Lecture Contact Hours: 64-72; Outside-of-Class: 128-144;
Laboratory Contact Hours: 48-54; Outside-of-Class Hours: 0;
Total Student Learning Hours: 240-270

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

Physics 201 – Mechanics and Waves

4 hours lecture, 4 units
3 hours laboratory, 1 unit
Total units: 5

Catalog Description
This is the first course of a three-semester, calculus level sequence of physics courses designed for engineering, physics, mathematics, and science majors. The course assumes no previous physics study, but makes extensive use of algebra, trigonometry, geometry, and calculus. Topics include linear and rotational kinematics and dynamics, energy and energy conservation, linear and angular momentum and their conservation laws, fluid dynamics, and gravitation, and wave motion.

Prerequisite
"C" grade or higher or "Pass" in MATH 180 or equivalent.

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

Course Content
1) Scalars and Vectors
2) One-dimensional kinematics.
3) Two and three-dimensional kinematics using vectors.
4) Newton's laws.
5) Applications of Newton's laws to circular motion and dynamics.
6) Work and energy.
7) Center of mass and momentum.
8) Collisions.
9) Computation of the moment of inertia.
10) Rotational kinematics and dynamics.
11) Angular momentum.
12) Newton's law of gravity and gravitational potential energy.
13) Static equilibrium.
14) Fluids.
15) Simple harmonic motion.
16) Properties of mechanical waves.
17) Techniques of problem solving using dynamical equations or conservation principles, as appropriate.

18) Use of basic and advanced equipment to perform experiments illustrative of the topics covered in lecture.
19) Analysis of data via calculus-based error propagation, t-scores, units, and significant figures

20) Implementation of data reduction via the use of model fitting, and statistics

Course Objectives
Students will be able to:
1) Describe basic concepts in mechanics of solids and define the laws and principles of fundamental physics related to these topics.
2) Interpret graphical and symbolic representations of position, velocity, and acceleration and their relationships in one, two, and three dimensions.
3) Analyze forces and torques in given physical situations, diagram them, and formulate equations to compute translational and rotational accelerations using Newton's laws.
4) Comprehend the concept of conserved quantities, recognize when they occur in different physical situations and formulate approaches to problem solving using conservation techniques.
5) Analyze the behavior of traveling and standing waves
6) Analyze written problems on all topics to determine which physical laws and concepts are required for solutions.
7) Calculate solutions to physics problems using the fundamental principles of physics and algebraic, trigonometric, and calculus principles.
8) Employ basic measurement equipment and laboratory techniques to study the laws and principles used in the course.
9) Assess the importance of error analysis and data reduction in laboratory experiments and evaluate experimental results in terms of expected results.

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 students' 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 students' ability to use the fundamental principles of physics and symbolic logic skills to calculate solutions to physics problems.
3) Lab techniques as demonstrated by students' ability to design an experiment, set up the equipment, make the appropriate measurements, and maintain a safe work environment.
4) Lab reports will demonstrate students' ability to use the English language; record, interpret and analyze data; and 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. Halliday, David, Resnick, Robert, and Walker, Jearl, Fundamentals of Physics, 12th edition, Hoboken, NJ, John Wiley & Sons, Inc., 2022.
   b. Knight, Randall, Physics for Scientists and Engineers - a Strategic Approach, 5th edition, Upper Saddle River, NJ, Pearson Education, 2022.
   c. Young, Hugh D., Freedman, Roger A., and Ford, A. Lewis, University Physics, 15th edition, Upper Saddle River, NJ, Pearson Education, 2020. ISBN
   d. Taylor, John R., *Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements*, 2nd edition, Sausalito, CA, University Science Books, 1997.
   e. *OpenStax University Physics*, OpenStax, Rice University, Houston, TX, 2016.
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) Analyze transverse and longitudinal waves.
6) Solve hydrostatic and hydrodynamic problems.

Student Learning Outcomes
Upon successful completion of this course, students will be able to:
1) Apply conservation of energy to estimate solutions to real world problems.
2) Use Newton's Second Law to analyze the forces acting on a system in order to obtain information about its motion (position, speed, acceleration).
3) LAB - Demonstrate good measurement techniques using basic lab equipment such as rulers, scales, or sensors.