FE1011/PH1011 Physics

[Lectures: 26 hours (2 hours/week); Tutorial: 12 hours (1 hour/week); Pre-requisites: JC physics; Vector algebra; Basic trigonometry and calculus; Academic Unit: 3.0]

Learning Objective

This course will reinforce students' understanding of physics from A-level. It will encourage critical thinking by emphasizing on reasoning, understanding the relationship between concepts and seeing the relevance of physics to everyday life. It will teach strategies for problem solving that can be applied to real world situations. After the study, students will be equipped with the basic knowledge for further study in the broad field of engineering.

Content

1. VECTORS
2. KINEMATICS
3. FORCES AND TORQUES
4. NEWTON'S LAWS OF MOTION
5. IMPULSE AND MOMENTUM
6. WORK AND ENERGY
7. THERMAL PHYSICS
8. ELECTRIC FIELD
9. MAGNETIC FIELD
10. MOTION OF CHARGED PARTICLES AND APPLICATIONS
11. CIRCUITS

Course Outline

1. VECTORS
Basic properties of vectors. Addition and subtraction of vectors both graphically and using components. Unit vectors. Differentiating vectors.

2. KINEMATICS
Coordinate systems and frames of reference. Relationships between position, displacement, velocity and acceleration. Verbal, pictorial, graphical and algebraic representations of kinematic information. Free fall motion in one and two dimensions. Basic ideas of circular motion.

3. FORCES AND TORQUES
What is a force? Types of force, including resistive forces and constraint forces. Vector properties of forces. Free body diagram. Resultant force. Equilibrium of rigid bodies. Concept of weight and centre of gravity. Turning effects of forces. Elastic properties of solids.

4. NEWTON'S LAWS OF MOTION
Relationship between force, mass and motion. Strategy for solving force and motion problems using Newton's Second Law. Newton's Third Law. Newton's laws for rotational motion.

5. IMPULSE AND MOMENTUM
Momentum as a state of motion. Impulse as an action of a force over time. The Momentum Principle. Isolated system and conservation of momentum. Example applications.

6. WORK AND ENERGY
Concept of work. Work and kinetic energy theorem. Conservative forces and potential energy. Transformations between kinetic, potential and thermal energy.

7. THERMAL PHYSICS
Zeroth law of thermodynamics. Temperature and thermal expansion. Kinetic theory of gases. Ideal gas law. *pV*-diagrams. First law of thermodynamics.

8. ELECTRIC FIELD
Nature of electric fields. Coulomb law and Gauss' law. Relationship between Gauss law and Coulomb's law. Potential difference and electric potential energy. Relationship between electric field and electric potential. Electric field and electrical potential due to different charge distributions.

9. MAGNETIC FIELD
Nature of magnetic fields. Difference between electric and magnetic fields. Gauss' law in magnetism. Biot-Savart law. Ampere's law. Magnetic flux. Faraday's law. Lenz's law. Displacement current. Ampere-Maxwell law. Induced electric fields. Eddy currents.

10. MOTION OF CHARGED PARTICLES AND APPLICATIONS
Electric current, conduction and resistance. Magnetic force on electric charges and currents. Motion of a charged particle in a magnetic field. Hall effects.

11. CIRCUITS
Ohm’s law. DC circuit. Capacitance and dielectrics. Energy stored in charged capacitors. AC circuit.

Learning Outcome
Upon successful completion of the course, students will be able to:

- Analyze the kinematics of a particle in order to predict its motion in standard 1-D and 2-D coordinate systems.
- Set up and solve vector equations for velocities and accelerations of simple motion of particles.
- Understand the concepts of forces and torques; Be able to solve equilibrium problems of rigid bodies.
- Understand the Newton’s laws; Be able to solve motion problems using Newton’s laws.
- Apply strategy for solving particle kinetic problems using the work and energy principle and the impulse and momentum principle.
- Understand basic thermodynamic laws and principles and use them for analysing simple engineering problems.
- Understand the basic concepts on topics related to electrical and magnetic fields, Ohm’s Law, charged particle motion, and basic electrical circuit components.

- Undertake more advanced study in mechanical, electrical or civil engineering in the following semesters.

Textbooks/References

1. Physics for Scientists and Engineers, 8th Edition
   R A Serway, J W Jewett Jr
   Brooks Cole
2. College Physics: A Strategic Approach
3. Randall D. Knight, Brian Jones, Stuart Field
   Addison Wesley