CREDIT COURSE OUTLINE

I. COVER PAGE

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

(4)	Lecture / Lab Hours:		
	Course Hours		
		Weekly Lec hours:	4.00
		Weekly Lab hours:	2.00
		Total Contact hours:	108.00
	Lec will generate _0_ hour(s) outside work.		
	Lab will generate _0_ hour(s) outside work.		
(5)	Grading Basis:	Grading Scale Only	X
		Pass/No Pass option	
		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:	
	Area A Natural Sciences	
Major:	BIOLOGICAL SCIENCE COMPUTER SCIENCE ENGINEERING PHYSICAL SCIENCE	
Certificate of:		
Certificate in:		
(10)CSU	Baccalaureate:	X
(11)Repeatable: (A course may be repeated three times)		0
Effective Term:		

(12) Catalog Description:
The topics covered in this course include: 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:

I. Solve problems applied to the theory of Maxwell's Equations of electromagnetism.
II. Solve problems applied to the theory of basic concepts of relativity and quantum theory.
III. Solve problems applied to the theory of basic concepts of atomic and nuclear interactions
IV. Solve problems applied to the theory of 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:

I. Improve mathematical skills through the process of applying mathematics to the physical world.
II. Learn fundamental laboratory techniques.
III. Experience the interaction between theory and experiment in scientific investigation.
IV. Learn to solve basic problems in classical mechanics.
V. Study important properties of matter.
VI. Study the laws of fluid mechanics.
VII. Learn to solve problems in oscillatory motion.
VIII. Learn the basic concepts of mechanical waves.

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:

I. Sample Text Title:
1. Recommended - Serway, R. and Jewett, J *Physics for Scientists and Engineers,* ed. 8 Thomson Brooks/Cole, 2009, and/or
2. Recommended - Appel, K. , Gasineau, J. , Bakken, C *Physics with Vernier,* ed. 4 Vernier Software and Technology, Beaverton, OR., 2009,
   or
3. Recommended - Giancoli, D *Physics for Scientists and Engineers,* ed. 4 Pearson, 2008,

II. 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		

<u>COURSE GRADE DETERMINATION:</u>
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%

VII. EDUCATIONAL MATERIALS

For degree applicable courses, the adopted texts, as listed in the college bookstore, or instructor-prepared materials have been certified to contain college-level materials.

Validation Language Level (check where applicable):

	College-Level Criteria Met YES	NO
Textbook	X	
Reference materials		X
Instructor-prepared materials	X	
Audio-visual materials		X

Indicate Method of evaluation:

Used readability formulae (grade level 10 or higher)	
Text is used in a college-level course	X
Used grading provided by publisher	

Other: (please explain; relate to Skills Levels) ______ -

Computation Level (Eligible for MATH 101 level or higher where applicable)	X	
Content		
Breadth of ideas covered clearly meets college-level learning objectives of this course	X	
Presentation of content and/or exercises/projects:		
Requires a variety of problem-solving strategies including inductive and deductive reasoning.	X	
Requires independent thought and study	X	
Applies transferring knowledge and skills appropriately and efficiently to new situations or problems.	X	

List of Reading/Educational Materials

Recommended - Serway, R. and Jewett, J *Physics for Scientists and Engineers,* ed. 8 Thomson Brooks/Cole, 2009, ISBN: 978-0-495-827

Recommended - Appel, K. , Gasineau, J. , Bakken, C *Physics with Vernier,* ed. 4 Vernier Software and Technology, Beaverton, OR., 2009, ISBN: 978-1-9290755

Recommended - Giancoli, D *Physics for Scientists and Engineers,* ed. 4 Pearson, 2008, ISBN: 9780131495081

Comments:

______ This course requires special or additional library materials (list attached).

__X__ This course requires special facilities:
Physics laboratory classroom

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.

REQUISITES

Subject Prerequisite -- PHYS 4B PHYSICS FOR SCIENTISTS AND ENGINEERS

- apply basic concepts and fundamental laws in thermodynamics, electricity, and magnetism.
- solve problems in thermal expansion.
- relate electric field and electric potential.

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.

_____Limitation on Enrollment (e.g. Performance tryout, honors**)

_____Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.

Justification: Indicate how this is so.

_____The health or safety of the students in this course requires the prerequisite.

Justification: Indicate how this is so.

_____The prerequisite course is part of a sequence of courses within or across a discipline.

_____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.

_____The prerequisite/corequisite is required by law or government regulations.

Explain or cite regulation numbers:

_____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.

_____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.
_____Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:

Justification:

Subject Advisory -- ENGL 1A READING AND COMPOSITION

1. Ability to read college level material. 2. Ability to write complete English sentences while avoiding errors most of the time. 3. Ability to summarize and paraphrase.	1. Students need to understand written material presented in lectures and in the text. 2. Students must be able to read and comprehend word problems on the homework and on tests. 3. Using their own words, students must summarize in writing their results from laboratory experiments

ESTABLISHING PREREQUISITES OR COREQUISITES

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

_____Limitation on Enrollment (e.g. Performance tryout, honors**)
_____Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.
Justification: Indicate how this is so.
_____The health or safety of the students in this course requires the prerequisite.
Justification: Indicate how this is so.
_____The prerequisite course is part of a sequence of courses within or across a discipline.
_____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.
_____The prerequisite/corequisite is required by law or government regulations.
Explain or cite regulation numbers:
_____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.
_____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.
_____Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:

Justification:

Subject Advisory -- MATH 7 DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA

1. Compute the vector dot and cross products and use them in application problems. 2. Determine partial derivatives. 3. Apply the chain rule to functions of multiple variables.	1. Apply the cross product to problems involving electric fields. 2. Apply partial derivatives to problems involving electric potential. 3. Apply the chain rule to problems involing electric fields.

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.

_____Limitation on Enrollment (e.g. Performance tryout, honors**)
_____Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.
Justification: Indicate how this is so.
_____The health or safety of the students in this course requires the prerequisite.
Justification: Indicate how this is so.
_____The prerequisite course is part of a sequence of courses within or across a discipline.
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Justification: Indicate how this is so.
_____Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:

Justification: