Department of Electrical and Electronic Engineering
Bangladesh University of Engineering and Technology

COURSE OUTLINE
Course No: PHY 165
Level 1/ Term 2
Credit (Contact) Hours: 3.0

PART A: General Information

Description of Course PHY 165

1	**Course Title**	: Electricity and Magnetism, Modern Physics and Mechanics
2	**Type of Course**	: Non-departmental course
3	**Offered to**	: Department of Electrical and Electronic Engineering
4	**Pre-requisite Course(s)**	: N/A

PART B: Course Details

1. Course Content (As approved by the Academic Council)

Electricity and magnetism: Electric charge and Coulomb's Law, Electric field, Concept of electric flux and the gauss's Law - some applications of gauss's Law, Gauss's Law in vector form, Electric potential, Relation between electric field and electric potential, Capacitance and dielectrics, Gradient, Laplace's and Poisson's equations, Current, Current density, Resistivity, The magnetic field, Ampere's Law, Biot-savart Law and their applications, Laws of electromagnetic induction- Maxwell's equations.
Modern Physics: Michelson-Morley's experiment, Galilean transformation, Special theory of relativity and its consequences; Quantum theory of radiation; Photo-electric effect, Compton effect, Wave particle duality, Interpretation of Bohr's postulates, Radioactive disintegration, Properties of nucleus, Nuclear reactions, Fission, Fusion, Chain reaction, Nuclear reactor.
Mechanics: Linear momentum of a particle, Linear momentum of a system of particles, Conservation of linear momentum, Some applications of the momentum principle; Angular momentum of a particle, Angular momentum of a system of particles, Kepler's Law of planetary motion, The Law of universal gravitation, The motion of planets and satellites, Introductory quantum mechanics; Wave function, Uncertainty principle, Postulates, Schrodinger time independent equation, Expectation value, Probability, Particle in a zero potential, Calculation of energy.

2. Course Objectives

Objective 1: To develop logical and critical thinking with scientific knowledge of electricity & magnetism, modern physics and mechanics required for the students of electrical and electronic engineering.

Objective 2: To understand the different laws of physics associated with electricity & magnetism, modern physics and mechanics, and apply them to solve the real life problems.

3. Knowledge required

Insert previous knowledge requirements: N/A

4. Course Outcomes

CO No.	CO Statement At the end of the course, a student should be able to	Corresponding PO(s)*	Domains and Taxonomy level(s)**	Delivery Method(s) and Activity(-ies)	Assessment Tool(s)
CO1	Describe the basic laws of physics related to electricity & magnetism, modern physics and mechanics to express different phenomena in the physical world.	PO 1	C1	e.g., Lectures, Homework	e.g., Written exams; viva voce; presentation; assignment
CO2	Explain the fundamental concepts and theories of electricity & magnetism, modern physics and mechanics applicable for different physical conditions.	PO 2	C2	e.g., Lectures, Homework	e.g., Written exams; viva voce; presentation; assignment

CO3	Apply the relevant laws of physics to solve various mathematical problems and interpret the result and its consequences.	PO 3	C3, C4	e.g., Lectures, Homework	e.g., Written exams; viva voce; presentation; assignment

***POs**
PO 1: Engineering knowledge; PO 2: Problem analysis; PO 3: Design/development of solutions; PO 4: Investigation; PO 5: Modern tool use; PO 6: Engineer and society; PO 7: Environment and sustainability; PO 8: Ethics; PO 9: Individual work and teamwork; PO 10: Communication; PO 11: Project management and finance; PO 12: life-long learning
****Domains**
C-Cognitive : C1: Knowledge; C2: Comprehension; C3: Application; C4: Analysis; C5: Synthesis; C6: Evaluation
A-Affective : A1: Receiving; A2: Responding; A3: Valuing; A4: Organizing; A5: Characterizing
P-Psychomotor: P1: Perception; P2: Set; P3: Guided Response; P4: Mechanism; P5: Complex Overt Response; P6: Adaptation; P7: Organization

5. Lecture Plan

wk	Lecture Topics	Corresponding CO(s)
1	• Electric charge, Coulomb's law, electric field, electric field lines, electric field due to a point charge, electric dipole, line of charge and charged disk, movement of charge in an electric field • Frame of reference, Failure of Newtonian mechanics, Galilean transformation, Concept of ether • Linear momentum of a particle, Linear momentum of a system of particles, Conservation of linear momentum, Some applications of the momentum principle	CO1, CO2
2	• Flux - Gauss' Law - Application of Gauss' Law: Cylindrical, spherical and planar symmetry • Michelson-Morley experiment, consequence of Michelson-Morley experiment • Angular momentum of a particle, Angular momentum of a system of particles, Kepler's Law of planetary motion	CO1, CO2, CO3
3	• Electric potential energy and electric potential, Equipotential surface, Calculating potential from the field • Derivation of Lorentz transformation equations, relativity of length, time and mass • The Law of universal gravitation, The motion of planets and satellites	CO1, CO2, CO3
4	• Potential due to a point charge and a group of point charges, Potential due to continuous charge distribution, Conductors in electrostatic equilibrium • Mass-Energy relation, relativistic addition of velocities, relativity of simultaneity • Introductory quantum mechanics Wave function, Schrodinger equation	CO1, CO2, CO3
5	• Capacitance - Capacitors in series and in parallel - Energy stored in an electric field - Capacitors with dielectric • Class Test (Modern Physics) • Postulates of quantum mechanics, probability density, normalization of wave function, mathematical problem	CO1, CO2, CO3
6	• Class Test (Electricity and Magnetism) • Theory of light, Planck's quantum theory, photo-electric effect, characteristics (laws) of photoelectric emission • Mathematical Problem on Normalization of wave function	CO1, CO2, CO3
7	• Electric current, resistance and Ohm's law - Resistors in series and parallel - Power in electric circuits - Kirchhoff's laws and solving circuits - RC circuits • Failure of wave theory of light to explain photoelectric effect, Einstein photoelectric equation, determination of Planck's constant, light-matter interaction, applications of photo-electric effect • Expectation values, quantum mechanical operator, mathematical problem	CO1, CO2, CO3

8	• Magnetic fields, Hall effect, Biot-savart law, torque on a current loop, magnetic dipole moment • Compton effect, Compton theory, Wave particle duality/de-Broglie hypothesis, Determination of de-Broglie wavelength • Time independent Schrodinger equation, stationary states	CO1, CO2, CO3
9	• Magnetic field due to a current, force between two parallel currents, ampere's law, solenoid • Limitation of Rutherford's atom model, postulates of the Bohr atomic model, limitation of Bohr's atom model, de-Broglie atom model • Class Test (Quantum Mechanics)	CO1, CO2, CO3
10	• Faraday's law of induction, Lenz's law, induction and energy transfer, induced electric field • Properties of nucleus: static nuclear properties and dynamic properties, mass defect, binding energy, binding energy per nucleon, nuclear force • Properties of stationary states and mathematical problem	CO1, CO2, CO3
11	• Inductors and inductance, self-induction, energy stored in a magnetic field, mutual induction, LR circuit • Nuclear chain reactions, Different condition for nuclear chain reactions, Nuclear fission, Nuclear fusion, Little Boy: A gun-type bomb, Fat Man: Implosion-type bomb • Particle in an infinite square well potential: wave function and energy	CO1, CO2, CO3
12	• Magnetic properties of matter, types of magnetic materials, application of magnetic materials • Nuclear power reactor, different parts of nuclear fission reactor, types of fission reactor, nuclear fusion reactor, types of fusion reactor • Mathematical problem on infinite square well potential	CO1, CO2, CO3
13	• Hysteresis curve; electromagnetic oscillation: L-C oscillations and its analogy to simple harmonic motion. • Difficulties against using nuclear fusion, nuclear models, the liquid drop model, semi-empirical mass formula • Particle in a zero potential: wave function and energy	CO1, CO2, CO3
14	• Mathematical problems related to magnetic field and magnetism • The shell model, radioactivity, radioactive transformation, decay law, average life period of a radioelement • Mathematical problems related to zero potential	CO1, CO2, CO3

6. Assessment Strategy

- Class Participation: Class participation and attendance will be recorded in every class.
- Continuous Assessment: Continuous assessment any of the activities such as quizzes, assignment, presentation, etc. The scheme of the continuous assessment for the course will be declared on the first day of classes.
- Final Examination: A comprehensive term final examination will be held at the end of the Term following the guideline of academic Council.

7. Distribution of Marks

Class Participation	10%
Continuous Assessment	20%
Final Examination	70%
Total	100%

8. Textbook/ Reference

1. Fundamentals of Physics (10th Edition), D. Halliday, R. Resnick, and J. Walker
2. Concepts of Modern Physics (6th edition); A. Beiser.
3. Quantum Mechanics, (2nd Edition), David J. Griffith
4. Physics for Engineers -Part-2; Giasuddin Ahmad

Prepared by:		
Name: Course Teacher Signature:	Name: Course Teacher Signature:	Name: Course Teacher Signature:
Date of Preparation: 29 May, 2022		
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