General Education Course NMHED Recertification Form

This form has been designed to guide you through the recertification process for the UNM General Education course in question. Please fill out your contact information below, and then review the information about the course provided to us by the New Mexico Department of Higher Education *(*NMHED*). After this, you will be instructed to fill out three separate narratives concerning the course and its relevance to NMHED's area and skills associated with the course.*

UNM Course Information

Prefix	**PHYS**
Number	**1310L**
Name	**Calculus-based Physics I Lab**

Contact Information

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NMHED's Description and Outcomes for the Common Course

The description and student learning outcomes below come from NMHED's Common Course Catalog, *which can be found here, and is meant to designate standard descriptions and outcomes of courses registered as a NMHED* Common Course.

PHYS 1310L: Calculus-based Physics I Lab

A series of laboratory experiments associated with the material presented in Calculus-based Physics

I. Students will apply the principles and concepts highlighting the main objectives covered in coursework for Calculus-based Physics

I.

Student Learning Outcomes:

Upon completion of this course, the student will be able to:

1. Develop a reasonable hypothesis.
2. Work effectively as part of a team.
3. Take measurements and record measured quantities to the appropriate precision.
4. Estimate error sources in experimental techniques.
5. Apply appropriate methods of analysis to raw data, including using graphical and statistical methods via computer-based tools.
6. Determine whether results and conclusions are reasonable.
7. Present experimental results in written form in appropriate style and depth.
8. Experience the relationship between theory and experiment.

Institution-specific Student Learning Outcomes

Please add additional SLOs of the general education course to the ones provided by NMHED, or if no SLOs are provided by NMHED, input the SLOs used in assessment for the course.

Area and Essential Skills

Below gives information concerning the area and associated skills of the course to be re-certified. The area here matches the General Education Area of UNM; the "Essential Skills" and their respective Component Skills are characterizations of the area determined by NMHED. You will use this information to fill out the narratives below.

Area in which *PHYS 1310L* resides: Science

Essential Skills in the Area:

Critical Thinking

Problem Setting: Delineate a problem or question. Students state problem/question appropriate to the context.

Evidence Acquisition: Identify and gather the information/data necessary to address the problem or question.

Evidence Evaluation: Evaluate evidence/data for credibility (e.g. bias, reliability, and validity), probable truth, and relevance to a situation.

Reasoning/Conclusion: Develop conclusions, solutions, and outcomes that reflect an informed, well-reasoned evaluation.

Personal and Social Responsibility

Intercultural reasoning and intercultural competence

Sustainability and the natural and human worlds

Ethical Reasoning

Collaboration skills, teamwork and value systems

Civic discourse, civic knowledge and engagement -- local and global

Quantitative Reasoning

Communication/Representation of Quantitative Information: Express quantitative information symbolically, graphically, and in written or oral language.

Analysis of Quantitative Arguments: Interpret, analyze and critique information or a line of reasoning presented by others.

Application of Quantitative Models: Apply appropriate quantitative models to real world or other contextual problems.

Narrative Input

In the boxes provided, write a short (~300 words) narrative explaining how the course weaves the essential skills associated with the content area throughout the course. Explain what students are going to do to develop the essential skills and how you will assess their learning. The narrative should be written with a general audience in mind and avoid discipline specific jargon as much as possible.

Be sure to address the component skills listed next to each essential skills. The number of component skills that must be addressed by your narrative is listed.

Critical Thinking: *Problem Setting; Evidence Acquisition; Evidence Evaluation; Reasoning/Conclusion.*

In Physics 1310L, students perform experiments related to specific areas of physics such as motion, forces, and energy. Critical thinking is crucial in both being able to properly perform an experiment and in ascertaining what the results of an experiment has revealed. Problem Setting: In order to properly perform an experiment and to understand why it is being done, a student must first be able to state what physical concept or quantity the experiment is probing. Evidence Acquisition: Next the student must gather the necessary data. In order to do this properly, students must have an understanding of how the apparatus in each day's experiment works and how it acquires and records data. Evidence Evaluation: Here students must validate that the apparatus used in the experiment is functioning properly and that the students are correctly reading the data provided by the experimental apparatus. In many cases in Physics 1310L, this is aided by the fact that commonplace quantities such as speed and force are being measured. Readings that indicate their lab partner is walking at 50 miles an hour or that a small block of wood weighs 200 pounds, helps the students realize that there must be something wrong with the measuring apparatus. Reasoning/Conclusion: The sole purpose of an experiment is to help develop conclusions about the natural world. Physics, like all sciences, is inherently experimental. All laws of nature are conclusions gathered from evaluating the outcomes of repeated experiments.

The problem setting component skill will most likely be given by the instructor during their introductory for a given experiment. The rest of the component skills of this essential skill will be developed in a hands-on way by the students themselves. Instructors can assess that the students are developing all of these skills in a variety of ways. The longer meeting

Personal and Social Responsibility: *Intercultural reasoning and intercultural competence; Sustainability and the natural and human worlds; Ethical Reasoning; Collaboration skills, teamwork and value systems; Civic discourse, civic knowledge and engagement -- local and global.*

As with all sciences, Personal and Social responsibility is an important part of Physics 1310L. Like all scientists, students are expected to be ethical individuals who contribute to the well-being of society and to the entire world, and, as such, are expected to develop all of the component skills in this essential skill. Intercultural reasoning and intercultural competence: Physicists come from all around the world and bring their unique cultural heritages with them. Students need to be able to interact respectfully and learn from those individuals thus showing intercultural competence. Sustainability and the natural and human worlds: Physics is a natural science; therefore, all of its topics touch directly on the natural world and most of them are directly related to sustainability. Specific examples from Physics 1310L include the motion of the earth around the sun and its relation to the seasons and conservation of energy and its profound implications of earth's future sustainability. The Physics 1310L lab manual contains open-ended questions on these topics and others like them thus aiding the students'development of a deep appreciation of sustainability and the natural world. Assessment data from these parts of the lab manual or student surveys can be gathered to determine student proficiency. Ethical Reasoning: Ethical reasoning is at the core of all sciences. Our guiding principle, the scientific method, requires honesty in the gathering and reporting of experimental results. Students are expected to model this same honesty by gathering their own data, doing their own data analysis, and never plagiarizing others'work as their own. Comparing results across different groups can determine whether students are developing this component skill. Collaboration skills, teamwork and value systems: All laboratory courses, Physics 1310L included, are collaborative. As such, students are required to work together in groups of two or three during each class. In the acquisition of data, the analysis of that data, and the preparation of the lab report, each group member must work with each other to determine which member performs each task. Student surveys, either written or online, can be used to gather assessment data that can be used to assess student growth in this component skill throughout the semester. Civic Discourse, civic knowledge and engagement: All teaching involves civic discourse and the teaching of physics is no exception. In turn students are expected to return this discourse to the instructor to show their mastery of the topics

Quantitative Reasoning: *Communication/Representation of Quantitative Information; Analysis of Quantitative Arguments; Application of Quantitative Models.*

Since its invention, physics has used graphs to convey information simply and efficiently. Both while recording and then analyzing data, students are expected to acquire information from graphs and to make their own graphs. As such, students will develop and can be assessed on all of the component skills of this essential skill.
Communication/Representation of Quantitative Information: Physics 1310L begins its studies of graphs early as one of its first topics is the graphing of the position and velocity of moving objects as functions of time. From these graphs, students are supposed to discover the famous interrelation between them, first discovered by Newton himself, that the slope of the position graph gives the velocity while acceleration is the slope of the velocity graph. Through assessment data gathered from lab reports or concept inventory surveys, students will be able to show their mastery and understanding of this cornerstone of physics. Gathering information from and the making of graphs is a skill that continues throughout the semester. The calculating of the physical quantities impulse and work for forces that change during motion both require making graphs and the ability to find the area under those graphs. The final topics covered in the Physics 1310L is that of periodic motion and waves, both of which make extensive use of sinusoidal graphs. Students are expected to be able to determine physical properties of the motion, such as the motion's period, from these graphs. Assessment of this ability from lab reports or concept inventories is a simple matter. Analysis of Quantitative Arguments: Students must always interpret, analyze, and critique the information given to them from others if they are to incorporate the subject matter into their mental models. Since lab classes, such as Physics 1310L, habitually have students working in groups, they are ideal for assessing this component skill. Every class requires students to interpret, analyze, and critique the information coming from their groupmates. Data from student surveys or embedded questions on lab reports will make it possible to assess the students'progress in developing this component skill. Application of Quantitative Models: As a natural science, all topics covered in physics quantitatively model problems and aspects from the real world. The specific topics of motion, forces, and energy covered in Physics 1310L are no exception. By repeatedly participating in the acquisition and analysis of data, students are developing and then gaining mastery of this component

Additional Information

Course Materials

NMHED requires that both a syllabus and a sample course assignment (project, paper, exam,etc.) from the course in question to be attached to the recertification form. Be sure and pick an assignment that correlates with the descriptions provided in the narratives above.

Assessment Plan

When it is submitted to NMHED, each general education course will also have attached the assessment plan that is used for General Education Assessment at UNM. For more information on this process, please visit this page from UNM's Office of Assessment.

Physics 1310L Syllabus – Fall 2019

TA:
email:

Welcome to Physics 1310L! I am here to help you do your labs and learn some physics that may help you in your lecture and future courses. Always feel free to ask questions or make suggestions. Also, feel free to talk to the Lab Director in room RH 113, phone 277-2751.

Description

Physics 1310L is a companion course to Physics 1310 covering topics in mechanics and waves at the calculus level. Lab experiments mirror and enhance lecture topics: motion (kinematics), interactions between objects and the resulting effects on their motions (dynamics), the effects of forces acting over displacements (work and energy), the effects of forces acting over time (impulse and momentum), and the physical nature of waves. Real time experiments involving computer assisted data acquisition and analysis give a better conceptual framework for understanding physics.
(Pre- or co-requisite: Physics 1310)

Objectives

This course serves to reinforce concepts presented in lecture, to give you experience working as a member of a team and to familiarize you with various experimental techniques.
Lab students will:

- Communicate and cooperate as a team to accomplish technical goals
- Read and interpret procedural instructions
- Gather and analyze data using computers interfaced to various probes
- Interpret graphical data
- Estimate uncertainties in measurements
- Use basic laboratory equipment (e.g., timer, balance, rods, clamps, etc.)

List of Experiments – schedule is posted http://regenerlab.unm.edu/

- Uncertainty in Measurement
- Introduction to Motion
- Vector Addition
- Changing Motion
- Force and Motion
- MIDTERM Project Proposal
- More on Forces
- Impulse – Momentum
- Work and Energy
- Experiment Problem
- Collision!
- Torque
- Periodic Motion
- The Pendulum
- Introduction to Waves

Materials

Lab workbooks are available at the UNM Copy Center in Dane Smith Hall. Every student is required to purchase one before the second week of lab. No copies will be provided.

Students with Disabilities

Qualified students with disabilities needing appropriate academic adjustments should contact me as soon as possible to ensure your needs are met. Handouts are available in alternative accessible formats upon request.

Attendance

Lab attendance is mandatory. You are responsible to perform all experiments.

- **Tardiness**
  You are expected to arrive on time to lab. If you are late, you will still be required to do the entire lab but your grade may be diminished at my discretion.
- **Excused absences**
  - If you cannot make it to lab and know in advance, contact me and we will arrange a time for you to do the lab.
  - If something comes up unexpectedly (sudden illness, accident, family emergency, etc.) contact me as soon as possible. Unscheduled absences WITH A VAILD EXCUSE must be made up. Contact me to arrange a mutually convenient time.
  - Missed labs must be made up promptly. If you do not make up a missed lab within one week, your grade may be diminished at my discretion.
- **Unexcused absences**
  One unexcused absence will reduce your final grade by one letter grade. Two unexcused absences will cause you to fail the class.

Grading

Each week, you will receive two grades: one for your attendance/participation, and one for your written lab report. Attendance and participation will count for 1/3 of your weekly grade. The lab report will count for 2/3 of your weekly grade. Your Midterm Project Proposal will count for one full week of work. Your semester grade will be the average of 13 weekly grades and the proposal grade.

Attendance/Participation Guidelines

A	Active Participation	Example behaviors: helps with set up, participates in data taking, asks questions, participates in discussions, etc.
B	Passive Participation	Example behaviors: is tardy to lab, merely records data, does not help with set up, does not participate in discussions, copies partners, etc.
C	Poor Participation	Example behaviors: Reads newspaper, does homework, antagonizes lab partners, etc.
0	No Participation	Not present in your section. Attendance in another section not verified by TA.

Lab Report Guidelines

A	Standard	The report is everything I would expect. All entries are complete, all questions meaningfully answered, data record including graphs is clear and correct, all calculations and units are correct. The report is organized and legible.
A-	Good	Report has minor error(s).
B	Acceptable	Report is OK, but there are errors and/or missing entries.
C	Unacceptable	Report has significant errors, unanswered questions, missing data, etc.
0	No Report	No report is turned in. Authorship not verified by TA.

Conduct:

UNM has strict guidelines for both student and TA conduct, which are outlined in the University catalogue. Both the students and the instructor are expected to adhere to these policies. In particular:

- **Please do not answer cell phones, texts, or tweets in the lab room!! If urgent,** Calls may be taken in the hallway so long as classes are not disturbed.
- **Drinks must be in a container with twist cap or other sealed top and kept on the floor or at the front of the room.** Food in the lab is not allowed without special permission from the instructor.

UNM Academic Dishonesty Policy:

Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found guilty of academic dishonesty or otherwise fails to meet the standards. Any student judged to have engaged in academic dishonesty in course work may receive a reduced or failing grade for the work in question and/or for the course.

Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests, or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional qualifications within or without the University; and nondisclosure or misrepresentation in filling out applications or other University records.

Title IX

In an effort to meet obligations under Title IX, UNM faculty, Teaching Assistants, and Graduate Assistants are considered "responsible employees" by the Department of Education (see pg 15 - http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404-title-ix.pdf). This designation requires that any report of gender discrimination which includes sexual harassment, sexual misconduct and sexual violence made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office of Equal Opportunity (oeo.unm.edu). If you want to retain anonymity, instead report the incident to other units on campus, namely Student Health and Counseling (SHAC), Counseling and Resource Center (CARS), a licensed medical practitioner on campus, or off campus to the Rape Crisis Center of Central New Mexico, or a sexual assault nurse examiner. If you report the incident to the LoboRESPECT advocacy center, Women's Resource Center, or the LGBTQ Resource Center, you retain anonymity but an anonymous record is made for statistical purposes. See more information at https://policy.unm.edu/university-policies/2000/2740.html#_Toc414642678.

Critical Thinking

Problem Setting: Delineate a problem or question. Students state problem/question appropriate to the context.
Evidence Acquisition: Identify and gather the information/data necessary to address the problem or question.
Evidence Evaluation: Evaluate evidence/data for credibility (e.g. bias, reliability, and validity), probable truth, and relevance to a situation.
Reasoning/Conclusion: Develop conclusions, solutions, and outcomes that reflect an informed, well reasoned evaluation.

Sample Assessment Questions (These questions are all taken directly from the lab manual and could be used an embedded assessment. More traditional assessments such as the Force Concept Inventory could also be used here):

1. From the "Force and Motion" lab: Check the calibration. First **Zero** the force probe. Then **Collect** data, and pull on the force probe with the spring scale with several different forces, each 2.0 N or smaller. Use the **Examine** tool to record the force probe readings and corresponding spring scale readings in the table below. How well do your force probe readings correspond to your spring scale readings?
2. From the "More on Forces" lab: You have a tug-of-war with someone who is much smaller and lighter than you are, but stronger. You both pull as hard as you can, and it's a tie. One of you might move a little in one direction or the other, but mostly you are both at rest. Predict the relative magnitudes of the forces between person 1 and person 2. Place a check next to your prediction.
   ____ Person 1 exerts a larger force on Person 2. ___ The people exert equal forces on each other ____ Person 2 exerts a larger force on Person 1.
3. From the "More on Forces" lab: Can an astronaut experience weightlessness? Masslessness? Explain.

Personal and Social Responsibility - Address 2 of the 5 component skills

Intercultural reasoning and intercultural competence
Sustainability and the natural and human worlds
Ethical Reasoning
Collaboration skills, teamwork and value systems
Civic discourse, civic knowledge and engagement -- local and global

These post-lab questions come from the "Work and Energy" lab and could be used to evaluate the Sustainability and the natural and human worlds component skill**.**

A glance at an old bill from PNM shows that I was charged for electrical energy in units of kilowatt-hours.

1 kilowatt-hour = (1,000 watts) x (3,600 seconds) = 3,600,000 J

I was charged $57.97 for 589 kWH of energy. This works out to a little more than 9.8¢ per kWH including tax and other charges. For the following estimations, use 10¢ as the cost per kWH.

Q10 How much would I pay to operate a 100-watt light bulb for one hour?
cost: _____

Q11 Looked at another way, according to the Energy Information Agency, the average monthly residential electric energy use in the United States in 2009 was 908 kWH. Suppose that lifting 16 tons through a height of one meter represents the amount of work a strong person can do in one day. If that person worked 365 days per year, how many years would it take to produce the electric energy used in one month in one household?

This activity comes from the "More on Forces" lab and could be used to evaluate the students' ability to work collaboratively.

Activity 2 Tutorial

Counterintuitive Ideas: Newton's Third Law

A. Newton's Third Law and Common Sense

Often, Newton's Third law just makes sense. But in some cases, it seems not to. Consider a heavy truck ramming into a parked, unoccupied car.

1. (*Work together*) According to *common sense*, which force (if either) is larger during the collision: the force exerted by the truck on the car, or the force exerted by the car on the truck? Explain the intuitive reasoning.

2. (*Work together*) We've asked this question of many students, and a typical response goes like this:

Intuitively, the car reacts more during the collision. (You'd rather be riding in the truck!) So the car feels the bigger force.

Is your group's explanation in part A similar to or different from this? Explain.

3. (*Work together*) According to Newton's third law, which of those forces (if either) is bigger?

4. *Experiment.* Is this a case where Newton's third law doesn't apply? At the front of the room, the TA has set up an experiment that simulates a truck ramming a car. Go do the experiment and record the results here. You can also test whether Newton's third law holds for other collisions.

B. What to do with the contradiction between common sense and Newton's 3rd Law

Let's consider the contradiction we just found between physics and common sense.

1. (*Work individually*) For most people, Newton's third law contradicts the common-sense intuition that the car reacts more during the collision. Which one of the following best expresses your attitude toward this contradiction?

a. We shouldn't dwell on these kinds of contradictions and should instead focus on learning exactly when Newton's third law does and doesn't apply.

b. There's probably some way to reconcile common sense with Newton's third law, though I don't see how.

c. Although physics usually can be reconciled with common sense, here the contradiction between physics and common sense is so blatant that we have to accept it.

Briefly explain why you chose the answer you chose.

2. Discuss your answer in your group. Is there a consensus or disagreement? If there was disagreement explain how you group decided to deal with this disagreement.

Quantitative Reasoning

Communication/Representation of Quantitative Information: Express quantitative information symbolically, graphically, and in written or oral language.
Analysis of Quantitative Arguments: Interpret, analyze and critique information or a line of reasoning presented by others.
Application of Quantitative Models: Apply appropriate quantitative models to real world or other contextual problems.

The following activity from the "Changing Motion" lab is just one of many that could be used to gather assessment data for quantitative reasoning. Given that this lab is very early in the semester, it could even be thought of as a pre-test of their ability to express quantitative information graphically.

Activity 2 Speeding Up "Away"

In this activity you will look at the motion of a cart when its speed is changing.
1. Set up the cart, ramp, pulley, and motion detector as illustrated below. Make sure that the end stop catches the cart before the hanging mass reaches the ground. If the cart has a friction pad, make sure that it does not drag. The cart should never get closer than 0.15 m to the detector.
2. **Prediction** What will the position and velocity graphs look like? *Ignore the acceleration graph for now.* Sketch predictions with **d-a-s-h-e-d---l-i-n-e-s**.
3. Test your predictions.
a. Open **L02A1-1(Speeding Up).cmbl.** Before releasing the cart, click **Collect** and move the cart with your hand to make sure that the detector can "see" the cart all the way to the end of the board. You may need to make adjustments.
b. Hang 50g from the end of the string. This will cause the cart to speed up when released. Hold the front of the cart until you are ready to graph. Hold it in such a way that *the motion detector does not see your hand*.
c. **Collect** data, and when you hear the clicks of the motion detector, release the cart from rest. Repeat, if necessary, until you get a nice set of graphs.
d. Change the position and velocity scales if necessary so that the graphs fill the axes. Save your data for Activity 6. Select **Save as . . .** from the **File** Menu, give your file a new name such as **SPEEDUP** __ __ __**.cmbl**, where are your initials, then click on **Save**.
e. Sketch your position and velocity graphs neatly on the previous axes with a solid line.

One of the final labs of the semester is a lab on pendulums. This activity could be used as a post-test for this component skill.

Measure the Displacement of the Pendulum

1. Set up the pendulum. Suspend the wooden sphere from the pendulum clamp.
   a. Pinch the string in the clamp. Do not cut the string or tie knots.
   b. A length of about 70 cm works well.
2. Measure the length of the pendulum. Measure from the edge of the clamp to the center of the bob.

Length of pendulum _____

3. Set up the detector. As the pendulum bob swings, it should come no closer than 0.15 m to the detector or the detector may not work properly.
4. Open ThePendulum.cmbl. The file should be on the desktop.
5. Zero the motion detector. The software has a zeroing feature to subtract off the equilibrium position x_0. Make sure the pendulum bob is at rest and hanging in its equilibrium position. Click the **Zero** tool.
6. Graph the motion of the pendulum bob. Set the bob in motion with an amplitude of about 10 cm, making sure that the motion is straight toward and away from the detector. When the pendulum is swinging smoothly, click **Collect**. When the data run is complete, make sure the detector "sees" the bob over the whole range of motion and that there are no obvious flat spots or spikes.
7. Save your data. From the **File** menu select **Save As**... Save your data with your name or initials, e.g. **Pendulum(name).cmbl**. Motion Detector

Period, Frequency and Amplitude

1. Determine the period and frequency. Use the **Examine Tool** to determine period, and frequency of the motion. For better accuracy, determine the beginning and ending times for several cycles. Enter data below.
2. Determine the amplitude. The **amplitude** is the maximum displacement from equilibrium. Use the **Examine Tool** to determine the amplitude. The motion should be symmetrical. Check maximum and minimum positions to verify.