COLLEGE OF THE DESERT

Course Code PH-003C

Course Outline of Record

1. Course Code: PH-003C
2. a. Long Course Title: Engineering Physics
   b. Short Course Title: ENGINEER PHYSICS
3. a. Catalog Course Description:
   This is the third semester of the calculus-based physics sequence for scientists and engineers including those entering the computer fields. Topics include electromagnetic waves, geometric and physical optics, relativity, quantum physics, and the physics of atoms, nuclei, and elementary particles.
   b. Class Schedule Course Description:
   This is the third semester of the calculus-based physics sequence for scientists and engineers including those entering the computer fields. Topics include electromagnetic waves, geometric and physical optics, relativity, quantum physics, and the physics of atoms, nuclei, and elementary particles.
   c. Semester Cycle (*if applicable*): Every spring
   d. Name of Approved Program(s):
   - PHYSICS
4. Total Units: 4.00 Total Semester Hrs: 108.00
   Lecture Units: 3 Semester Lecture Hrs: 54.00
   Lab Units: 1 Semester Lab Hrs: 54.00
   Class Size Maximum: 24 Allow Audit: No
   Repeatability No Repeats Allowed
   Justification 0
5. Prerequisite or Corequisite Courses or Advisories:
   Course with requisite(s) and/or advisory is required to complete Content Review Matrix (CCForm1-A)
   Prerequisite: PH 003B or
   Prerequisite: PH 004B
6. Textbooks, Required Reading or Software: *(List in APA or MLA format.)*
   a. Young,R.,Freedman,G. (2011). *University Physics with Modern Physics* (13/e). Addison-Wesley. ISBN: 0321696867
   College Level: Yes
   Flesch-Kincaid reading level: 12
   b. MacIntire, D.. Physics 4C Lab Manual. COD , 01-30-2014.
7. Entrance Skills: *Before entering the course students must be able:*
   a. Understand the relationships between Charge, Electric Forces and Coulomb's Law.
   - PH 004B - Understand the relationships between Charge, Electric Forces and Coulomb's Law.

   b. Use Gauss' Law to determine Electric Fields of continuous charge distributions.
   - PH 004B - Use Gauss' Law to determine Electric Fields of continuous charge distributions.

   c. Determine the Electric Potential of a continuous charge distribution and relate Electric potential to energy.
   - PH 004B - Determine the Electric Potential of a continuous charge distribution and relate Electric potential to energy.

   d. Understand Magnetic forces and Fields.
   - PH 004B - Understand Magnetic forces and Fields.

   e.
   Determine the motion of a charged particle in a time independent electric and magnetic field.

   - PH 004B - Determine the motion of a charged particle in a time dependent electric and magnetic field. Understand modern particle accelerator technology including projects based on Fermilab and LHC design parameters.

f. Use Faraday's law in the context of Induction.

- PH 004B - Use Faraday's law in the context of Induction.

g. Understand Electromagnetic Waves and how they relate to mechanical waves and Maxwell's equations.

- PH 004B - Understand Electromagnetic Waves and how they relate to mechanical waves and Maxwell's equations.

h.
Understand the concepts of Heat & Temperature, Phase Changes, Thermal Expansion, Heat Transfer, Kinetic Theory and the Ideal Gas Law.

- PH 004B - Understand the concepts of Heats & Temperature, Phase Changes, Thermal Expansion, Heat Transfer, Kinetic Theory and the Ideal Gas Law.

i. Use the concepts of Thermodynamics, with emphasis on Heat Engines.

- PH 004B - Use the concepts of Thermodynamics, with emphasis on Heat Engines.

8. Course Content and Scope:

Lecture:

1. Maxwell's Equations
2. Electromagnetic Waves
3. Geometric Optics: Reflection, refraction, lenses, mirrors, optical instruments
4. Physical Optics: Interference, Diffraction, Polarization
5. Special Relativity
6. Introduction to Quantum Physics
7. Quantum Mechanics
8. Atomic Physics
9. Nuclear Physics
10. Particle Physics and Cosmology

Lab: *(if the "Lab Hours" is greater than zero this is required)*

1. Electromagnetic Waves: Speed of Light Experiment
2. Geometric Optics: Reflection, refraction, lenses, mirrors, optical instruments
3. Physical Optics: Interference, Diffraction, Polarization: Diffraction Lab, Polarization Lab, Michelson Interferometer Lab
4. Special Relativity: Computer simulation lab
5. Introduction to Quantum Physics: Photoelectric Effect Experiment, Franck-Hertz Experiment, Millikan Oil Drop Experiment, e/m Experiment
6. Quantum Mechanics: Computer simulation labs
7. Atomic Physics: Atomic Spectra Lab
8. Nuclear Physics: Nuclear Physics Lab

9. Course Student Learning Outcomes:

1. Discuss the history of modern physics and examine its impact on human history.
2.
Describe various optical phenomena, such as image formation, interference effects, diffraction, and polarization and relate to real-world everyday experiences and phenomena.

3. Describe the basic principles and phenomena of quantum theory and discuss the historical origins of the quantization.
4. Describe the principles of quantum mechanics, and apply Schrodinger's Equation to analyze and predict the quantum behavior of simple physical systems.
5. Describe the physics of nuclei and elementary particles.
6. Discuss the basic postulates and predictions of the Special Theory of Relativity and use the equations of Relativity to calculate physical quantities in different reference frames.
7. Apply the scientific method of inquiry and appropriate experimental techniques in the laboratory setting to set up basic physics experiments, acquire, record, analyze data, and formulate conclusions from the data.

10. Course Objectives: *Upon completion of this course, students will be able to:*
    a. Describe electric and magnetic components of light waves
    b. Explain the relationship between the speed of light and the fundamental constants of electricity and magnetism
    c. Analyze geometric optical systems, including systems involving refraction, reflection, lenses, mirrors and optical instruments
    d. Explain the phenomena of interference, diffraction, polarization
    e. Discuss the two postulates of Special Relativity
    f. Discuss frames of reference and transformations between frames
    g. Explain length contraction, time dilation, simultaneity
    h. Discuss the twin paradox and other paradoxes in Special Relativity
    i. Solve problems involving relativistic dynamics
    j. Discuss the basic postulates of quantum theory and discuss the historical origins of the quantization, including the photoelectric effect and the discrete spectra of atomic transitions
    k. Describe the wave nature of particles, the particle nature of light, and the Heisenberg Uncertainty Principle.
    l. Apply Schrödinger's Equation to simple one-dimensional problems, including particle in a box, particle in a potential well, tunneling, and harmonic oscillator.
    m. Discuss the application of Schrödinger's Equation to three dimensional problems
    n. Describe the quantum nature of the Hydrogen atom, including energy levels, Zeeman Effect, and angular momentum quantization.
    o. Apply the Pauli Exclusion Principle to analyze the energy levels of many-electron atoms
    p. Discuss key properties of atomic nuclei, including radii, densities, spins, magnetic moments, and binding energies
    q. Describe the basics types of radioactive decays of nuclei and the application to radioactive dating
    r. Discuss fission and fusion and compute the energy yield from reactions
    s. Describe the different types of fundamental particles and how accelerators and detectors are used to determine their properties
    t. Discuss the four fundamental forces and their mediating particles
    u. Describe how the protons, neutrons, and other particles are comprised of more fundamental particles called quarks.

11. Methods of Instruction: *(Integration: Elements should validate parallel course outline elements)*
    a. Collaborative/Team
    b. Demonstration, Repetition/Practice
    c. Laboratory
    d. Lecture
    e. Technology-based instruction

12. Assignments: *(List samples of specific activities/assignments students are expected to complete both in and outside of class.)*
    In Class Hours: 108.00
    Outside Class Hours: 108.00
    a. Out-of-class Assignments
        1. Reading (text, study guides)
        2. Homework problems (involving analyzing physical systems, calculations, graphing, formula derivations; conceptual questions testing comprehension of material)
        3. Submit completed weekly supervised laboratory assignments in thesis format.
        4. Maintain a comprehensive laboratory notebook documenting all lab activities.
    b. In-class Assignments
        1. Students develop critical thinking skills through class participation and discussion of course topics.

13. Methods of Evaluating Student Progress: *The student will demonstrate proficiency by:*
    - Written homework
    - Laboratory projects
    - Computational/problem solving evaluations

- Group activity participation/observation
- Mid-term and final evaluations

14. Methods of Evaluating: Additional Assesment Information:

a. Periodic examinations: essay; practical parts and short answer. b. A comprehensive final. c. Laboratory examinations. d. Weekly laboratory activities. f. Weekly quizzes.

15. Need/Purpose/Rationale -- *All courses must meet one or more CCC missions.*

IGETC Area 5: Physical and Biological Sciences (mark all that apply)

A: Physical Science with Lab
A: Physical Science without Lab
A: Physical Science, Lab only

CSU GE Area B: Physical and its Life Forms(mark all that apply)

B1 - Physical Science
B3 - Laboratory Sciences

PO-GE C1-Natural Sciences

Explain concepts and theories related to physical, chemical, and biological natural phenomena.
Draw a connection between natural sciences and their own lives.
Use college-level mathematical concepts and methods to understand, analyze, and explain issues in quantitative terms.

IO - Scientific Inquiry

Predict outcomes utilizing scientific inquiry: using evidence and assertions determine which conclusions logically follow from a body of quantitative and qualitative data.
Analyze quantitative and qualitative information to make decisions, judgments, and pose questions.

IO - Critical Thinking and Communication

Apply principles of logic to problem solve and reason with a fair and open mind.

16. Comparable Transfer Course

University System	Campus	Course Number	Course Title	Catalog Year
CSU	CSU San Bernadino	Physics 225		
CSU	CSU Fresno	Physics 4C		
CSU	San Diego State University	Physics 197		
UC	UC Berkeley	Physics 7C		
UC	UC Riverside	Physics 40D &40E		
UC	UCLA	Physics 17 & 18L		

17. Special Materials and/or Equipment Required of Students:

18. Materials Fees: ☐ Required Material?

Material or Item	Cost Per Unit	Total Cost

19. Provide Reasons for the Substantial Modifications or New Course:

TMC

20. a. Cross-Listed Course *(Enter Course Code)*: *N/A*
    b. Replacement Course *(Enter original Course Code)*: PH-004C

21. Grading Method *(choose one)*: Letter Grade Only

22. MIS Course Data Elements
    a. Course Control Number [CB00]: CCC000559803
    b. T.O.P. Code [CB03]: 190200.00 - Physics, General
    c. Credit Status [CB04]: D - Credit - Degree Applicable
    d. Course Transfer Status [CB05]: A = Transfer to UC, CSU
    e. Basic Skills Status [CB08]: 2N = Not basic skills course
    f. Vocational Status [CB09]: Not Occupational
    g. Course Classification [CB11]: Y - Credit Course
    h. Special Class Status [CB13]: N - Not Special
    i. Course CAN Code [CB14]: *N/A*
    j. Course Prior to College Level [CB21]: Y = Not Applicable
    k. Course Noncredit Category [CB22]: Y - Not Applicable
    l. Funding Agency Category [CB23]: Y = Not Applicable
    m. Program Status [CB24]: 1 = Program Applicable

    Name of Approved Program *(if program-applicable)*: PHYSICS
    Attach listings of Degree and/or Certificate Programs showing this course as a required or a restricted elective.)

23. Enrollment - Estimate Enrollment
    First Year: 15
    Third Year: 25

24. Resources - Faculty - Discipline and Other Qualifications:
    a. Sufficient Faculty Resources: Yes
    b. If No, list number of FTE needed to offer this course: *N/A*
25. Additional Equipment and/or Supplies Needed and Source of Funding.
    N/A
26. Additional Construction or Modification of Existing Classroom Space Needed. *(Explain:)*
    N/A
27. FOR NEW OR SUBSTANTIALLY MODIFIED COURSES
    Library and/or Learning Resources Present in the Collection are Sufficient to Meet the Need of the Students Enrolled in the Course: Yes
28. Originator Doug MacIntire Origination Date 10/15/14