Department of Chemical Engineering
Bangladesh University of Engineering and Technology

COURSE OUTLINE
Course No: PHY 127
Level 1/ Term 1
Credit (Contact) Hours: 3.0

PART A: General Information

Description of Course PHY 127

1	**Course Title**	: Physical Optics, Waves & Oscillations and Modern Physics
2	**Type of Course**	: Non-departmental course
3	**Offered to**	: Department of Chemical Engineering
4	**Pre-requisite Course(s)**	: N/A

PART B: Course Details

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

Physical Optics: Theories of light; Interference of light, Young's double slit experiment, Displacement of fringes and its uses, Fresnel Bi-prism, Interference at wedge shaped films, Newton's rings, Interferometers; Diffraction of light; Fresnel and Fraunhofer diffraction, Diffraction by single slit, Diffraction from a circular aperture, Resolving power of optical instruments, Diffraction at double slit and N-slits-diffraction grating; Polarization; Production and analysis of polarized light, Brewster's Law, Malus Law, Polarization by double refraction, Retardation plates, Nicol prism, Optical activity , Polarimeters, Polaroid.
Waves & Oscillations: Differential equation of a Simple Harmonic Oscillator, total energy and average energy, Combination of simple harmonic oscillations, Lissajous figures, spring- mass system, Calculation of time period of torsional pendulum, Damped oscillation, Determination of damping co-efficient. Forced oscillation, Resonance, Two-body oscillations, Reduced mass, Differential equation of a progressive wave, Power and intensity of wave motion, Stationary wave, Group velocity and phase velocity, Architectural acoustics, Reverberation and Sabine's formula.
Modern Physics: Michelson-Morley's experiment, Galilean transformation, Special theory of relativity and its consequences; Quantum theory of radiation; Photoelectric 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 physical optics, waves & oscillation, and modern physics required for the students of chemical engineering.
Objective 2: To understand the different laws of Physics associated with physical optics, waves & oscillation, 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 physical optics, waves & oscillation, and modern physics to express different phenomena in the physical world.	PO(a)	C1	e.g., Lectures, Homework	e.g., Written exams; viva voce; presentation; assignment
CO2	Explain the fundamental concepts and theories of physical optics, waves & oscillation, and modern physics applicable for different physical conditions.	PO(a)	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(a)	C3, C4	e.g., Lectures, Homework	e.g., Written exams; viva voce; presentation; assignment

***POs**
PO (a): Engineering knowledge; PO(b): Problem analysis; PO (c): Design/development of solutions; PO(d): Investigation; PO(e) Modern tool use; PO(f): Engineer and society; PO(g): Environment and sustainability; PO(h): Ethics; PO(i): Individual work and teamwork; PO(j): Communication; PO(k): Project management and finance; PO(l): 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	• Theories of light, Interference of light, Young's double slit experiment • Introductory discussion of this course; Definition of wave motion and Simple harmonic motion (SHM), differential equation of SHM. • Frame of reference, failure of Newtonian mechanics, Galilean transformation, concept of ether	CO1, CO2, CO3
2	• Displacements of fringes and its uses, Fresnel bi-prism • Solution of differential equation of SHM, velocity and acceleration of SHM, Significance of angular frequency, and solving mathematical problems. • Michelson-Morley experiment, consequence of Michelson-Morley experiment	CO1, CO2, CO3
3	• Interference at parallel and wedge-shaped films • Total energy and average energy of SHM, and solving mathematical problems related to energy of SHM • Derivation of Lorentz transformation equations, relativity of length, time and mass	CO1, CO2, CO3
4	• Newton's rings, interferometers • Examples of SHM: spring-mass system, effect of spring mass in the oscillation (effective mass), torsional pendulum, and solving mathematical problems • Mass-Energy relation, Relativistic addition of velocities, Relativity of simultaneity	CO1, CO2, CO3
5	• Solving mathematical problems related to interference of light • Combination of simple harmonic motions (in a same line and right angles), Lissajous figures • Class Test (Modern Physics)	CO1, CO2, CO3
6	• Class Test (Physical Optics) • Damped harmonic oscillation (over-, under- and critical-damping conditions), quality factor, and logarithmic decrement • Theory of light, Planck's quantum theory, Photo-electric effect, Characteristics (laws) of photoelectric emission	CO1, CO2, CO3
7	• Diffraction of light, Fresnel and Fraunhofer diffraction, diffraction due to single slit • Forced oscillation, resonance, two-body oscillations and reduced mass • Failure of wave theory of light to explain photoelectric effect, Einstein photoelectric equation, determination of Planck's constant, light-matter interaction, applications of photoelectric effect	CO1, CO2, CO3
8	• Diffraction from a circular aperture, diffraction at double slits	CO1, CO2, CO3

	• Solving mathematical problems related to damped, forced and two-body oscillations • Compton effect, Compton theory, wave particle duality/de-Broglie hypothesis, determination of de-Broglie wavelength	
9	• N-slits-diffraction grating • Class Test (Waves & Oscillations) • 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
10	• Resolving power of optical instruments • Various types of waves, progressive wave equation and differential equation of a progressive wave, and solving mathematical problems. • Properties of nucleus: static nuclear properties and dynamic properties, mass defect, binding energy, binding energy per nucleon, nuclear force	CO1, CO2, CO3
11	• Solving mathematical problems related to diffraction of light • Energy, power and intensity of wave motion, stationary wave, analytical treatment of stationary wave, and solving mathematical problems. • 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	• Polarization of light, production and analysis of polarized light, Brewster's Law, Malus law • Energy of stationary wave, group velocity, phase velocity and relation between group velocity and phase velocity. • Nuclear power reactor, different parts of nuclear fission reactor, types of fission reactor, nuclear fusion reactor, types of fusion reactor	CO1, CO2, CO3
13	• Polarization by double refraction, retardation plates, Nicol prism, optical activity • Architectural acoustics, reverberation and Sabine's reverberation formula for growth of intensities • Difficulties against using nuclear fusion, nuclear models, the liquid drop model, semi-empirical mass formula	CO1, CO2, CO3
14	• Polarimeters, polaroid, solving mathematical problems related to polarization of light • Sabine's reverberation formula for decay of intensities, equation for reverberation time and solving mathematical problems related to reverberation. • 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. Physics Part-I; D. Halliday, and R. Resnick
2. Physics Part-II ; D. Halliday, and R. Resnick
3. Fundamentals of Optics (4th Edition); F. A. Jenkins, and H. E. White
4. Vibrations & Waves; A. P. French
5. Concepts of Modern Physics (6th edition); Arthur Beiser
6. Waves & Oscillations; N. Subrahmanyum and Brij Lal
7. Physics for Engineers - Part-1; Giasuddin Ahmad
8. 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		
Date of Approval by BUGS: 01 June, 2022		