Miami Dade College

Course Description

PHY2053 | Physics (without Calculus) 1 | 3.00 credits

This course is the first in a two-part series intended for non-physics majors, offering an algebra and trigonometry approach to topics such as kinematics, dynamics, energy, momentum, rotational motion, fluid dynamics, oscillatory motion, and waves. The course fosters analytical and critical thinking skills to promote a scientific understanding of the real world. Student learning outcomes: students will solve analytical problems describing different types of motion, including translational, rotational, and simple harmonic motion using algebra and trigonometry; students will apply newton's laws, and conservation laws by using algebra and trigonometry to solve analytical problems of mechanics; students will identify and analyze relevant information presented in various formats such as graphs, tables, diagrams, and/or mathematical formulations; and students will solve real world problems using critical thinking skills and knowledge developed from this course. Prerequisite: MAC1114 or MAC1147; Corequisite PHY 2053L. Special fee**.**

Course Competencies:

Competency 1: The student will demonstrate knowledge, comprehension, application and synthesis of units and dimensions by:

1. Stating or recognizing the fundamental dimensions of mass, length, and time.
2. Expressing the dimensions of physical quantities in terms of these fundamental dimensions.
3. Evaluating the consistency of formulas through consideration of the dimensions involved.
4. Stating or recognizing the decimal pattern and prefixes used in the metric system.
5. Stating or recognizing the units of all the physical quantities discussed in this course.
6. Expressing the units of complex physical quantities discussed in this course in terms of simpler units.
7. Stating approximate measurements of ordinary objects using either SI or British units.
8. Converting between different units of measure.
9. Deriving the conversion factors for area and volume units from the related length conversion factors.

Competency 2: The student will demonstrate comprehension and application of scientific notation by:

1. Converting between scientific and standard notation.
2. Performing calculations with scientific notation.
3. Demonstrating comprehension and application of significant figures.
4. Keeping track of the proper number of significant figures when expressing values of physical quantities.
5. Performing mathematical operations.

Competency 3: The student will demonstrate knowledge, application, and analysis of the relationship between two directly proportional variables by:

1. Recognizing analytically or graphically when two quantities are in direct proportion.
2. Obtaining graphically or analytically the constant of proportionality between those quantities.
3. Calculating unknown values of directly proportional quantities using known values of those quantities.

Competency 4: The student will demonstrate knowledge, comprehension, application and evaluation of vectors by:

1. Stating or recognizing the definition of vector quantities.
2. Distinguishing between vectors an scalars.
3. Representing vectors graphically in polar coordinates in rectangular coordinates.
4. Converting between polar and rectangular representations of vectors.
5. Adding and subtracting vectors graphically and analytically.
6. Multiplying a vector times a scalar graphically and analytically.

Competency 5: The student will demonstrate knowledge, comprehension, and application analysis and evaluation of translational kinematics by:

1. Stating, recognizing and applying the definitions of the fundamental kinematics quantities -- position, displacement, distance, velocity, speed, and acceleration.

2. Distinguishing between the concepts of instantaneous and average change in general and as they apply to displacement, velocity, speed, acceleration and power.
3. Plotting position, displacement, velocity, or acceleration vs. Time graphs from given data.
4. Calculating instantaneous and average velocities from position or displacement vs. time graphs.
5. Calculating instantaneous and average accelerations from velocity vs. time graphs.
6. Calculating velocity changes from acceleration vs. time graphs.
7. Calculating displacements form velocity vs. time graphs.
8. Solving problems involving the kinematics (in one and two dimensions) of motion with constant speed motion with constant velocity motion with constant acceleration free-fall projectile motion uniformly circular motion.
9. Stating or recognizing the Galilean transformation.
10. Applying the Galilean transformation to solve relative motion problems.
11. Stating or recognizing the limitations in velocity imposed by the special theory of relativity.

Competency 6: The student will demonstrate knowledge, comprehension, application and evaluation of translational dynamics by:

1. Stating, recognizing and applying the definitions of force, mass and weight.
2. Distinguishing mass and weight.
3. Stating, recognizing and applying Newton's three laws of motion and law of universal gravitation.
4. Stating, recognizing and applying the definitions of the normal force, the tension exerted by a string, and the forces of static and kinetic friction.
5. Stating, recognizing and applying Hooke's law.
6. Solving problems involving forces and their effects by identifying the forces involved, drawing a free body diagram and applying Newton's laws.
7. Distinguishing between centripetal and centrifugal force.
8. Solving problems involving centripetal force.
9. Stating, recognizing and applying the definitions of work, kinetic energy, potential energy, and power.
10. Distinguishing between conservative and non-conservative forces.
11. Stating or recognizing the work-energy theorem and principle of conservation of energy.
12. Solving dynamics problems using work-energy methods.
13. Distinguishing between rest energy, total energy and kinetic energy using results from the special theory of relativity.
14. Stating, recognizing, and applying the definition of power.
15. Stating or recognizing the definition of momentum, and impulse.
16. Stating or recognizing the impulse-momentum theorem.
17. Stating or recognizing the principle of conservation of momentum.
18. Solving problems involving impact forces using the impulse- momentum theorem.
19. Solving collision, explosion, and propulsion problems using work- energy and momentum-impulse methods.

Competency 7: The student will demonstrate knowledge, comprehension, and application of rotational kinematics by:

1. Stating, recognizing, and applying the definition of the fundamental quantities of rotational kinematics -- angular displacement, angular speed, angular velocity and angular acceleration.
2. Stating, recognizing, and applying the relationship between the fundamental kinematic angular quantities and their translational counterparts.
3. Solving problems involving rotational kinematics.

Competency 8: The student will demonstrate knowledge, comprehension, application and evaluation of translational dynamics by:

1. Stating, recognizing, and applying the definition of the fundamental quantities of rotational dynamics -- moment of inertia, torque, rotational kinetic energy, and angular momentum.
2. Stating or recognizing the relationships between torque and angular acceleration and solving rotational dynamics problems using these relationships.

3. Solving rolling motion problems using rotational kinetic energy and the conservation of energy principle.
4. Stating or recognizing the principle of conservation of angular momentum and the conditions for its applicability.
5. Solving problems involving the conservation of angular momentum.
6. Stating or recognizing the relationship of angular momentum to Kepler's second law of planetary option.
7. Stating or recognizing the role of angular momentum in the quantum theory of the hydrogen atom.
8. Stating or recognizing the conditions for rotational and translational equilibrium.
9. Solving statics problems involving rotational and translational equilibrium.

Competency 9: The student will demonstrate knowledge, comprehension, and application of elasticity by:

1. Stating, recognizing, and applying definition of stress and strain.
2. Stating, recognizing, and applying the definition of Young's modulus, shear modulus, and bulk modulus.

Competency 10: The student will demonstrate knowledge, comprehension, and application of fluid statics by:

1. Stating or recognizing the definition of a fluid.
2. Stating, recognizing, and applying the definition of density and pressure.
3. Stating or recognizing the basic principles of fluid statics --Pascal's principle and Archimedes principle.
4. Stating or recognizing the relationship between the buoyant force and the variation of pressure with depth in a fluid.
5. Solving problems involving pressure and buoyant force.

Competency 11: The student will demonstrate knowledge, comprehension, and application of fluid dynamics by:

1. Stating or recognizing the conditions for ideal fluid flow.
2. Stating, recognizing, and applying the definition of flow rate.
3. Stating or recognizing the basic principles of fluid dynamics --the equations of continuity and Bernoulli's principle.
4. Solving problems involving the equation of continuity and Bernoulli's principle.

Competency 12: The student will demonstrate knowledge, comprehension, application and evaluation of simple harmonic motion by:

1. Stating or recognizing the definition of simple harmonic motion and the conditions under which it occurs.
2. Stating, recognizing, and applying the definitions of period, amplitude, frequency, and phase as they relate to simple harmonic motion.
3. Stating or recognizing the conditions under which a simple pendulum executes simple harmonic motion.
4. Stating, recognizing, and applying the equations for the period of a simple pendulum and a simple harmonic oscillator.
5. Solving simple harmonic motion problems using energy principles.
6. Distinguishing between natural and forced oscillations.
7. Distinguishing between damped and undamped oscillations.
8. Stating or recognizing the concept of resonance.

Competency 13: The student will demonstrate knowledge, comprehension, application and evaluation of wave motion by:

1. Stating or recognizing the definition of a wave.
2. Distinguishing between transverse and longitudinal waves.
3. Stating or recognizing the concepts of period, frequency and amplitude as they apply to waves.
4. Stating, recognizing, and applying the principle of superposition as it applies to waves.
5. Distinguishing between constructive and destructive interference.
6. Stating or recognizing how waves transport energy and momentum.
7. Distinguishing between amplitude and intensity.
8. Solving problems involving the relationship between amplitude and intensity and energy transport.
9. Stating or recognizing the following wave phenomena: Interference The Doppler effect The beat phenomenon.

Competency 14: The student will demonstrate knowledge, comprehension, and application of sound by:

1. Stating or recognizing the definition of a sound wave.
2. Stating or recognizing the relationship between the physical properties of a medium and the speed of sound in that medium.
3. Stating or recognizing the concepts of wave motion as they relate to sound.
4. Stating or recognizing the relationship between frequency, wavelength, pitch and timbre.
5. Solving problems involving the decibel scale of sound intensity.
6. Stating or recognizing details of the production of sound by strings and pipes.
7. Solving problems involving interference, the Doppler effect and the brat phenomenon as they apply to sound waves.

Competency 15: The student will demonstrate knowledge, comprehension, and application of temperature and kinetic theory by:

1. Stating or recognizing the definition of temperature.
2. Describing the operation of the mercury thermometer.
3. Stating or recognizing the Celsius, Fahrenheit, and Kelvin temperature scales.
4. Converting between the different temperature scales.
5. Stating or recognizing the law of thermal expansion of materials in its linear, area, and volume form.
6. Stating or recognizing the conditions under which a gas is an ideal gas.
7. Stating or recognizing the equation of state of ideal gases.
8. Describing the operation of the constant volume ideal gas thermometer.
9. Stating or recognizing the relationship between molecules and moles.
10. Solving problems involving the equations of state.
11. Solving problems involving the relationship of temperature and pressure and molecular motion in ideal gases.

Competency 16: The student will demonstrate knowledge, comprehension, application and evaluation of the theory of heat by:

1. Stating or recognizing the definition of heat.
2. Stating or recognizing the definition of the internal energy of an ideal gas.
3. Distinguishing between heat, temperature and internal energy.
4. Stating or recognizing the definition of heat capacity.
5. Solving problems involving heat capacity and the mixture of substance at different temperatures.
6. Stating or recognizing the definition of latent heat.
7. Solving problems involving changes in the state of substances.
8. Stating or recognizing the definition of heat transfer by conduction, convection, and radiation.
9. Distinguishing between heat transfer by conduction, by convection and by radiation.
10. Solving problems involving heat transfer by conduction.

Competency 17: The student will demonstrate knowledge, comprehension, application and evaluation of thermodynamics by:

1. Stating or recognizing the definition of a thermodynamic process.
2. Stating or recognizing the definition isobaric, isothermal, adiabatic, and isochoric processes.
3. Distinguishing between reversible and irreversible processes.
4. Stating or recognizing the definition of a heat engine.
5. Relating the concept of heat, work, and internal energy to thermodynamic processes and heat engines.
6. Stating or recognizing the first and second law of thermodynamics.
7. Stating or recognizing the definition of efficiency as it applies to heat engines.
8. Solving problems involving simple processes and heat engines by applying the first and second law of thermodynamics.
9. Applying the laws of thermodynamics to the Carnot cycle.
10. Calculating the efficiency of engines operating in a Carnot cycle.

11. Relating the maximum possible efficiency of heat engines to the second law of thermodynamics, reversibility, and entropy, and to the Carnot cycle.
12. Stating or recognizing the definition of entropy.
13. Calculating the entropy change of simple thermodynamic processes.
14. Relating reversibility to entropy.
15. Relating order and disorder to entropy.

Learning Outcomes:

- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information
- Use quantitative analytical skills to evaluate and process numerical data