**General Education Course Inclusion Proposal**

**SCIENTIFIC INQUIRY**

**Course Name and Number: College Physics 1 -- PH 201**

**Home Department: Physics**

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

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

**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 201 is a survey course covering the principles of mechanics as embodied in Newton’s laws of motion. It has lecture and laboratory components, in which theory and application are treated quantitatively. The main topics are kinematics, forces, and conservation laws, as applied to linear and rotational motion of point objects, extended objects, and fluids. Time permitting, thermodynamics topics may be covered. The course assumes a background in algebra and trigonometry, but not in calculus.

**B (i).** Why this course satisfies the Critical Thinking Outcome:
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. The process begins in the first week, when students learn that quantities must have units. For example, the number 10 is greater than 7, but a distance of 10 kilometers is shorter than 7 miles.
Integration: In lecture and lab assignments, the students must apply knowledge covered earlier in the course to succeed. For example, a student answering a question on Newton’s second law would need to make use of the earlier concept of acceleration. This in turn involves understanding concepts of changing velocity, studied before acceleration. The student also learns multiple approaches to understanding. For example, students are expected to answer questions using conservation laws in the later part of the course. Thus students integrate their understanding of the Newtonian approach with their understanding of the conservation-laws approach.
Evaluation: The laboratory exercises in PH 201 focus on whether experimentally measured quantities agree with theoretically predicted ones. A good example of this is the projectile motion experiment, in which the students first predict the distance travelled by a ball bearing and then fire the projectile launcher to test the prediction.

**B (ii).** Why this course satisfies the Scientific Inquiry Outcome: Students study and generate hypotheses appropriate for application of the scientific method to the behavior of point objects, extended objects, and fluids. The concepts taught are needed in applied fields such as medicine, dentistry, geology, chemistry, sports science, engineering technology and so on. As such PH 201 also plays a supporting role in building 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, the force table experiment allows students to investigate whether forces are vectors. In the projectile motion laboratory, students determine whether a projectile lands in a position consistent with their application of the laws of motion.
Methodology/Data Collection: Labs involve the careful collection of relevant data for a given system. Students learn to use a variety of measuring instruments such as hand-held stop watches and meter sticks as well as electronic timers such as photo-gates. Graphing techniques are taught, and include requiring students to create plots by hand on graphing paper, as well as using computer software to present their measurements in various ways.
Analysis, Results and Presentation: Students have to apply mathematical analyses in a variety of contexts, including laboratory analysis as well as homework problems. They have to present their conclusions and to think critically about their results. They are required to present their laboratory results using well-formatted plots, best-fit lines, tables, and statistical analyses.
Discussion/Conclusions: Students are expected to think critically about their work. For example, in laboratory work, the use of significant figures is often discussed. They are asked to consider the main sources of experimental uncertainty in their results, and how they might eliminate them.

**C.** Describe the target audience (level, student groups, etc.) The target audience is students who have basic mathematical proficiency in algebra and trigonometry at the 100 level and want to take physics out of interest 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 concentrations, Biochemistry, Chemistry, Construction Management, Earth Science, Electrical Engineering Technology, Environmental Science, Forensic Biochemistry, Mechanical Engineering Technology, and Sports Science. PH 201 also meets the laboratory science graduation requirement.

**E.** Provide any other information that may be relevant to the review of the course by GEC:
During regular semesters, PH 201 is taught by multiple instructors and involves two lecture sections, and six laboratory sections. Coordination and consistency of the assessment tasks offers significant challenges.

**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 score**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:** 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. |
| **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:** 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. |
| **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:** 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. |

**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 hypothesis 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. |