CATALOG INFORMATION

Dept and Nbr: PHYS 40  Title: CLASSICAL MECHANICS
Full Title: Classical Mechanics for Scientists and Engineers
Last Reviewed: 5/14/2018

Catalog Description:
This course employs vectors and calculus to investigate translational and rotational motion, work and energy, conservation of energy and momentum, static equilibrium and universal gravitation. Intended for science and engineering students.

Prerequisites/Corequisites:
Completion of MATH 1A or higher (MATH)

Recommended Preparation:
One year of high school physics or PHYS 1

Limits on Enrollment:

Schedule of Classes Information:
Description: This course employs vectors and calculus to investigate translational and rotational motion, work and energy, conservation of energy and momentum, static equilibrium and universal gravitation. Intended for science and engineering students. (Grade Only)
Prerequisites/Corequisites: Completion of MATH 1A or higher (MATH)
Recommended: One year of high school physics or PHYS 1
Limits on Enrollment:
Transfer Credit: CSU;UC.
Repeatability: Two Repeats if Grade was D, F, NC, or NP

ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:

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<td>5C</td>
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<td>Calculus-Based Physics for Scientists and Engineers: A</td>
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Certificate/Major Applicable:
Major Applicable Course

COURSE CONTENT

Student Learning Outcomes:
Upon completion of the course, students will be able to:
1. Apply physical principles and laws of classical mechanics to analyze and solve physics problems in mechanics through critical thinking, mathematical modeling, and laboratory experimentation.
2. Design and assemble apparatuses to measure physical phenomena.
3. Analyze and make meaningful comparisons between experiment and theory.
4. Effectively communicate ideas and processes of physics.

Objectives:
During this course, students will:
1. Apply the SI (Systeme International) units and metric prefixes to the solution of problems in mechanics.
2. Use vectors to represent vector quantities in mechanics and use vector operations to solve mechanics problems.
3. Relate the kinematics concepts and graphs of displacement, velocity, and acceleration versus time using integration, and differentiation.
4. Solve one and two dimensional kinematics problems including free fall, projectile, and circular motion.
5. Explain the concepts of force, inertia, and mass and apply Newton's laws to solve problems in linear and circular motion.
6. Describe the concepts of work, energy, kinetic energy, potential energy, and power, and use them to solve translational and rotational mechanics problems.
7. Use the concepts of linear momentum and impulse to solve problems involving elastic, inelastic, and perfectly inelastic collisions in one and two dimensions.
8. Use the concepts of moment of inertia, torque, and angular momentum to solve problems involving rotating and rolling objects and systems.
10. Describe the conditions necessary for static equilibrium and solve problems involving static equilibrium of rigid bodies in two dimensions.
11. Apply Kepler's Laws and Newton's Law of Universal Gravitation to solve problems involving planetary motion and the launching and orbit of satellites.
12. Place the significant advancements in mechanics on an historical timeline and within a developmental context.

Lab Objectives:
1. Develop and conduct experiments that apply the scientific method and error analysis to explore principles in mechanics.
2. Use manual and computerized data collection techniques to measure and analyze parameters related to mechanics.
3. Plot, curve fit, and interpret data using a spreadsheet or another analysis tool.

Topics and Scope:

I. Measurement and Units
   A. SI (Systeme International)
   B. Metric prefixes
   C. Common conversions

II. Vectors
   A. Vector components
   B. Vector addition
   C. Dot product
   D. Cross product

III. Motion in One and Two Dimensions
   A. Displacement, velocity, acceleration definitions
   B. Instantaneous and average values of quantities
   C. Integration and differentiation of motion graphs
   D. Free-fall, projectile and circular motion

IV. Newton's Laws of Motion
   A. Newton's First Law and static equilibrium
   B. Newton's Second Law and linear and rotational dynamics
   C. Newton's Third Law and the interactions of objects

V. Work and Energy
   A. Definitions of work, kinetic energy and potential energy
   B. Conservative and non-conservative forces
   C. Conservation of energy
   D. Power
   E. Work-Energy Theorem

VI. Linear Momentum and Impulse
   A. Definitions
   B. Conservation of linear momentum
   C. Elastic and inelastic collisions
D. Impulse-Momentum Theorem

VII. Rotational Motion
A. Angular position, velocity and acceleration
B. Torque
C. Moments of inertia
D. Angular momentum
E. Conservation of angular momentum
F. Newton's Second Law for rotational motion

VIII. Static Equilibrium of Rigid Bodies in Two Dimensions

IX. Universal Gravitation
A. Newton's Law of Universal Gravitation
B. Kepler's Laws
C. Gravitational field and potential energy

X. Historical Development of Physics

XI. Fluid Mechanics (Optional, as time allows.)
A. Pressure-depth relationship and Pascal's Law
B. Buoyancy and Archimedes' Principle
C. Fluid dynamics and Bernoulli's Equation

Lab Topics:
I. Laboratory Safety and Procedures
II. Writing Lab Reports
III. Measurement Techniques for Mechanical Systems
   A. Manual data collection with calipers, stop watches, meter sticks, etc.
   B. Computerized data collection with motion detectors, force probes, etc.
IV. Data Processing and Graphing Results with Spreadsheets
V. Error Analysis

Assignment:

Lecture-Related Assignments:
1. Homework problem sets (12-30)
2. Quizzes (5-15)
3. Mid-term exams (3-5)
4. Reading (20-30 pages per week)

Lab-Related Assignments:
1. Laboratory experiments (12-16)
2. Written lab reports (12-16)

Lecture- and Lab-Related Assignments:
1. Final exam

Methods of Evaluation/Basis of Grade:

Writing: Assessment tools that demonstrate writing skills and/or require students to select, organize and explain ideas in writing.

| Writing lab reports | Writing 5 - 10% |
**Problem Solving:** Assessment tools, other than exams, that demonstrate competence in computational or non-computational problem solving skills.

| Homework problems, lab experiments | Problem solving 15 - 35% |

**Skill Demonstrations:** All skill-based and physical demonstrations used for assessment purposes including skill performance exams.

| None | Skill Demonstrations 0 - 0% |

**Exams:** All forms of formal testing, other than skill performance exams.

| Quizzes, exams, final exam | Exams 50 - 75% |

**Other:** Includes any assessment tools that do not logically fit into the above categories.

| Class participation | Other Category 0 - 5% |

**Representative Textbooks and Materials:**