New – 10/26/2006
(Combined Revision of PHYS 210
& PHYS 210L)

ANTELOPE VALLEY COLLEGE

Academic Affairs Office
Course Outline of Record

COURSE SUBJECT & NUMBER: PHYS 211 (formerly PHYS 210, General Physics & PHYS 210L, General Physics Lab)
COURSE NAME: GENERAL PHYSICS
COURSE UNITS: 5
COURSE HOURS: 7

COURSE REQUISITES: ***(Follow format of similar courses found in the college catalog.)***
Prerequisite: completion of PHYS 110 and completion of or concurrent enrollment in MATH 160

Advisory: completion of Math 220

COURSE DESCRIPTION: ***(Write a short paragraph providing an overview of topics covered. Be sure to identify target audience--transfer, major, GE, degree/certificate, etc. If repeatable, state the number of times at end of description).***

This course covers thermodynamics, the kinetic theory of gases, sound, optics, special relativity, introduction to quantum mechanics, introduction to solid state physics and introduction to general relativity, particle physics and cosmology.
[CAN PHYS 14] (CSU, UC, AVC)

COURSE OBJECTIVES: ***(Should be stated as performance-based, measurable expected student outcomes. Use Bloom's taxonomy to formulate clear and concise objectives. These objectives are common to all students; they must be clearly related to course content, assignments, and methods of evaluation.)***
Upon completion of course, the successful student will be able to:
Derive the kinetic theory of gases from basic considerations
Formulate the concept of entropy and the second law of thermodynamics from thought experiments
Derive the theories of spectra and diffraction from experimental results
Formulate the theories of sound waves, interference and the doppler effect from historical information and experimental results
Derive and apply the principles of geometric optics
Formulate the special theory of relativity from relativity two postulates
Apply the special theory of relativity to an appropriate reformulation of Newtonian mechanics
Formulate general relativistic mechanics from Einstein's local principle of equivalence
Derive the Einstein field equations from modifications of the La Place equation that are dictated by the principle of equivalence
Formulate early quantum theory (Planck, Bohr and Einstein) from experimental results
Derive Schrodinger's wave equation from the experimental considerations that motivated Schrodinger
Reproduce an outline of the solution of Schrodinger's wave equation
Derive and apply the laws of solid state physics
Formulate the concept of spin and the relativistic wave from the results of the Stern-Gerlach experiment and Dirac's mathematical observations
Derive the gauge theories from generalizations of Noether's theorem and experimental results
Derive the Feynman calculus from a completely syymmetric relativistic Lagrangian
Apply the above to a description of the weak and strong nuclear interactions
Outline (give basic mathematical formulation of) the hierarchy problem and its solution in terms of supersymmetry
Show qualitatively that supergravity is not a finite theory
Formulate, in terms of graphs and discussion, the theory of closed strings
Discuss at least one approach to the unique reduction of this theory to the standard particle model

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COURSE CONTENT: ***(Enter course content in terms of specific topics or a specific body of knowledge that each instructor must cover. Put topics in outline form with major and minor headings. Title 5 requires that each instructor covers all material listed here.)***

See Attached Sheets

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COURSE TITLE: GENERAL PHYSICS

COURSE CONTENT

A. Kinetic Theory of Gases
   1. Ideal gas and ideal gas law
   2. Molar specific heat of constant volume
   3. Molar specific heat of constant pressure
   4. Adiabatic processes

B. First and Second laws of Thermodynamics
   1. First law of thermodynamics
   2. Isobaric, isothermal and adiabatic expansion
   3. Carnot cycle
   4. The expression describing the efficiency of a Carnot engine
   5. Second law of thermodynamics
   6. Reversible and irreversible cycles
   7. Entropy
   8. Free expansion and the second law of thermodynamics

C. Gratings, spectra and diffractions
   1. Elements of spectra
   2. Single slit diffraction pattern
   3. Double slit interference patterns
   4. Problem related to the presence and absence of interference patterns under specific conditions related to intensities of particle detectors

D. Special relativity
   1. The classical theory underlying the Michaelson-Morley experiment, and why the experiment failed in the context of this mathematical analysis (actually how the classical mathematical analysis failed).
   2. The two postulates of special relativity and the mathematical derivation of the Lorentz transformations from these postulates
   3. The relations of relativistic mechanics such as $E=mc^2$
   4. The concept of simultaneity and that underlying the twin paradox from the basic equations of special relativity
   5. The 3-velocity transformation equation
   6. The relativistic Doppler effect

E. Quantum theory
   1. Mathematically describe the black body and photoelectric problems and the solutions introduced by Planck and Einstein
   2. Derive the Balmer formula from Bohr's hypothesis
   3. Mathematically describe the problems encountered by the Bohr model
   4. Formulate the Schrodinger theory
   5. Mathematically demonstrate Born's interpretation of the Schrodinger equation
   6. Mathematically describe the Stern-Gerlach experiment and the impact of spin upon the hydrogenic model

E. Solid state physics
1. The electrical properties of solids
    a. Resistivity
    b. Temperature coefficient of resistivity
    c. Number density of charge carriers
2. Energy levels in a crystalline solid
3. Insulators
4. Metals
    a. Number of conduction electrons
    b. Conductivity at T>0
    c. Number of quantum states
    d. The occupancy probability P(E)
    e. Number of occupied states
    f. Calculating the Fermi energy
5. Semiconductors
    a. Number density of charge carriers, n
    b. Resistivity, ρ
    c. Temperature coefficient of resistivity,
6. Doped semiconductors
    a. n-type semiconductors
7. The p-n junction
    a. Motions of the majority carriers
    c. Motions of the minority carriers
8. The junction rectifier
9. The light-emitting diode (LED)
10. a. The photo diode
    b. The junction laser
11. The transistor
    a. Integrated circuits

F. Introduction to general relativity and the gauge theories
1. Classical mechanics in one dimension in terms of a Lagrangian
2. The local principle of equivalence, and
   Riemann's effort to account for gravitational fields in terms of spacetime curvature.
3. The equations of motion of a test particle in a gravitational field from a (Riemannian) metrical Lagrangian
4. Tensorial theorems
5. The Einstein field equations in terms of the Riemannian curvature tensor and the energy-momentum tensor
6. Brief descriptions of the Schwarzschild, Kerr and Robertson-Walker solutions of the field equations
7. Large scale implications of the Robertson-Walker solution
8. Kaluza-Klein and Yang-Mills theories

G. Particle physics and cosmology
1. Neutrinos, anti-fermions and beta decay
2. Discoveries of baryons and mesons

3. The flavor hypothesis of Gell-Mann and Ne'eman
4. Baryons and mesons in terms of the 8-fold way
5. Cosmology and particle physics that constitutes the so called 'Standard Model'
6. The free Dirac equation and its theoretical description of spin-(1/2)
7. Feynman calculus from the perfectly symmetric relativistic Lagrangian
8. Application of Yang-Mills theory to weak and strong interactions
9. The color theory and the interfacing of experiment and theory which avoids the large magnitude of the strong coupling to produce a finite formalism
10. The hierarchy problem and a rough account of its solution in terms of N=1 supersymmetry
11. A qualitative formulation of the heterotic string theory (HST) and one formulation of supergravity in terms of the HST that relates string theory to the standard model
12. The impact upon cosmology of the inflation events that are indicated by this formulation of supergravity

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TYPICAL READING, WRITING, AND COMPUTATIONAL HOMWORK ASSIGNMENTS

This material is necessary for all credit courses. Assignments should be clearly related to course objectives, content, and methods of evaluation. (See sample of a "Model Outline" in the AP&P Standards & Practices handbook.) Include a range of assignments (minimum of three) from which faculty may choose when designing their syllabus.

1. ***Describe nature and frequency of typical reading assignments if applicable; note if any are required:***
One reading assignment per week in the text that is provided by the instructor (Notes on Symmetry and Quantuzation)

These assignments describe physical processes in terms of the necessary mathematics.

2. ***Describe nature and frequency of typical writing assignments if applicable; note if any are required:***
The writing of a lab report is required once per week.

3. ***Describe nature and frequency of typical computational assignments if applicable; note if any are required:***
One computation assignment per week. These assignments consist partly of problems of the kind that appear in typical text books that are used for lower division physics courses (e.g. Resnick, Halliday and Walker). They also consist of derivations of equations that are fundamental in the areas of thermodynamics, relativity and quantum mechanics.

4. ***Describe other types of assignments that students may be asked to complete:***

None

5. ***If course is degree applicable/transfer, describe those critical thinking skills that are required; be sure that they reflect course objective. (Title 5 requirements can be found in the AP&P Standards and Practices book.)***
The student must learn to formulate known theory from experiments that motivated initial formulations. The student must learn to read and analyze problems, and apply physical theory in terms of the necessary mathematics to formulate and solve necessary equations. Finally the student must evaluate theories and experimental techniques and compare conclusions with current consensus of physics community.

6. ***For categories 1-4 above,☐ describe the estimated time per week it would take a student to complete typical out-of-class assignments.*** *The Carnegie formula uses a 2:1 ratio as follows: 1 hr. lecture = 2 hrs. homework; 2 hrs. lecture = 4 hrs. homework; etc. For example: reading text—2 hours; writing reports—3 hour; etc.*

Reading: four hours

Writing: three hours

Computational: 7 hours

Other: none

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METHODS OF INSTRUCTION: ***(Methods must be consistent with content and appropriate to objectives; state in terms of what instructor will be doing in order to present course content to students.)***

Lecture, demonstration, problem solving sessions, supervised experimentation

METHODS OF EVALUATION: ***(These must be clearly related to course content, assignments, and objectives, in order to comply with Title 5 requirements. Describe what instructor will be looking for when evaluating assignments and tests in order to determine whether students have met course objectives. Grades must be based on demonstrated proficiency in subject matter and determined, where appropriate, by essays, objective and essay tests, research papers, problem solving exercises, or skills' demonstrations.)***

Examination is done through three written examinations: one on thermodynamics and sound; a second on relativity and solid state physics and a third on quantum mechanics and related topics (particles, strings and cosmology). Laboratory work is evaluated by reports that are presented to the instructor one week after an experiment is completed. Reports are graded on content and presentation, where content is based upon the percent error that was obtained and upon average deviation of the student's data from the mean; and upon the student's explanation of error that exceeds that admissible on a basis of maximum error analysis.

Suggested Texts or other Instructional Materials ***(include title, author, publisher, date, and edition):***

The texts are that written by the instructor: Notes on Symmetry and Quantization, and Modern Physics from Alpha to Z eta sub zero by J. William Rohlf; John Wiley and Sons, 1994, 1st . There is no new edition of this text, but the text is still in print

Effective Date: ____Fall 2007________
(date course can first be offered to be filled in by Office of Academic Affairs)