HAROLD WASHINGTON COLLEGE
MASTER SYLLABUS – COLLEGE CREDIT COURSE

1. TITLE, NUMBER, AND CLASSIFICATION:

Name of Course Engineering Physics I
Department Name Physical Science
Number Code 077
Course Number 0235

2. COURSE TERM: 16 Week Semester

3. CREDIT AND CONTACT HOURS:

(i) credit hours 4 (ii) contact hours per week 6 (iii) types of activities

X Lecture/Discussion
X Lab
Clinical/Work Experience
Other

4. PREREQUISITES - if none check here ; otherwise describe below:

Eligibility for English 101 and credit in Mathematics 207, or consent of the department chairperson.

5. CATALOG DESCRIPTION - write below, as in current college catalog;

Engineering Physics I: Mechanics and Wave Motion
Emphasizes methods of analysis of practical and theoretical problems in mechanics and wave motion involving use of elementary calculus. Primarily for students in engineering or the physical sciences. Writing assignments, appropriate to the discipline, are part of the course. 2 lecture and 4 lab hours per week

6. STUDENTS FOR WHOM THE COURSE IS INTENDED:

Those intending to transfer to four year schools with a major in engineering or a physical science.

7. COURSE OBJECTIVES:

The course is to cover:
kinematics, including vector treatment of motion in a plane;
dynamics in terms of Newton's laws of motion, including a conceptual understanding of these laws; Newton's law of gravity and circular orbits treated in the context of general circular motion;
conservation of momentum as following from Newton's third law;
conservation of energy, including energy diagrams, thermal energy developed by friction, work and power;
harmonic motion, including damped and driven oscillations, and resonance;
rotational motion, including rotational kinematics, rotational dynamics, torque and angular velocity as vectors, rotational kinetic energy in the context of conservation of energy, angular momentum and its conservation.

8. STUDENT LEARNING OUTCOMES

By means of written responses, drawing diagrams, and solving problems involving calculation, the student will demonstrate the ability to

draw and interpret motion diagrams; describe motion with vectors; use multiple representations of motion (vector diagrams, motion diagrams, graphs, equations); analyze, solve and interpret motion problems;

use the mathematics of position, velocity and acceleration describing motion along a line; represent motion graphically; use the text problem solving strategy to solve kinematics problems; describe free fall and motion along an inclined plane, and solve problems involving these types of motion;

describe and use the basic properties of vectors (magnitude, direction, components); decompose a vector into components, and use components to calculate magnitude and direction; add and subtract vectors, both graphically and using components;

define force in physical terms; describe the actions of the four fundamental forces; describe how contact forces arise from electrical interactions; identify the forces acting on a body and draw a free body diagram for it; describe the relation between the net force acting on a body, its velocity and its acceleration;

recognize and solve dynamic equilibrium problems along a line applying Newton's first law; recognize and solve dynamics problems along a line applying Newton's second law; describe the difference between mass and weight, and calculate apparent weight; solve dynamics problems involving friction and drag, including the use of coefficients of friction and drag coefficients;

solve problems involving general motion in a plane described in terms of vectors, and projectile motion. Demonstrate an understanding of the independence of perpendicular directions in projectile motion; solve problems involving relative velocity and acceleration;

solve dynamics problems involving uniform circular motion, including demonstration of knowledge of the magnitude and direction of the acceleration of a body in uniform circular motion; solve dynamics problems involving circular orbits; demonstrate an understanding of real and fictitious forces in circular motion, including apparent weight and the non-existence of centrifugal force.;

identify action-reaction pairs of forces on interacting bodies; solve dynamics problems involving action-reaction pairs of forces; solve dynamics problems involving tension and pulleys.

use Newton's law of gravity to calculate gravitational forces on bodies and the accelerations they cause; use Newton's law of gravity to solve dynamics problems involving circular orbits;

identify the interacting objects that comprise a closed system; apply the principle of conservation of momentum in one and two dimensions to collisions, explosive events and other interactions;

explain the meaning of the principle of conservation of energy; calculate kinetic energy, gravitational potential energy near Earth's surface, and the elastic potential energy stored in a spring; apply the principle of conservation of energy to problems involving kinetic energy and the above forms of potential energy;

calculate gravitational potential energy at large distances from gravitating bodies; apply the principle of conservation of energy to problems involving kinetic energy and gravitational potential energy at large distances; explain the meaning of escape velocity, and calculate the escape velocity of a body from any point in the vicinity of any number of gravitating bodies;

define and calculate the scalar product of vectors, using magnitudes or components; calculate the work done by a constant force in one or two dimensions, and by a variable force in one dimension; calculate power delivered in these cases; state in mathematical form the relationship between work and potential energy;

calculate thermal energy developed by frictional forces, either directly, using the magnitude of frictional force, or indirectly, using the principle of conservation of energy; apply the relation between work and energy to problems involving work and all forms of energy encountered previously;

use the definitions of angular position, velocity and acceleration, the relations between them, and their connections to linear velocity and acceleration to solve rotational kinematics problems; calculate the position of the center of mass of a collection of point masses, and identify the center of mass position of uniform symmetric bodies;

define and calculate torque, including torque due to gravity on an extended body; calculate moments of inertia of bodies consisting of point masses;

use the definitions of torque, moment of inertia and angular acceleration, and the dynamical equation that relates them, to solve problems in rotational dynamics; solve problems involving equilibrium of extended bodies;

calculate rotational kinetic energy, both for rotation about a fixed axis and rolling motion, and apply the principle of conservation of energy in problems including rotational motion; describe angular velocity, torque and particle angular momentum as vector quantities. Calculate the angular momentum of a rotating rigid body; use the principle of conservation of angular momentum to solve problems involving rotating bodies and particles with angular momentum.

describe simple harmonic motion, and identify the functions that give the displacement of a body in simple harmonic motion. Identify or be able to calculate the amplitude, period, angular frequency and frequency of a harmonic oscillator;

calculate position, velocity and acceleration at any time for a harmonic oscillator, and identify maximum values of displacement, speed and acceleration; given initial conditions for a harmonic oscillator, find the complete function that describes its motion, including amplitude, angular frequency and phase constant;

calculate the angular frequency for harmonic oscillation of a mass on a spring. Apply the principle of conservation of energy to problems involving motion of a mass on a spring; calculate the period of a simple pendulum and use it in problems involving pendulum motion;

given appropriate data, calculate the decreased amplitude of a damped oscillator at any time; describe resonance, and identify the resonant frequency of a force driving a harmonic oscillator.

Students will be required to demonstrate laboratory skills in a series of experiments by:

measuring quantities carefully and correctly, including units and uncertainties;
making calculations from data correctly, including uncertainties in results where required;
recording data and calculations in a clear and organized way, with notes that make their meanings clear;
carefully and correctly plotting required graphs, and obtaining quantitative results from them;
organizing data, calculations, graphs, results and additional written work to clarify them into a clear and literate report on the experiment.

9. TOPICAL COURSE OUTLINE:

Kinematics: motion diagrams; displacement, velocity and acceleration vectors
Kinematics: mathematical treatment of motion in one dimension
Kinematics: coordinate systems, vectors and their properties
Forces and Newton's Laws of Motion
Dynamics of motion in one dimension
Dynamics of motion in a plane
Dynamics of circular motion; Newton's law of gravity and circular orbits
Conservation of momentum
Forms of energy, conservation of energy, Newton's law of gravity and gravitational potential energy
Work and power, thermal energy
Rotational kinematics
Rotational dynamics
Equilibrium of a rigid body
Rotational kinetic energy and conservation of energy
Rolling motion
Vector description of rotational motion
Angular momentum and conservation of angular momentum
Simple harmonic motion

10. TEXTS AND MATERIALS USED: List of books and/or materials suggested for this course.

Knight, R. D., Physics for Scientists and Engineers with Modern Physics, vol. 1, Pearson/Addison Wesley, 2004
Physics 235 Laboratory Manual, written by the instructor and handed out in class

11. AMOUNT OF WRITING REQUIRED:

Ten reports on experiments, approximately three pages each

12. METHODS OF EVALUATION: (Direct and indirect)

Four examinations (75%), ten quizzes (10%), ten reports on experiments (15%)

13. AUTHORIZED SIGNATURE AND FILE DATE:
DEPARTMENT AND CAMPUS **Physical Science Department**
Harold Washington College

5/06