COURSE NUMBER: PH1101

COURSE TITLE: Physics

COURSE DESCRIPTION:

This is a second semester course designed to extend the students' knowledge and understanding of basic Physics principles, concepts and applications relating to kinetic theory, heat, vibrations, sound and light. It also extends abilities in data handling, problem solving and experimentation.

PREREQUISITES: MA1700 – Mathematics
PH1100 – Physics

CO-REQUISITES: None

CREDIT VALUE: Four (4)

COURSE HOURS PER WEEK: Three (3)

LAB HOURS PER WEEK: Two (2)

SUGGESTED TEXT:

Cutnell, J.D., & Johnson, K.W.(2012). *Physics* (9th ed.).New Jersey: Wiley & Sons. ISBN-13: 9780470879528.
and

College of the North Atlantic (Current edition). *Physics laboratory manual.*

or

Walker, J.S. (2009). *Physics with MasteringPhysics* (4th ed.). Addison Wesley. ISBN-13: 978-0132558823 (ebook created for College of the North Atlantic)
or

Wilson, J.D., Buffa, A.J., & Lou, B. (2010). *College physics with MasteringPhysics* (7th ed.). Addison-Wesley. ISBN-10: 0321571118; ISBN-13: 9780321571113
or

Giancoli, D. (2005). *Physics: Principles with applications* (6th ed.). Prentice Hall. ISBN-10: 0-13-060620-0; ISBN-13: 9780130606204

LEARNING RESOURCES: To be determined by instructor

MAJOR TOPICS:

1.0 Properties of Materials
2.0 Fluid Mechanics
3.0 Vibrations and Wave Motion
4.0 Sound
5.0 Kinetic Theory
6.0 Heat and Heat Transfer
7.0 Light

LEARNING OBJECTIVES:

1.0 Properties of Materials

1.1 Elasticity: Stress and Strain
- 1.1.1 Explain the origin of elasticity in matter
- 1.1.2 Define stress and strain
- 1.1.3 State Hooke's Law
- 1.1.4 Explain Young's modulus, Bulk modulus, Shear modulus
- 1.1.5 Solve problems involving stress and strain as they relate to the deformation of a body

2.0 Fluid Mechanics

2.1 Density and Specific Gravity
- 2.2.1 Distinguish between density and specific gravity
- 2.2.2 Calculate the density of a substance in kg/m^3
- 2.2.3 Given the density or specific gravity of a substance, calculate the other quantity

2.2 Pressure in Fluids
- 2.2.1 Calculate pressure as a function of depth in a fluid of known density

2.3 Atmospheric Pressure and Gauge Pressure
- 2.3.1 Distinguish between gauge pressure and absolute pressure
- 2.3.2 Calculate the absolute pressure, given a gauge pressure

2.4 Pascal's Principle
- 2.4.1 State Pascal's Principle
- 2.4.2 Solve simple problems involving Pascal's Principle

2.5 Measurement of Pressure: Gauges and the Barometer
- 2.5.1 Describe the use of the open manometer and mercury barometer

2.6 Buoyancy and Archimedes' Principle
- 2.6.1 Define Buoyancy

2.6.2 State Archimedes' Principle
2.6.3 Calculate the buoyant force on an object immersed in a fluid

2.7 Fluid Dynamics
2.7.1 State Bernoulli's Principle
2.7.2 Apply the work-energy equation to a fluid system to yield the Bernoulli equation
2.7.3 Examine some applications of Bernoulli's Principle in everyday life
2.7.4 Discuss Torricelli's Theorem
2.7.5 Calculate the pressure changes in fluids flowing through closed systems of varying geometry
2.7.6 Calculate the flow rate of a fluid through a pipe of known diameter and length, given the pressure difference between ends of the pipe

3.0 Vibrations and Wave Motion

3.1 Rotational Kinetics
3.1.1 Calculate angular displacement
3.1.2 Define angular velocity and solve problems
3.1.3 Define uniform angular acceleration and solve problems involving angular displacement, angular velocity and angular acceleration

3.2 Simple Harmonic Motion
3.2.1 Define simple harmonic motion (SHM)
3.2.2 Recognize the conditions necessary to produce simple harmonic motion
3.2.3 Explain the terms:
3.2.3.1 amplitude
3.2.3.2 frequency
3.2.3.3 period

3.2.4 Calculate the period and frequency of a simple harmonic oscillator (pendulum and masson spring)
3.2.5 Calculate the energy involved in SHM from the values of the spring constant and the maximum amplitude

3.3 Damped Harmonic Motion
3.3.1 Describe damped harmonic motion

3.4 Forced Vibration-Resonance
3.4.1 Describe the conditions necessary for resonance
3.3.2 List some effects of resonance

3.5 Mechanical Waves
3.5.1 Describe the production of mechanical waves
3.5.2 List properties of mechanical waves
3.5.3 Define wavelength, frequency

3.5.4 Classify mechanical waves as either:
3.5.4.1 transverse
3.5.4.2 longitudinal

3.5.5 Identify sinusoidal wave form
3.5.6 Calculate the speed of a wave given wave length and frequency

3.6 Speed of Wave Propagation
3.6.1 Calculate the speed of a transverse wave on a string given the tension and the linear density for the string
3.6.2 Calculate the speed of a longitudinal wave given the elastic modulus and density of the substance

3.7 Reflection of a Wave and Superposition
3.7.1 Define pulse
3.7.2 Discuss reflection, refraction and diffraction
3.7.3 Describe wave behaviour at the ends of the medium, fixed and free and at the boundary of a medium of different density
3.7.4 State the principle of superposition
3.7.5 Explain how constructive and destructive interference occurs

3.8 Standing Waves on a String
3.8.1 Discuss the conditions that produce standing wave patterns
3.8.2 Identify the location of nodes and antinodes
3.8.3 Show on a diagram, modes of vibration:
3.8.3.1 fundamental mode
3.8.3.2 first overtone, second harmonic
38.3.3 second and third overtones

3.8.4 Calculate the location of nodes for standing waves given the speed of propagation and the geometry of the medium
3.8.5 Calculate the frequencies of the fundamental mode and overtones for standing waves on a string

4.0 Sound

4.1 Nature of Sound
4.1.1 Define Sound:
4.1.1.1 psychologically
4.1.1.2 physically

4.1.2 Calculate the speed of sound in air given its temperature
4.1.3 Discuss the effect of frequency on the sound we hear
4.1.4 State the frequency range of human hearing
4.1.5 Calculate the sound intensity level in decibels, given the intensity in W/m^2
4.1.6 Calculate the intensity and intensity level at a distance from the source

4.1.7 Describe how sound intensity level determines loudness
4.1.8 Define threshold of hearing and threshold of pain
4.1.9 Discuss the sound intensity level vs. frequency graph (Loudness curve)

4.2 Standing Longitudinal Waves
4.2.1 Discuss conditions that produce longitudinal standing wave patterns in closed and open tubes
4.2.2 Identify location of nodes and antinodes
4.2.3 Show on a diagram, modes of vibration for a closed and open tube
4.2.4 Calculate the position of nodes for longitudinal standing waves in closed and open tubes given the speed of the wave and the geometry of the tube
4.2.5 Calculate the frequencies of the fundamental mode and overtones for standing waves in air columns

4.3 Beats
4.3.1 Discuss conditions that produce beats
4.3.2 Given two frequencies, calculate the beat frequency that results

4.4 Doppler Effect
4.4.1 Demonstrate the Doppler Effect
4.4.2 Calculate the Doppler shift of frequency, given the velocities of the source and observer and the frequency of the source

4.5 Shock Waves and Sonic Boom
4.5.1 Explain how shock waves are produced
4.5.2 Describe sonic boom and its effect

5.0 Kinetic Theory

5.1 Kinetic Theory of Matter
5.1.1 Describe the kinetic theory of gases
5.1.2 List and describe the three phases of matter on the basis of kinetic theory
5.1.3 Discuss temperature as a measure of molecular motion
5.1.4 Describe how physical changes in matter can be the basis for constructing a thermometer
5.1.5 Compare the three different temperature scales - Celsius, Kelvin and Fahrenheit
5.1.6 Convert readings between the three different temperature scales

5.2 Thermal Expansion
5.2.1 Explain expansion of materials as a result of heating
5.2.2 Calculate the changes in length (area and volume) of a solid given the appropriate coefficient and temperature change
5.2.3 Calculate the volume expansion of a liquid given the initial volume and the temperature change

5.3 Gas Laws
- 5.3.1 State Boyle's Law
- 5.3.2 Solve problems involving absolute pressure and volume of an enclosed gas given that temperature and mass are kept constant
- 5.3.3 State Charles's Law
- 5.3.4 Solve problems involving volume and absolute temperature given that the absolute pressure and mass are kept constant
- 5.3.5 State Gay-Lussac's Law
- 5.3.6 Solve problems involving absolute pressure and absolute temperature given that the volume and mass are kept constant
- 5.3.7 State the relationship called the "equation of state"
- 5.3.8 Solve problems involving the simultaneous change of pressure, volume and temperature of an enclosed gas
- 5.3.9 State the ideal gas law
- 5.3.10 Calculate the pressure, volume, temperature, or mass of a gas for which three of these variables are given

6.0 Heat and Heat Transfer

6.1 Internal Energy and Heat
- 6.1.1 Discuss the historical development of a theory of heat, particularly the caloric theory
- 6.1.2 Define heat units:
  - 6.1.2.1 calorie
  - 6.1.2.2 Joule
  - 6.1.2.3 B.T.U.
- 6.1.3 Define and discuss the mechanical equivalent of heat J=W/Q
- 6.1.4 Discuss the modern theory of heat
- 6.1.5 Distinguish between internal energy, heat and temperature

6.2 Specific Heat Capacity
- 6.2.1 Define specific Heat Capacity
- 6.2.2 Perform calculations involving the amount of heat required to produce a temperature change in a given material

6.3 Calorimetry
- 6.3.1 Develop an understanding of the law of mixtures
- 6.3.2 Formulate and execute calculations of calorimetry where heat is exchanged between two or more thermally confined substances

6.4 Change of Phase: Latent Heat
- 6.4.1 Define melting point, boiling point
- 6.4.2 Explain change of phase in terms of motion of molecules
- 6.4.3 Define latent heat of fusion
- 6.4.4 Perform calculations involving latent heat of fusion

6.4.5 Define latent heat of vaporization
6.4.6 Perform calculations involving latent heat of vaporization
6.4.7 Discuss the heating curve for water

6.5 Conduction
6.5.1 Define conduction
6.5.2 Describe how heat is transferred by conduction
6.5.3 Define thermal conductivity
6.5.4 Calculate the heat flow through a single layer

6.6 Convection
6.6.1 Describe the process of heat transfer known as convection

6.7 Radiation
6.7.1 Describe the process of heat transfer known as radiation
6.7.2 Using Stefan's law, calculate the amount of heat energy radiated or absorbed by an object
6.7.3 Calculate the net heat loss or gain by an object having emissivity, and maintained at a temperature T relative to the surrounding temperature

7.0 Light

7.1 Electromagnetic Waves
7.1.1 Describe how electromagnetic waves are produced
7.1.2 Classify electromagnetic waves in an electromagnetic spectrum
7.1.3 Identify the frequencies and wavelengths of the region in the spectrum that produces light
7.1.4 Calculate frequency, wavelength, or the speed of propagation from any two of the three

7.2 Reflection
7.2.1 State the laws of reflection
7.2.2 Construct a ray diagram showing the formation of an image and its location by a plane mirror

7.3 Refraction
7.3.1 Define refractive index
7.3.2 Calculate the speed of light in a material given its refractive index or vice versa
7.3.3 State Snell's Law
7.3.4 Calculate the change in direction of travel of a light ray at the boundary between two transparent materials of known refractive indices
7.3.5 Define critical angle
7.3.6 Calculate the critical angle for light travelling from an optically dense material to one of lesser density
7.3.7 Explain the condition that produces total internal reflection

7.3.8 Explain the application of total internal reflection to fibre optics
7.3.9 Describe dispersion of light by a prism and raindrops

7.4 Spherical Mirrors
7.4.1 Define the terms:
7.4.1.1 center of curvature
7.4.1.2 focal length
7.4.1.3 concave mirror
7.4.1.4 convex mirror
7.4.1.5 real image
7.4.1.6 virtual image

7.4.2 Draw ray diagrams to describe the appearance of an image given the size and location of the object
7.4.3 Calculate the position of an image, given the position of the object and the geometry of the mirror
7.4.4 Calculate the magnification of a spherical mirror given its geometry and the position of the object

7.5 Lenses and Optical Instruments
7.5.1 Identify types of lenses
7.5.2 Construct three rays from an object through a lens and beyond
7.5.3 Locate the image of a given object formed by a single lens of known focal length by the use of ray diagrams
7.5.4 Calculate the position and size of an image of an object formed by a single lens of known focal length
7.5.5 Determine the focal length of a lens given the object and image distance from the lens
7.5.6 Determine the magnification of a single lens
7.5.7 Calculate the focal length of a simple lens given the refractive index of the substance and the geometry of the lens
7.5.8 Illustrate the basic structure of magnifiers and cameras as single lens applications
7.5.9 Show how combinations of lenses can make:
7.5.9.1 microscopes
7.5.9.2 telescopes

7.5.10 Identify and describe lens aberrations:
7.5.10.1 spherical
7.5.10.2 chromatic

7.6 Physical Optics
7.6.1 Describe the cause of the pattern produced by light passing through a double slit
7.6.2 Calculate the bright and dark fringe position of double-slit interference
7.6.3 Explain the nature of polarized light

EVALUATION:

Laboratory Reports:	10%
Assignments:	10%
In-Class Quizzes:	30%
Final Exam:	50%

If a student misses a laboratory session *without a valid documented reason***, a mark of 0 for that lab will be assigned. In order to be eligible to write the final examination (including a supplementary final examination) and pass the course, students must pass (minimum of 50%) the essential laboratory component of the course. A student who misses more than 3 labs without valid documentation will be required to drop the course. Please note that dropping the course without academic prejudice must be done within established College processes and time frames.
** What would be considered as a "valid documented reason" will be at the discretion of the campus administrator in consultation with the faculty responsible for this course.

DATE DEVELOPED: February 21, 1996 **DATE REVIEWED:** February 2014

REVISION NUMBER: 1 **DATE REVISED:** July 2012

Note to instructor: Check PIRS to ensure this outline is the most current version.