Lecture Contact Hours: 64-72; Homework Hours: 128-144; Total Student Learning Hours: 192-216
Laboratory Contact Hours: 48-54; Homework Hours: 0; Total Student Learning Hours: 48-54

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

PHYSICS 190 – MECHANICS AND HEAT

4 hours lecture, 3 hours laboratory, 5 units

Catalog Description
This course covers linear and rotational kinematics and dynamics, equilibrium, work, energy, momentum, gravitation, simple harmonic motion, thermal properties of matter, and thermodynamics. This course is the first of a three semester sequence intended for students majoring in physical sciences and engineering.

Prerequisite
"C" grade or higher or "Pass" in MATH 280 or equivalent or concurrent enrollment

Entrance Skills
Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:
1) Solve algebraic word problems by using substitution or simultaneous equations.
2) Application of trigonometric functions and their identities.
3) Solve linear, quadratic and trigonometric equations.
4) Application of related rates and derivatives.
5) Integrate polynomial, exponential and trigonometric functions.
6) Apply Taylor and Fourier series as approximations of functions using simpler functions.
7) Convert between polar and rectangular coordinates.

Course Content
1) Lecture Content
    a. Vectors and Scalars
    b. Newtons Laws
    c. One dimensional kinematics
    d. Two dimensional kinematics
    e. Statics and Dynamics
    f. Dynamics (frictionless)
    g. Dynamics (friction)
    h. Work and energy
    i. Conservation of energy
    j. Linear momentum
    k. Collisions
    l. Rotational kinematics
    m. Rotational dynamics
    n. Rigid body equilibrium
    o. Simple harmonic motion
    p. Gravitation
    q. Temperature
    r. Heat and Heat Engines
    s. Kinetic Theory and Ideal gas behavior
    t. Thermodynamics and Entropy
    u. Historical development of physics

v. Application of physics principles to engineering, chemistry, etc.

2) Laboratory Content
   a. Motion in one dimension
   b. Freefall
   c. Projectile Motion
   d. Friction and/or static forces
   e. Circular Motion
   f. Conservation of Energy and Momentum
   g. Impulse and Momentum
   h. Torque and Rotational Inertia
   i. Simple Harmonic Motion
   j. Thermodynamics

Course Objectives

Students will be able to:

1) Recognize the basic concepts concerning kinematics, dynamics, energy, momentum, gravitation, oscillations and thermodynamics, and use algebraic, trigonometric and advanced calculus expressions to represent physical situations involving these subjects.
2) Investigate and delineate the relationship between the theoretical principles of physics and their practical applications, and explain how this relationship affects real world problem solving.
3) Investigate, interpret and analyze the fundamental principles of physics based on reading assignments and in-class discussions.
4) Calculate solutions to physics problems using the fundamental principles of physics and symbolic logic skills.
   a. Predict the future trajectory of an object moving in two dimensions with uniform acceleration.
   b. Analyze a physical situation with multiple constant forces acting on a point mass using Newtonian mechanics.
   c. Analyze a physical situation with multiple forces acting on a point mass or extended object using concepts of work and energy.

During the lab students will:

5) Design experiments using the scientific method.
6) Collect and analyze data using both traditional and computer data acquisition methods; interpret and analyze numerical data, including appropriate use of error propagation, units and significant figures, and generate a visual representation of the data.
7) Evaluate and interpret the experimental results using concepts covered in class.

Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in the subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

1) Quizzes, exams that measure the student's ability to recognize physical situations and the concepts associated with them, and use mathematical expressions to formulate solutions while under a time pressure.
2) Homework that measures the student's ability to use the fundamental principles of physics and symbolic logic skills to calculate solutions to physics problems.
3) Lab technique as demonstrated by the student's ability to design an experiment, set up the equipment, make the appropriate measurements, and maintain a safe work environment.
4) Lab reports will demonstrate the student's ability to use the English language; record, interpret and analyze data; draw conclusions from the results.
5) Physics research paper(s) in which students are required to analyze, interpret and draw conclusions from scientific sources.
6) Participation based on in-class responses to questions, contribution to discussions and attendance.

Special Materials Required of Student
Scientific calculator

Minimum Instructional Facilities
1) Laboratory with blackboard, Smart Cart, appropriate lab/demonstration equipment
2) Computers with data acquisition probes

Method of Instruction
1) Integrated lecture, demonstration, discussion
2) Small/large group discussion
3) In-class activities and independent homework, research projects
4) Group work in a laboratory situation
5) Auxiliary use of study groups, peer tutoring and/or instructional office hours

Out-of-Class Assignments
1) Reading assignments
2) Homework assignments solving practice problems
3) Completion of lab reports

Texts and References
1) Required (representative examples):
   a. Serway and Jewett. *Physics for Scientists and Engineers*. 9th edition. Cengage, 2014.
   b. Young and Freedman, University Physics, 14th edition, Pearson, 2015.
   c. Laboratory Manual for Physics 190, Cuyamaca College
2) Supplemental: None

Exit Skills
Students having successfully completed this course exit with the following skills, competencies and/or knowledge:
1) Solve linear and rotational kinematics problems.
2) Use the relationship between force, mass and acceleration to solve dynamics problems.
3) Use conservation of energy and conservation of momentum concepts.
4) Understand simple harmonic motion and apply its concepts to analyze oscillating systems.
5) Understand the concepts of heat, thermodynamics and ideal gases and be able to use them in solving problems involving thermal equilibrium, heat transfer and heat engines.

Student Learning Outcomes
Upon completion of this course, students will be able to:
1) Solve problems using a conceptual understanding of kinematics.
2) Solve problems using a conceptual understanding of dynamics with linear or rotational applications.
3) Apply energy and momentum techniques to analyze systems.
4) Understand the concepts of heat, thermodynamics, and ideal gases and be able to use them in solving problems involving thermal equilibrium, heat transfer or heat engines.
5) Collect and analyze experimental data using graphical representation, including appropriate use of units and significant figures.
6) Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.