**General Education Course Inclusion Proposal**

**SCIENTIFIC INQUIRY**

**Course Name and Number: College Physics 2 -- PH 202**

**Home Department: Physics**

**Department Chair Name and Contact Information**: Dr. David Lucas, dlucas@nmu.edu

**Expected frequency of Offering of the course**: Each fall and winter

**Official Course Status**: Has this course been approved by CUP and Senate? YES

**Overview of course** (please attach a current syllabus as well):
**A.** Overview of the course content: PH 202 is a survey course covering the principles of electromagnetism as embodied in Maxwell’s laws. It has lecture and laboratory components, in which theory and application are treated quantitatively. The main topics are electrostatics, magnetism, circuits, and optics. The course assumes a scientific background in mechanics at the level of PH 201. It also assumes a background in algebra and trigonometry, but not in calculus.

**B (i).** Why this course satisfies the Critical Thinking Outcome: Students make decisions about what measurements to take, and select settings to optimize the resolution of measuring apparatus. In lecture and laboratory assignments, students combine their knowledge from multiple areas to do calculations. Students use multiple approaches to verify the consistency of answers. Students consider the validity of their measurements and assess whether calculated answers are physically reasonable.
Evidence: In quantitative calculations, the student has to decide which information is relevant and which is not. In assessing the meaning of graphs, the student needs to understand the quantities being plotted. In laboratory measurements, the student needs to think about how to limit uncertainties.
Integration: Students use material from earlier chapters to build new knowledge. For example, students understand the electric field through their existing knowledge of forces and charges. Similarly, students comprehend electric potential through their existing knowledge of the electric field. Students learn about Ohm’s law through their existing knowledge of electric potential and currents. The pattern of building new knowledge through integration with existing knowledge continues throughout PH 202.
Evaluation: The laboratory exercises in PH 202 focus on whether experimentally measured quantities agree with theoretically predicted ones. An example of this is the experiment on Lenz’s law, in which students predict the directions of induced currents using their theoretical knowledge and then test their predictions using the apparatus.

**B (ii).** Why this course satisfies the Scientific Inquiry Outcome: In PH 202 lecture and laboratory disciplines, students apply all aspects of the scientific method to systems involving electric fields, magnetic fields, circuits, and optics. The concepts taught are the foundation for various applied fields and other sciences, thereby supporting the next generation of scientific inquirers.
Research question: Many of the laboratories are set up to allow students to investigate a hypothesis, or test the consistency of measurements with predictions. For example, in the optics labs, the validity of the laws of reflection and refraction are studied by comparing theoretical predictions with laboratory measurements.
Methodology/Data Collection: This is a central feature of all the laboratory work in PH 202. Students learn to collect data using a variety of measuring instruments such as analog and digital voltmeters, oscilloscopes, compasses, and ammeters. Techniques for using the apparatus are honed as the semester progresses. Data are displayed in tables and graphs, and results are extracted from appropriate regression techniques.
Analysis, Results and Presentation: Students apply mathematical analyses in a variety of contexts, including laboratory activities and homework problems. They present their conclusions and critically discuss their results.
Discussion/Conclusions: Students are expected to assess the validity of their work. They learn to present results with the correct number of significant figures. They discuss the sources of experimental uncertainty in their results.

**C.** Describe the target audience (level, student groups, etc.) The target audience is students who have a physics background equivalent to a pass in PH 201 and a basic mathematical proficiency in algebra and trigonometry at the 100 level. Those who take PH 202 are either taking it out of scientific curiosity or out of necessity based on a program requirement.

**D.** Give information on other roles this course may serve (e.g. University Requirement, required for a major(s), etc.): This course can be used to meet requirements for a number of majors, including several Biology emphases, Biochemistry, Chemistry, Forensic Biochemistry, and Mechanical Engineering Technology. PH 202 also meets the laboratory science graduation requirement.

**E.** Provide any other information that may be relevant to the review of the course by GEC:
PH 202 is taught by multiple instructors and involves several laboratory sections with several adjunct instructors. This implies challenges for coordinating assessment.

**PLAN FOR LEARNING OUTCOMES
CRITICAL THINKING**

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| **DIMENSION** | **WHAT IS BEING ASSESSED** | **PLAN FOR ASSESSMENT** |
| **Evidence** | Assesses quality of information that may be integrated into an argument | **Type:** quiz, test, homework, or exam questions**Relation to dimension:** students decide what information to use to solve problems and answer questions**Frequency:** the course includes quizzes most weeks, about two class tests, regular homework, and a final exam**Importance:** about 30% of the course**Success rate:** based on past experience, a success rate of 60% is expected. **Type:** laboratory reports, worksheets, or quizzes**Relation to dimension:** students choose how to make measurements or select what measurements to make**Frequency:** weekly**Importance:** Labs are 20% of the course**Success rate:** based on past experience, a success rate of 60% is expected. |
| **Integrate** | Integrates insight and or reasoning with existing understanding to reach informed conclusions and/or understanding | **Type:** quiz, test, homework, or exam questions**Relation to dimension:** students combine information from multiple chapters of the course to solve problems and answer questions**Frequency:** the course includes quizzes most weeks, about two class tests, regular homework, and a final exam**Importance:** about 30% of the course**Success rate:** based on past experience, a success rate of 60% is expected.**Type:** laboratory reports, worksheets, or quizzes**Relation to dimension:** students analyze their lab results using multiple concepts from lectures and other labs.**Frequency:** weekly**Importance:** Labs are 20% of the course grade**Success rate:** based on past experience, a success rate of 60% is expected. |
| **Evaluate** | Evaluates information, ideas, and activities according to established principles and guidelines | **Type:** quiz, test, homework, or exam questions**Relation to dimension:** students assess whether the results of calculations make physical sense. **Frequency:** the course includes quizzes most weeks, about two class tests, regular homework, and a final exam**Importance:** about 10% of the course **Success rate:** based on past experience, a success rate of 60% is expected.**Type:** laboratory reports, worksheets, or quizzes**Relation to dimension:** students assess whether their results are sensible in the context of theoretical predictions and experimental limitations**Frequency:** weekly**Importance:** Labs are 20% of the course**Success rate:** based on past experience, a success rate of 60% is expected. |

**PLAN FOR LEARNING OUTCOMES
SCIENTIFIC INQUIRY**

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| --- | --- | --- |
| **DIMENSION** | **WHAT IS BEING ASSESSED** | **PLAN FOR ASSESSMENT** |
| **Research Question** | Develop a manageable and appropriate research question that is tied to testable hypotheses. | **Type:** laboratory reports, worksheets, or quizzes**Relation to dimension:** students investigate a scientific question using laboratory methods**Frequency:** one or two of the weekly labs**Importance:** Labs are 20% of the course**Success rate:** based on past experience, a success rate of 60% is expected. |
| **Methodology/Data Collection** | Select and/or develop appropriate scientific methodologies  | **Type:** laboratory reports, worksheets, or quizzes**Relation to dimension:** students collect data using laboratory apparatus**Frequency:** one or two of the weekly labs**Importance:** Labs are 20% of the course**Success rate:** based on past experience, a success rate of 60% is expected. |
| **Analysis, Results and Presentation** | Collected data is appropriately analyzed and presented | **Type:** laboratory reports, worksheets, or quizzes**Relation to dimension:** students analyze their lab results and present them using scientific methods**Frequency:** one or two of the weekly labs**Importance:** Labs are 20% of the course**Success rate:** based on past experience, a success rate of 60% is expected. |
| **Discussion/Conclusions** | Conclusions are linked to evidence and are in the context of scientific limitations and implications. | **Type:** laboratory reports, worksheets, or quizzes**Relation to dimension:** students discuss their results in the context of experimental limitations. **Frequency:** one or two of the weekly labs**Importance:** Labs are 20% of the course**Success rate:** based on past experience, a success rate of 60% is expected. |