College Of DuPage **Implementation Date:** Fall/05

ACTIVE COURSE FILE

B. *Curricular Area: Physics Course Number: PHY2111

Course Title: Physics for Science and Engineering I

Semester Credit Hours: 5 Lecture Hours: 4 Lab Hours: 2.5 Clinical Hours: 0

*Changes from the present course must be accompanied by a yellow Course Revision or Deletion Form.

Course description to appear in catalog:

Calculus-based study of classical linear and rotational kinematics and dynamics, including work, energy, impulse, momentum, collisions, periodic motion, and wave motion.

Prerequisite: Completion of or concurrent enrollment in MATH 2232

A. General Course Objectives

Upon successful completion of this course the student should be able to do the following:

1. Describe the relationship between different units of measure
2. Interpret and explain the relationship between an object's displacement, velocity, and acceleration in multiple dimensions
3. Calculate the effect of external forces on an object's motion using Newton's Laws in multiple dimensions
4. Create and label simple free-body diagrams in multiple dimensions
5. Explain and apply the relationship between work and kinetic energy
6. Calculate the effect of external forces on an object's motion using work-energy methods in the case of both conservative and non-conservative forces in multiple dimensions
7. Calculate the effect of both static and kinetic friction on the motion of an object using both direct force/acceleration methods and work/energy methods
8. Identify and calculate the different forms of energy in classical dynamics (potential, kinetic, and mechanical)
9. Explain and apply the relationship between impulse and momentum
10. Calculate the effect of external and internal forces on a system of objects using impulse and momentum methods in multiple dimensions
11. Identify situations in which a system's momentum is conserved
12. Predict the motion of a system of particles using center-of-mass methods
13. Formulate the outcome of collisions of particles in both elastic and inelastic cases
14. Interpret and explain the relationships among an object's rotational displacement, velocity, and acceleration in multiple dimensions
15. Create and label simple free-body diagrams for rotational situations
16. Formulate the effect of external torques on an object's motion using Newton's Laws in rotational form
17. Calculate kinematical characteristics of an object undergoing simple harmonic motion using the equations of motion for force, position, velocity, and acceleration

18. Formulate the kinematical characteristics of a sinusoidal wave based on data in both graphical and numerical form
19. Interpret the motion of a sinusoidal wave and explain the superposition principle.
20. Calculate the resonant frequencies and wave lengths for both transverse and longitudinal waves given physical information about the situation
21. Apply the superposition principle to calculate positions of maximum destructive and constructive interference for waves
22. Calculate sound wave intensities and intensity levels given physical information about the situation
23. Calculate Doppler shifts and beat frequencies

B. Topical Outline

1. General/Measurement
   a. Units of measurement
   b. Change of units and compound units
2. Motion in One Dimension
   a. One-dimensional kinematics (position, velocity, acceleration)
   b. Average and instantaneous kinematics
   c. Relations between kinematic variables
   d. Special cases-constant velocity and constant acceleration
3. Vectors and Vector Operations
   a. Vectors and vector algebra
   b. Commutivity and associativity for addition and subtraction
   c. Resolution and vector components
   d. Multiplication by a scalar
   e. Vector operations and components
   f. Two vector scalar (dot) products and vector (cross) products
4. Motion in Two and Three Dimensions
   a. Position, velocity, and acceleration as vectors
   b. Two and three dimensional kinematics
   c. Projectile motion
   d. Uniform circular motion and centripetal acceleration
   e. Relative motion
5. Force and Motion
   a. Dynamics and Newton's Laws of motion
   b. Inertial mass
   c. Principle of linear superposition
   d. Applications of Newton's Laws (tension, friction, normal forces)
   e. Radial and tangential components of acceleration
6. Energy and Work
   a. Work-energy theorem
   b. Calculation of work done by different forces
   c. Applications of the work-energy theorem
   d. Conservative and non-conservative forces
   e. Power
   f. Conservative and non-conservative forces and potential energy
   g. Gravitational and spring potential energies
   h. Conservation of mechanical energy
   i. Applications of energy conservation
   j. Graphical representation of energy conservation

7. Systems of Particles
    a. Measurement and calculation the position of the center of mass
    b. Velocity and acceleration of the center of mass
    c. Relative motion-frames of reference
    d. Galilean transformation equations
    e. Review of Newton's Laws for macroscopic body motion
8. Impulse/Momentum
    a. Impulse-momentum theorem for one and two or more particles
    b. Conceptual meaning of impulse
    c. Net impulse, internal forces, and momentum conservation
    d. Vector momentum conservation
    e. Applications of momentum conservation
9. Collisions
    a. Elastic Collisions
    b. Inelastic Collisions
    c. Macroscopic motion and the center of mass
    d. Collisions in two dimensions
10. Rotation Kinematics
    a. Rotational kinematics and dynamics of a particle
    b. Simple applications of particle rotational dynamics
    c. Rotational dynamics for a rigid object
11. Rotational Dynamics
    a. Definition of moment of inertia, net external torque
    b. Applications of rotational dynamics
    c. Rotational kinetic energy and energy conservation
    d. Angular momentum conservation
12. Equilibrium and Elasticity
    a. Requirements for equilibrium
    b. Examples of equilibrium
    c. Elasticity of materials
    d. Stress-strain relationships
13. Oscillations
    a. Hooke’s Law and simple harmonic motion (SHM)
    b. Examples of SHM
    c. Damped and forced harmonic motion
14. Waves
    a. Waves and their mathematical description
    b. Speed of a string wave
    c. Sinusoidal waves and wave trains
    d. Superposition principle and standing waves
    e. Longitudinal and transverse waves
    f. Waves in two and three dimensions
    g. Interference of waves
    h. Intensity and intensity level
    i. Doppler shift and beat frequency

C. Methods of Evaluating Student:

Students will be evaluated using a combination of grades from homework, quizzes, tests, and labs.

Initiator	Date	Division Dean	Date
Sponsor	Date		