PHYS 307

California State University, San Marcos

FORM UDGE-BB (WHITE)

UPPER DIVISION GENERAL EDUCATION NEW COURSE PROPOSAL
FOR AREA BB – MATHEMATICS/QUANTITATIVE REASONING OR PHYSICAL AND LIFE SCIENCES

Please Read Instructions on Next Page of This Form

Course Number __PHYS 307_ Course Title__Physics for Elementary Teachers________________

- ⊘ This is a new course. A FORM C is being filed concurrently.
- ⑥ This is an existing course not currently satisfying an UDGE requirement, which is not being changed.
- ⑥ This is an existing course not currently satisfying an UDGE requirement, which is undergoing change. A FORM C-2 is being filed concurrently.
- ⑥ This is an existing course currently satisfying an UDGE requirement which is being submitted for recertification. *A FORM C-2 is required only if the course is being changed.*

1. Please attach a syllabus or draft syllabus of the course.

2. How many units is this course? __3__ (Upper-Division General Education courses are limited to 3 units.)

3.a. Does this course have (a) prerequisite (s) other than completion of LDGE requirements?

___yes _X_no

b. Does this course fulfill requirements for a major by the academic unit in which the course is offered? Check the YES box even if the course counts as an elective in the major.

___yes _X_no

c. If you answered "yes" to 3.a. or 3.b., then the course is an exception to the definition printed on the next page of this form, and you must explain why the GE committee should make an exception for this course. Please describe how this course is designed to provide valuable and appropriate learning experiences to both majors and non-majors.

Read Questions 4-7 in the instructions on the next page of this form and submit your answers as attachments. The instructions do not have to be printed or submitted.

Signatures

Edward Price [signature]	February 2, 2016
Originator	Date
Edward Price [signature]	February 2, 2016
Program Director	Date
______________________	______________
General Education Coordinator	Date
______________________	______________
General Education Committee Chair	Date

4. Upper division general-education students may have fulfilled their lower division area B requirements in broad, interdisciplinary courses or in a different discipline than the discipline in which this course is offered. Please explain how this course introduces such students to the basic assumptions, principles and methods of the discipline, and how connection is made between these fundamentals and the particular applications emphasized in the course.

Fundamentally, physics is the study of the world around us. Furthermore, one of the most basic tenets of physics is that the physical world is comprehensible; we can describe patterns, provide explanations, and make predictions by modeling physical systems. Physics for Elementary Teachers introduces the fundamental concepts of conservation of energy, Newton's Laws (forces), and waves. These concepts are applied to understand everyday physical situations. Students recognize that physics is about their world and experiences, and that through physics, their world can be comprehensible. Students thereby see the relevance of physics to their lives. In addition, this course includes explicit attention to how elementary students learn the same physics ideas that are covered in this course (at an age-appropriate level), which is relevant to future teachers who are the intended audience for this course.

5. Please specify how the course requires students to use reasoning skills characteristic of common scientific and mathematical practice to do one or more of the following: to solve problems, to interpret observations, to make predictions, to design experiments for the testing of hypotheses, or to prove theorems. Examples given should illustrate how these skills are used throughout the course.

Students will engage in practices of science such as performing experiments, collecting and analyzing data, developing models, and writing and evaluating explanations. For example, in first unit of the course, students develop, test, and refine models of physical systems in the context of magnetism and static electricity. Through simple hands-on experiments, students collect evidence about what kinds of materials are attracted to a magnet, and how a magnetized nail (one rubbed a special way with a magnet) affects an unmagnetized nail and another magnetized nail. These observations are generalized to develop the law of magnetic poles (opposite poles attract, likes repel). Using this evidence, students construct their first model of magnetism. They use their model to make predictions about what would happen if their magnetized nail is cut into two pieces, test their predictions, and revise their model as necessary. Eventually, students use a small magnets alignment model to explain other magnetic phenomena that they have not observed before.

6. Please specify how both past successes and current uncertainties in science or mathematics are well represented in the course, in order that the cumulative, historical nature of the development of science and mathematics can be illustrated. Give examples covered in the course of (a) older, well-established laws and theories that are no longer debated in scientific and mathematical circles, and (b) issues where either fundamental questions remain unanswered or where the application of well-established principles to new situations carries some uncertainty or controversy.

The course includes a unit focused on developing and using Newton's Second Law to understand how forces affect the motion of objects. Newtonian mechanics is a well-established model for force and motion and low speeds, such as those encountered in everyday life. The course also includes a unit on Waves, Sound and Light. The wave model of light is a powerful explanatory framework that enables us to understand visible light, yet it fails to explain phenomena such as the quantized emission of light from atoms (which is the basis of fluorescent lighting, foe instance). The photon model of light is used to explain other phenomena. Reconciling and interpreting the dual nature of light (referred to as "wave-particle duality") remains a challenging area for physics.

Assessment for Upper Division Area BB Courses: Question 7 will help the General Education Committee to evaluate whether you have planned sufficiently for assessing the success of your course.

7. a. Please give examples explaining how the work assigned to students (quizzes, tests, essays, projects, etc.) allows you to measure how successful individual students are in meeting the UDGE learning objectives for this course. Please attach an example of the type of assignment you will use to evaluate how successfully students meet the UDGE learning objectives.

Here is a written assignment related to students' development of a model for magnetism. Students are provided with background material that introduces the scenario and includes a video of a nail being magnetized by rubbing with a permanent magnet, and demagnetized by hammering.

For this assignment, you should produce a diagram and written explanation.

On a single sheet of paper draw two iron nails. Label one "unmagnetized nail" and the other "magnetized nail." Using the Alignment Model, draw the entities inside the unmagnetized nail. Next, draw the entities inside the magnetized nail, and label the poles (taking into account the situation described above).

Provide a written explanation addressing the following four prompts:
(1) Describe how you have drawn your diagram for the unmagnetized nail; that is, what is your diagram trying to show. Also explain why the nail is unmagnetized; that is, why it produces no magnetic effects in the region outside the nail. [You need to use the Alignment Model.]⍰
(2) Explain how you know, based on the evidence provided, whether the tip end of the magnetized nail is a NP or a SP. [You need to state and use the appropriate law.]⍰
(3) Explain how you know which end of the magnet, its NP or its SP, was used to slide across the nail from head to tip. [You need to use the Alignment Model and state and use the appropriate law.]⍰
(4) Explain why hammering the magnetized nail caused it to become unmagnetized. Begin by describing your drawing for the magnetized nail, and then explain what happened when the nail was hammered. [You need to use the Alignment Model.]

Here is a multiple-choice question that requires application of Newton's second law:

Some students form three teams to enter a competition to build a small rocket-powered toy car. The winner of the competition will be the car that achieves the highest top speed after a 2 second firing of their rocket engine (starting from rest). Team Arrow builds a car that has a mass of 0.75 kg and uses a rocket engine with a force of 15 N; Team Bluebird's car has a mass of 0.65 kg with an engine force of 13 N; Team Cleanup's car has a mass of 0.80 kg with an engine force of 17 N. Assuming frictional effects can be ignored, which team's car will win the competition?

A. *Team Arrow* ⍰
B. *Team Bluebird* ⍰
C. *Team Cleanup* ⍰
D. *Two teams will tie for the fastest top speed* ⍰
E. *All three teams will tie for the fastest top speed* ⍰

b. If you use any course assessment activities (e.g., "pre" and "post" testing, class-wide analysis of individual test questions, etc.) that measure whether or not the class as a whole successfully meets the General Education learning objectives for this course, please attach examples of these as well.

PHYS307: Physics for Elementary Teachers

INSTRUCTOR

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Office Hours: TIMES

WEB PAGE

http://cc.csusm.edu

Lecture Times and location

TEXT & REQUIRED MATERIALS

Next Generation Physics and Everyday Thinking, Goldberg, et al. This is a workbook - bring to class daily.
iClicker (remote) is required – we will use them daily

COURSE DESCRIPTION

Fundamental physics ideas including conservation of energy, Newton's Laws, and waves. Students will engage in practices of science such as performing experiments, collecting and analyzing data, developing models, and writing and evaluating explanations. Also includes development of ideas about the nature of science and learning science, including elementary students' learning of science. Course content is aligned with content, practices, and cross-cutting concepts of the Next Generation Science Standards, and is intended to help prepare future elementary teachers to teach science. *Intended for the Liberal Studies majors in the Elementary option.* **Prerequisite**: Entry Level Mathematics Certification

LEARNING GOALS AND OUTCOMES

We will focus on physics content, practices, and the nature of science and learning. By semester's end, you should have a conceptual understanding of

Physics content

By the end of the course you should be able to understand and apply these ideas to provide a conceptual explanation of physical phenomena including:
1. The relationship between force and motion
2. The nature of energy, energy transformations, and conservation of energy
3. Waves, including mechanical waves and electromagnetic waves.

Practices of Science

By the end of the course you will have gained experience in practices of science, including performing experiments, collecting and analyzing data, proposing, testing and revising models, and writing and evaluating explanations.

The nature of science and learning science

You will learn the process by which knowledge is developed within a scientific community: that doing science involves using evidence and creative thinking, that knowledge is established through collaboration and consensus, and that science knowledge can change over time. You will also become more aware of how your own science ideas change and develop over time.

COURSE FORMAT

Class meetings:

Classes will feature participatory elements designed to get you actively thinking instead of passively listening and taking notes, as well as lots of demos designed to illustrate physical situations. ***Bring your workbook to every class!***

Class will feature questions to make lectures more interactive and effective; you will participate with class response system (aka "clickers"). Research shows these techniques increase student learning compared to standard lectures. ***To get credit for class participation, you must bring a clicker to class and register it with your email user name.***

This course will include days that will be mainly lecture-discussion, including watching videos of experiments, and days where you will mainly be engaged in performing simple experiments and working with computer simulations. The course content will focus on important physics ideas, as well as ideas about the nature of science and the nature of learning. Some activities will involve viewing videos from elementary classrooms and analyzing the children's ideas and reasoning. The course is divided into four approximately equal length units:

Unit 1: Models of Magnetism and Static Electricity
Unit 2: Interactions and Energy
Unit 3: Interactions and Forces
Unit 4: Waves, Sound, and Light

The three 'big ideas' in physics that we will focus on are the Law of the Conservation of Energy (Unit 2), Newton's Laws (mainly unit 3), and the wave behavior of sound and light (Unit 4). We will also focus on engaging you in important practices of science, including performing experiments, collecting and analyzing data, proposing, testing and revising models, and writing and evaluating explanations. Unit 1 focuses on model development in the context of magnetism and static electricity. Finally, specific activities will focus your attention on aspects of the nature of science (how scientists' develop new knowledge) and the nature of learning (both your own learning of science as well as the learning of children). The knowledge and skills you will learn and practice in this course should help you more effectively learn science and teach science to elementary students.

Structure of class meetings

Each class period is 75 minutes in duration. At the beginning of the semester you will be assigned to a group of three or four students, and you will be expected to sit and work together during class. To make the process efficient, your group will be assigned seats as well. The instructor may call on your team at any time to share answers to questions with the whole class. During the semester we will change groups and/or reassign seating of groups within the classroom.

During the portions of the course that are mainly lecture-discussion, you will work through two lessons each class period, guided by the instructor. Each lesson consists of three sections with different aims.

Purpose This provides a short introduction describing the aims of the lesson and how it ties in to the topic. It also poses the *key question(s)* for the lesson.

Predictions, Observations and Making Sense This is the main section of the lesson. Here is where you will record your answers to questions in the lesson sheets (including some questions that you respond to with your *clicker*), record data and describe your observations from videos of demonstrations or computer simulations, summarize your interpretations of why you think certain things happen, and take notes from class discussions.

Summarizing Questions In the last part of a lesson you will answer questions that draw on the ideas developed during the lesson, including some that may be clicker questions. The last question will ask you to reflect on the key question(s) for the lesson; because of time constraints you should plan on answering this question at home as a review of the lesson.

During the portions of the course that are mainly hands-on, your group will be given some materials and you will spend most of the class time carrying out simple experiments, recording and analyzing data, and sharing your results with the rest of the class. One or two members of your group will also need to bring a laptop computer, and your group will spend part of the class time working with special computer simulations that will be related to the experiments you do. The instructor will provide some guidance during these periods, will occasionally show videos of experiments that are difficult to do during class, and will organize whole class discussions of results.

HOMEWORK ASSIGNMENTS

Online homework Homework will be assigned for most lessons and due before the next class meeting. Homework will be online through Cougar Courses. There is more info about the HW on Cougar Courses.

Since we will work through more than one lesson in a typical class period, you may have more than one homework assignment to do for each class period. Each homework has two major parts. In the first part you will be guided through some material to read, some movies or computer simulations to view, and a series of questions to answer. This may be online or on paper. The second part of each homework assignment is a quiz, which you will take on Cougar Courses. In the quiz, you will be asked a few questions (usually between 3 and 5) relevant to the content of the homework, and your answers will be graded and reported to the instructor.

I encourage you to work together, however, you are responsible for ensuring that you learn from the experience. You will learn very little by copying someone else's work, plus it's cheating. ***You must answer the graded homework questions on your own.***

CPR homework Five times during the semester you will be given a writing/evaluation assignment where you will construct an explanation or provide answers to a set of questions. Three other students in the class will evaluate your explanation, and you will evaluate the explanations of three other students (all anonymously), and you will do a self-evaluation of your own explanation. After submitting your own explanation, but before evaluating other students' explanations, you will practice evaluating some sample 'calibration' explanations. You will be working on each of these types of homework assignments for about 1½ weeks. The online system we will use to do this is called *Calibrated Peer Review* (or *CPR*). The first CPR assignment will be worth up to 3 points, and each of the following four CPR assignments will be worth 6 points each. Thus, the semester total score for CPR assignment is 27 points (maximum).

EXAMS

Four, closed-book quizzes will be given; one after each unit. The final will be a closed-book exam and cover **all** course material. **No makeup exams will be allowed. Be sure you are available for the final!**

Each unit quiz will consist of 10-20 multiple-choice questions. On days when you take a quiz, we will start the class by going through one lesson, and then you will work through the quiz during the last 30-35 minutes.

The final exam will consist of about 35-50 multiple-choice questions plus one explanation for you to write; it will cover the material from the entire semester (all four units). For each quiz and the final exam you will need to bring a #2 pencil and the appropriate scantron test form for recording your answers.

COURSE GRADE

You are not in competition with each other for grades. Instead, your grade will depend on how well you complete the assignments and exams, which will count towards your course grade as follows:

Course component	Point value	Tentative Dates
Unit 1 Quiz	10 points	
Unit 2 Quiz	10 points	
Unit 3 Quiz	10 points	
Unit 4 Quiz	10 points	
Final Exam (Units 1-4)	20 points	
Participation	5 points	
Regular homework (total points scaled to 20)	20 points	Before next class period
CPR homework (3 points each)	15 points	Must be completed on time.
Total points =	**100 points**	

Letter grades will be approximately follow this scale: A > 88 > B > 76 > C > 64 > D > 52

ACADEMIC HONESTY POLICY: DON'T CHEAT (YOURSELVES)!

Students are responsible for the honest completion and representation of their work, and will be expected to adhere to the standards of academic honesty and integrity outlined in the CSUSM Student Academic Honesty Policy. All assignments must be the student's own original work, clear and error-free. All ideas/materials that are borrowed from other sources must have appropriate references to the original sources.

In this class, cheating includes submitting another person's work as your own or claiming credit for work you did not do (including class participation and homework), copying from another student on exams (or knowingly allowing another student to copy from you), and use of unauthorized materials during an Exam. Cheating also includes inappropriate clicker use and attempts to manipulate grades unfairly.