Effective Implementation date: SUMMER 2018, 201910

Required Syllabus Information – all must be included in the course syllabus

PHY 211
Course Title: Physics: Calculus-Based I with Lab: GT-SC1
Course Credits: 5
Course Description: Covers the physics of kinematics, dynamics, and conservation laws and requires application of classical physics to both mathematical and conceptual problems. Specific concepts covered include 1D and 2D kinematics, Newton's Laws, rotational motion, energy and work, momentum and impulse, and simple harmonic motion. This course may also cover thermodynamics and fluid mechanics.

GT Pathways Requirements:

Guaranteed Transfer (GT) Pathways Course Statement:
The Colorado Commission on Higher Education has approved PHY 211 for inclusion in the Guaranteed Transfer (GT) Pathways program in the GT- SC1 category. For transferring students, successful completion with a minimum C– grade guarantees transfer and application of credit in this GT Pathways category. For more information on the GT Pathways program, go to CCHE GT Pathways Program Information.

NATURAL & PHYSICAL SCIENCES (N&PS) CONTENT CRITERIA – GT-SC1

1. The lecture content of a GT Pathways science course (GT-SC1)
    a. Develop foundational knowledge in specific field(s) of science.
    b. Develop an understanding of the nature and process of science.
    c. Demonstrate the ability to use scientific methodologies.
    d. Examine quantitative approaches to study natural phenomena.

2. The laboratory (either a combined lecture and laboratory, or a separate laboratory tied to a science lecture course) content of a GT Pathways science course (GT-SC1)
    a. Perform hands-on activities with demonstration and simulation components playing a secondary role.
    b. Engage in inquiry-based activities.
    c. Demonstrate the ability to use the scientific method.
    d. Obtain and interpret data, and communicate the results of inquiry.
    e. Demonstrate proper technique and safe practices.

COMPETENCIES & STUDENT LEARNING OUTCOMES FOR GT-SC1

Inquiry & Analysis:

4. **Select or Develop a Design Process**
    a. Select or develop elements of the methodology or theoretical framework to solve problems in a given discipline.
5. **Analyze and Interpret Evidence**

   a. Examine evidence to identify patterns, differences, similarities, limitations, and/or implications related to the focus.
   b. Utilize multiple representations to interpret the data.
6. **<u>Draw Conclusions</u>**
   a. State a conclusion based on findings.

<u>Quantitative Literacy</u>:

1. Interpret Information
   a. Explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).
2. Represent Information
   a. Convert information into and between various mathematical forms (e.g., equations, graphs, diagrams, tables, words).

SYSTEM REQUIREMENTS:

REQUIRED COURSE LEARNING OUTCOMES

1. Produce both numerical and symbolic solutions to problems using the techniques of calculus and the concepts of classical physics.
2. Apply physics concepts and equations to real-world problems and design challenges.
3. Design scientific experiments, collect and analyze data, and draw conclusions.
4. Communicate the ideas of classical physics both in everyday language and in the language of mathematics.
5. Apply scalar and vector concepts to a variety of real-world problems.
6. Interpret and use the kinematic variables of displacement, velocity, and acceleration.
7. Analyze and calculate, under equilibrium and non-equilibrium conditions, results using Newton's Laws.
8. Analyze free-body diagrams.
9. Discuss Newton's Law of Gravity and its effect on masses.
10. Apply uniform circular motion concepts in calculating centripetal acceleration, velocity, and forces on an object in uniform circular motion.
11. Describe the relationship between impulse and momentum.
12. Analyze and calculate, in one and two dimensions, results based on the conservation of linear momentum.
13. Calculate the work done on a system and its relationship to the system's kinetic energy.
14. Analyze and calculate results based on the conservation or transfer of total mechanical energy for problems involving conservative forces.
15. Interpret the rotational kinematic variables of angular displacement, angular velocity, and angular acceleration.
16. Analyze and calculate results using the rotational kinematics equations derived from constant angular acceleration.
17. Analyze and calculate, under equilibrium and non-equilibrium conditions, results in a rotational dynamics context.
18. Compare and contrast rotational work and energy to linear work and energy, and the conservation of linear momentum to conservation of angular momentum.

19. Explain, conceptually and mathematically, the relationship between a simple mass-spring system or pendulum and the position, velocity, and acceleration of the mass at any given time.
20. Relate the position and velocity of the mass in a mass-spring system to the energy in the system.

RECOMMENDED COURSE LEARNING OUTCOMES:

1. Explain, conceptually and mathematically, pressure, density, and fluid dynamics.
2. Analyze and interpret the thermal properties of matter including specific heats, thermal expansion, and gas laws.
3. Apply energy-transfer concepts to work and heat.
4. Describe the relationship between temperature and molecular motion.

REQUIRED TOPICAL OUTLINE

The required topical outline information MUST be included in the syllabi. It may be incorporated using one of the following variations: copying the topical outline as written below, integrating the topics within the assignment schedule, or listing the topics to be covered.

I. Kinematics
    a. Linear
        i. Scalars and vectors
        ii. ii. Vector manipulation
        iii. Position, displacement and distance
        iv. Speed versus velocity
        v. Acceleration
        vi. Kinematic equations for constant acceleration
        vii. Freefall
        viii. Kinematic equations in 2D
        ix. Projectile motion
        x. Relative velocity
    b. Rotational
        i. Angular position and displacement
        ii. Angular velocity
        iii. Angular acceleration
        iv. Kinematic equations for constant angular acceleration
        v. Angular and tangential variables
II. Dynamics
    a. Linear
        i. Newton's First Law
        ii. Newton's Second Law
        iii. Newton's Third Law
        iv. Mass and weight
        v. Vector nature of Newton's Second Law
        vi. Free-body diagrams
        vii. Normal force
        viii. Frictional forces
        ix. Equilibrium and non-equilibrium applications
    b. Rotational
        i. Uniform circular motion

    ii. Centripetal acceleration
    iii. Non-uniform circular motion
    iv. Angular and tangential acceleration
    v. Forces and torques
    vi. Rigid body model
    vii. Moment of inertia

III. Conservation laws
  a. Work and energy
    i. Work and forces
    ii. Work-Kinetic Energy Theorem
    iii. Conservative forces and potential energy
    iv. Conservative vs. non-conservative forces
    v. Conservation of mechanical energy
    vi. Power
    vii. Rotational work and energy
  b. Impulse and momentum
    i. Impulse and forces
    ii. Impulse-Momentum Theorem
    iii. Conservation of linear momentum
    iv. Conservation of angular momentum
    v. Center of mass
    vi. 1D and 2D collisions

IV. Simple harmonic motion
  a. The spring-mass system
  b. The simple pendulum
  c. The physical pendulum

V. Energy in simple harmonic motion

RECOMMENDED TOPICAL OUTLINE:

I. Fluids
  a. Pressure and forces
  b. Density and Archimedes' principle
  c. Continuity equation and Bernoulli's principle

II. Thermodynamics
  a. The First Law of Thermodynamics
  b. The Second Law of Thermodynamics
  c. The Third Law of Thermodynamics
  d. Specific heat and heat capacity
  e. Thermal expansion
  f. Gas laws
  g. Temperature and molecular motion

Syllabi requirements, including legal compliance information must be included. Individual College syllabi guidelines may include additional information. Please contact your VPI/CAO for specific College requirements.