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)

| **Criteria** | **4 – Excellent** | **3 – Good** | **2 – Fair** | **1 – Poor** |
|---|---|---|---|---|
| **3.** 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 |
| **6.** 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)

| **Criteria** | **4 – Excellent** | **3 – Good** | **2 – Fair** | **1 – Poor** |
|---|---|---|---|---|
| **6.** 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 |