Department of Industrial and Production Engineering
Bangladesh University of Engineering and Technology

COURSE OUTLINE
Course No: PHY 117
Level 1/ Term 1
Credit (Contact) Hours: 3.0

PART A: General Information

Description of Course PHY 117

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

PART B: Course Details

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

Structure of Matter: Crystalline and non-crystalline solids, Single crystal and polycrystal solids, Unit cell, Crystal systems, Co-ordinations number, Crystal planes and directions, NaCl and CsCl structure, Packing factor, Miller indices, Relation between interplanar spacing and Miller indices, Bragg's Law, Methods of determination of interplanar spacing from diffraction patterns; Defects in solids: Point defects, Line defects; Bonds in solids, Interatomic distances, Calculation of cohesive and bonding energy; Introduction to band theory: Distinction between metal, Semiconductor and insulator.

Electricity and Magnetism: Coulomb's Law, Electric field (E), Gauss's Law and its application, Electric potential (V), Capacitors and capacitance, Capacitors with dielectrics, Dielectrics an atomic view, Charging and discharging of a capacitor, Ohm's Law, Kirchoff's Law; Magnetic field: Magnetic induction, Magnetic force on a current carrying conductor, Torque on a current carrying loop, Hall effect, Faradays Law of electromagnetic induction, Lenz's Law, Self induction, Mutual induction; Magnetic properties of matter; Hysteresis curve; Electromagnetic oscillation: L-C oscillations and its analogy to simple harmonic motion.

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.

2. Course Objectives

Objective 1: To develop logical and critical thinking with scientific knowledge of structure of matter, electricity & magnetism and modern physics required for the students of industrial and production engineering.

Objective 2: To understand the different laws of physics associated with structure of matter, electricity & magnetism and modern physics, 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 structure of matter, electricity & magnetism and modern physics 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 structure of matter, electricity & magnetism and modern physics applicable for different physical conditions.	PO 1	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 1	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	• Crystalline and non-crystalline solids, single crystal and polycrystalline solids, unit cell, crystal systems • 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	CO1, CO2
2	• Co-ordinations number, density and packing factor. • Flux - Gauss' Law - application of Gauss' Law: cylindrical, spherical and planar symmetry • Michelson-Morley experiment, consequence of Michelson-Morley experiment	CO1, CO2, CO3
3	• Crystal planes and directions, Miller indices. • Electric potential energy and electric potential, equipotential surface, calculating potential from the field, • Derivation of Lorentz transformation equations, relativity of length, time and mass	CO1, CO2, CO3
4	• Relation between interplanar spacing and Miller indices, mathematical problems related to crystal directions. • 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	CO1, CO2, CO3
5	• Class Test 1 (Structure of Matter) • Capacitance - capacitors in series and in parallel - energy stored in an electric field - capacitors with dielectric	CO1, CO2, CO3

	• Theory of light, Planck's quantum theory, photo-electric effect, characteristics (laws) of photoelectric emission	
6	• Crystal structures: NaCl, CsCl, etc. • Class Test 2 (Electricity & Magnetism) • 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	CO1, CO2, CO3
7	• Bragg's law, methods of determination of interplanar spacing from diffraction patterns, mathematical problems related to crystal structure analysis. • Electric current, resistance and Ohm's law - resistors in series and parallel - power in electric circuits - Kirchhoff's laws and solving circuits - RC circuits • Compton effect, Compton theory, wave particle duality/de-Broglie hypothesis, determination of de-Broglie wavelength	CO1, CO2, CO3
8	• Bonds in solids, interatomic distances. • Magnetic fields, Hall effect, Biot-savart law, torque on a current loop, magnetic dipole moment • Limitation of Rutherford's atom model, postulates of the Bohr atomic model, limitation of Bohr's atom model, de-Broglie atom model	CO1, CO2, CO3
9	• Calculation of cohesive and bonding energy; mathematical problems related to bonds in solids • Magnetic field due to a current, force between two parallel currents, Ampere's law, solenoid • Class Test 3 (Modern Physics)	CO1, CO2, CO3
10	• Introduction to band theory • 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	CO1, CO2, CO3
11	• Distinction between metal, semiconductor, and insulator. • 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	CO1, CO2, CO3
12	• Defects in solids, point defects • 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	CO1, CO2, CO3
13	• Line defects, Plane defects • Hysteresis curve; electromagnetic oscillation: L-C oscillations and its analogy to simple harmonic motion.	CO1, CO2, CO3

	• Difficulties against using nuclear fusion, nuclear models, the liquid drop model, semi-empirical mass formula	
14	• Volume defects, consequences of defects and discussion based on application point of view. • Mathematical problems related to magnetic field and magnetism • The shell model, radioactivity, radioactive transformation, decay law, average life period of a radioelement	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; D. Halliday, R. Resnick, and J. Walker
2. Concepts of Modern Physics; Arthur Beiser
3. Introduction to Solid State Physics; C. Kittel
4. Solid State Physics; M. A. Wahab
5. Physics for Engineers – Part 1 & Part 2; Giasuddin Ahmad

Prepared by:		
Name: Course Teacher Signature:	Name: Course Teacher Signature:	Name: Course Teacher Signature:
Date of Preparation: 24 August, 2022		
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