PHY3202: MODERN PHYSICS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Modern Physics

Subject Code
PHY - Physics
Course Number
3202

Academic Unit
Physics (PHY)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
(1) PHY1101 Introductory Classical Mechanics or AP1201/PHY1201 General Physics I or equivalent*
(2) AP1202/PHY1202 General Physics II or equivalent*
(3) AP1203/PHY1203 General Physics III or equivalent*

Precursors
Nil

Equivalent Courses
AP3202 Modern Physics

Exclusive Courses
AP3210/PHY3210 Modern Physics for Nuclear Technology

Additional Information
* This pre-requisite requirement is waived for Advanced Standing I students and Advanced Standing II students.

Part II Course Details

Abstract

Understand the development, concepts and principles of Physics starting from the beginning of the 20th century. The two central areas are in relativity and quantum physics. Apply these concepts and principles to develop useful models of the atom, molecule, nucleus, and materials. Appreciate the limitations of these models. Appreciate the importance of experimental data for testing and developing modern physics.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe some important phenomena and principles in modern physics		x		
2	Explain some specific phenomena observed using physics principles covered in the course.			x	
3	Apply physics principles and mathematical methods in modern physics to analyze and solve basic problems in modern physics.			x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Explain basic concepts of quantum theory, theories of relativity, atomic physics and nuclear physics	1, 2, 3	2 hours/week
2	Tutorials	Apply physics principles and mathematical methods in modern physics to analyze and solve basic problems in modern physics.	1, 2, 3	1 hour/week
3	Laboratory	Practical experience with modern physics experiments	1, 2, 3	1 hour/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3	30	
2	Laboratory reports	2	20	

Continuous Assessment (%)
50

Examination (%)
50

Examination Duration (Hours)
2

Additional Information for ATs
For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task
Assignments

Criterion
Demonstrated excellent understanding of the modern physics principles

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal level

Assessment Task
Laboratory reports

Criterion
Ability to solve modern physics problems

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal level

Assessment Task
Examination

Criterion
Overall understanding of modern physics principles and concepts

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal level

Part III Other Information

Keyword Syllabus

- Special Relativity
  Basic principles, Michelson-Morley experiment, speed of light. Time dilation, length contraction and Relativity of simultaneity, Lorentz transformation. Relativistic mass energy, momentum.
- Concepts of general relativity
  Principle of equivalence, bending of space-time continuum, experimental evidences.
- Quantum Physics
  Wave-particle duality, double-slit experiment, uncertainty principle, atomic structure
- Molecules & solids
  Molecular bonds, molecular spectra, free electron theory in solids, band theory, electrical conduction, semiconductor devices, superconductivity
- Optical coherence & Lasers
  Young’ s interference, first and second order coherence, photon detection, Hanbury-Brown-Twiss experiment, quantum eraser, laser theory
- Nuclear structure
  Nuclear properties, nuclear models, radioactivity, decay law, radiation safety, fission and fusion, nuclear power, X-ray, neutron scattering

- Introduction to elementary particles
  Hadrons and Leptons, weak and strong interaction, quarks.

Reading List

Compulsory Readings

	Title
1	A Beiser, Concepts of Modern Physics, McGraw-Hill (latest edition)The Open University; S271 Discovering Physics – Block C: units 12, 16.
2	R A Serway, Physics for Scientists and Engineers, Saunders (latest edition).The Open University; S271 Discovering Physics – Block C: units 13, 14, and 15.
3	Hugh D. Young and Roger A. Freedman, University Physics with Modern Physics, Addison-Wesley (13th Edition) 2011

Additional Readings

	Title
1	Nil