CREDIT COURSE OUTLINE

I. COVER PAGE

(1) PHYS 4C	(2) PHYSICS FOR SCIENTISTS AND ENGINEERS	(3) 4
Number	Title	Units

(4)	Lecture / Lab Hours:		
	Total Course Hours		
		Total Lec hours:	70.00
		Total Lab hours:	34.00
		Total Contact hours:	104.00
	Lec will generate _0_ hour(s) outside work.		
	Lab will generate _0_ hour(s) outside work.		
(5)	Grading Basis:	Grading Scale Only	
		Pass/No Pass option	X
		Pass/No Pass only	
(6)	Advisories: ENGL 1A - READING AND COMPOSITION MATH 7 - DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA		
(7)	Pre-requisites(requires C grade or better): PHYS 4B		
	Corequisites:		

(8)Classification:		
	Degree applicable:	X
	Non-degree applicable:	
	Basic skills:	
(9)RC	Fulfills AS/AA degree requirement: (area)	
	General education category:	
	Major:	
	Certificate of:	
	Certificate in:	
(10)CSU	Baccalaureate:	X
(11)Repeatable: (A course may be repeated three times)		0

(12) Catalog Description:
Electromagnetic waves, optics, modern physics, condensed matter and nuclear physics.

II. COURSE OUTCOMES:

(Specify the learning skills the student demonstrates through completing the course and link critical thinking skills to specific course content and objectives.)

Upon completion of this course, students will be able to:

A. understand basic concepts in the theory of electromagnetic waves, optics, and modern physics.
B. understand Maxwell's Equations of electromagnetism.
C. understand the propagation of light.
D. understand the formation of images using lenses and mirrors.
E. understand interference in thin films.
F. determine the wavelength of light using a diffraction grating.
G. understand the basic concepts of relativity and quantum theory.
H. understand the basic concepts of atomic and nuclear interactions
I. understand the basic concepts of condensed matter physics

III. COURSE OBJECTIVES:

(Specify major objectives in terms of the observable knowledge and/or skills to be attained.)

In the process of completing this course, students will:

A. complete assignments and lab reports outside of class requiring the application of concepts studied in class.
B. use the scientific method for experiments illustrating basic ideas in physics, producing results which must be compared and/or correlated with what has been presented in class lectures.
C. develop new ideas using previously held knowledge as their foundation.
D. use the appropriate language of physics and mathematics in order to solve problems in physics.
E. As the course outline illustrates, the course covers many fundamental concepts in one semester. It is necessary for students to complete problem assignments and lab reports outside of class. This is necessary in order for the student to fully comprehend the material.
F. use the scientific method, students are given the opportunity to experiment with basic ideas in physics, and this allows them to better understand what has been presented in class lectures.
G. solve the word problems in physics. Physics is an extremely systematic discipline, and the students must be able to develop new ideas using previous knowledge as their foundation.
H. apply problem solving processes to foster sound reasoning skills and responsible decision making.

IV. COURSE OUTLINE:

Lecture Content:

Week 1: Review: the linear wave equation and Maxwell's Equations (Phy 4A, 4B);
derivation of the differential form of Maxwell's Equations; derivation of the linear wave equation from Maxwell's Equations; plane-wave solutions to the linear wave equation; the Poynting vector; momentum and radiation pressure; half-wave antennas; the EM spectrum (Serway, Ch 34).
Week 2: Measuring the speed of light; the ray approximation; the Law of Reflection;
specular vs. diffuse reflection; the Law of Refraction; dispersion and prisms with demonstration; total internal reflection with demonstration (Serway, Ch 35).
Week 3: plane mirrors; spherical mirrors (convex and concave) with demonstration; thin
lenses (converging and diverging) with demonstration; optical systems (lens-lens, mirror-mirror, and lens-mirror combos); lens aberrations; the human eye (Serway, Ch 36). Demostration: the "mirage" device (Serway, Ch 36 Problem #76).
Week 4: geometric vs. physical optics; Review: path-length difference and the conditions for constructive and destructive interference (Phy 4B); Young's Experiment with demonstration; phase changes upon reflection; interference in thin films (Serway, Ch 37).
Week 5: diffraction; intensity distribution in single-slit diffraction; combining double-slit
interference and single-slit diffraction; resolution and Rayleigh's Criterion; the diffraction grating; polarization of light waves with demonstration (Serway, Ch 38).
Week 6: Galilean relativity; the Michelson-Morley experiment and the Ether hypothesis; the postulates of special relativity; time dilation and length contraction; the twin Paradox and special vs. general relativity; the relativistic Doppler Effect; the Lorentz Transformation; the Lorentz Transformation for velocities; relativistic momentum, derivation of E = mc**2 and mass-energy equivalence; the postulates of general relativity and the Eddington expedition.
Week 7: Review: radiation, Stefan's Law, and blackbodies (Phy 4B); the spectrum of BB radiation; Wien's displacement law; Planck's hypothesis (Serway, Ch 40); MT exam review: optics and relativity; midterm exam #1.
Week 8: The photoelectric effect; the Compton Effect; wave-particle duality and the de Broglie hypothesis; the uncertainty principle (Serway, Ch 40).
Week 9: wavefunctions and the Copenhagen interpretation; expectation values; the particle in a box; the Schrodinger equation; tunneling; quantum treatment of the harmonic oscillator (Serway, Ch 41).
Week 10: emission spectroscopy; the Bohr model of hydrogen; the quantum model of the hydrogen atom; quantum numbers; the Pauli Exclusion Principle and the periodic table; lasers (Serway, Ch 42).
Week 11: Molecular bonds: ionic, covalent, and Van der Waals bonding; rotational and vibrational states of molecules; bonding in solids; electron gas theory of Metals (Serway, Ch 43).
Week 12: Electron gas theory of metals; band theory of solids; semiconductors; junction diodes; superconductivity (Serway, Ch 43).

Week 13: Rutherford's experiment and the discovery of the nucleus; properties of nuclei: the N, A and Z numbers and nuclear isotopes; binding energy; the liquid-drop model; radioactivity; nuclear decays; nuclear reactions (Serway, Ch 44).
Week 14: MT exam review: quantum mechanics, solid state and nuclear physics; MT exam #2.
Week 15: neutrons in nuclear reactions; nuclear fission; nuclear fusion; radiation and radiation detectors (Serway, Ch 45).
Week 16: The four fundamental forces; particles vs. anti-particles; classification of particles: hadrons vs. leptons, baryons vs. leptons; conservation laws: momentum, energy, baryon number, lepton number; strange particles; resonances (Serway, Ch 46).
Week 17: Types of quarks; the Standard Model of Particle physics; the cosmic background radiation; the expanding universe; string theory; final exam review.

Lab Content:

A. Magnetic field simulations
B. Magnetic force
C. Faraday’s and Lenz’s laws
D. Mutual inductance
E. EM wave simulations
F. Geometric optics simulations
G. Interference and polarizations
H. Time dilation and length contraction simulations and calculations
I. Quantum theory simulations
J. Nuclear physics simulations
K. Condensed matter simulations

V. APPROPRIATE READINGS

Reading assignments may include but are not limited to the following:

A. Sample Text Title:

1. Recommended - Serway, R. and Jewett, J *Physics for Scientists and Engineers,* ed. 8 Thomson Brooks/Cole, 2009,

   or

2. Recommended - Giancoli, D *Physics for Scientists and Engineers,* ed. 4 Pearson, 2008,

   and/or

3. Recommended - Appel, K. , Gasineau, J. , Bakken, C *Physics with Vernier,* ed. 4 Vernier Software and Technology, Beaverton, OR., 2009,

B. Other Readings

1. Recommended - *Instructor-supplied handouts and supplements, especially for labs.*

___ Global or international materials or concepts are appropriately included in this course
___ Multicultural materials and concepts are appropriately included in this course

If either line is checked, write a paragraph indicating specifically how global/international and/or multicultural materials and concepts relate to content outline and/or readings.

VI. METHODS TO MEASURE STUDENT ACHIEVEMENT AND DETERMINE GRADES:

Students in this course will be graded in at least one of the following four categories. Please check those appropriate. A degree applicable course must have a minimum of one response in category A, B, or C.

A. Writing Check either 1 or 2 below			
X	***1. Substantial writing assignments are required. Check the appropriate boxes below and provide a written description in the space provided.***		
	2. Substantial writing assignments are NOT required. If this box is checked leave this section blank. For degree applicable courses you must complete category B and/or C.		
X	a) essay exam(s)	X	d) written homework
X	b) term or other paper(s)		e) reading reports
X	c) laboratory report(s)		f) other (specify)

Required assignments may include but are not limited to the following:
Written lab reports which describe, explain, and interpret the data collected, provide analysis, and present final results.

B. Problem Solving Computational or non-computational problem-solving demonstrations, including:			
X	a) exam(s)	X	d) laboratory reports
X	b) quizzes		e) field work
X	c) homework problems		f) other (specify):

Required assignments may include but are not limited to the following:
Weekly homework assignments and lab reports.

C. Skill demonstrations, including:			
	a) class performance(s)		c) performance exams(s)
	b) field work		d) other (specify)

Required assignments may include but are not limited to the following:

D. Objective examinations including:			
	a) multiple choice		d) completion
	b) true/false		e) other (specify):
	c) matching items		

COURSE GRADE DETERMINATION:
Description/Explanation: Based on the categories checked in A-D, it is the recommendation of the department that the instructor's grading methods fall within the following departmental guidelines; however, the final method of grading is still at the discretion of the individual instructor. The instructor's syllabus must reflect the criteria by which the student's grade has been determined. (A minimum of five (5) grades must be recorded on the final roster.)

If several methods to measure student achievement are used, indicate here the approximate weight or percentage each has in determining student final grades.
homework = 20% labs = 20% midterm exam 1 = 15% midterm exam 2 = 15% final exam = 30%

Attached Files:

BASIC SKILLS ADVISORIES PAGE The skills listed are those needed for eligibility for English 125, 126, and Math 101. These skills are listed as the outcomes from English 252, 262, and Math 250. In the right hand column, list at least three major basic skills needed at the beginning of the target course and check off the corresponding basic skills listed at the left.
Check the appropriate spaces. _____ Eligibility for Math 101 is advisory for the target course. _____ Eligibility for English 126 is advisory for the target course. _____ Eligibility for English 125 is advisory for the target course. *If the reviewers determine that an advisory or advisories in Basic Skills are all that are necessary for success in the target course, stop here, provide the required signatures, and forward this form to the department chair, the appropriate associate dean, and the curriculum committee.*

CONTENT REVIEW	
PHYS 4B PHYSICS FOR SCIENTISTS AND ENGINEERS	
understand basic concepts and fundamental laws in thermodynamics, electricity, and magnetism.	
understand basic concepts and fundamental laws in electricity and	

magnetism.	
relate electric field and electric potential.	
determine the capacitance of various electrical systems.	

REQUISITES	
Subject Prerequisite -- PHYS 4B PHYSICS FOR SCIENTISTS AND ENGINEERS	
• understand basic concepts and fundamental laws in thermodynamics, electricity, and magnetism.	• complete assignments and lab reports outside of class requiring the application of concepts studied in class.

ESTABLISHING PREREQUISITES OR COREQUISITES

Every prerequisite or corequisite requires content review plus justification of at least one of the seven kinds below. Prerequisite courses in communication and math outside of their disciplines require justification through statistical evidence. Kinds of justification that may establish a prerequisite are listed below.

Check one of the following that apply. Documentation may be attached.

1. _____ The prerequisite/corequisite is required by law or government regulations.
   Explain or cite regulation numbers:
2. _____ The health or safety of the students in this course requires the prerequisite.
   Justification: Indicate how this is so.
3. _____ The safety or equipment operation skills learned in the prerequisite course are required for the successful or safe completion of this course.
   Justification: Indicate how this is so.
4. __X__ The prerequisite is required in order for the course to be accepted for transfer to the UC or CSU systems.
   Justification: Indicate how this is so.
   For articulation, our courses must have requisites equivalent to the requirements for corresponding physics courses taught at CSU and UC.
5. _____ Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.
   Justification: Cite the statistical evidence from the research.
6. _____ The prerequisite course is part of a sequence of courses within or across a discipline.
7. __X__ Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:
   UC Berkeley UC Davis Cal Poly SLO