PHY3210: MODERN PHYSICS FOR NUCLEAR TECHNOLOGY

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Modern Physics for Nuclear Technology

Subject Code
PHY - Physics
Course Number
3210

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
PHY1101 Introductory Classical Mechanics or
AP1201/PHY1201 General Physics I or equivalent

Precursors
Nil

Equivalent Courses
AP3210 Modern Physics for Nuclear Technology

Exclusive Courses
AP3202/PHY3202 Modern Physics

Part II Course Details

Abstract

To prepare students of nuclear science and technology with a good foundation of modern physics. The two central areas of attention are in the physics of radiation and the atomic nucleus. As tools to aid the learning of these areas, electromagnetism, relativity and quantum physics are introduced.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe important phenomena and principles in modern physics needed as a base to nuclear science and technology		x	x	x
2	Explain specific phenomena observed in nuclear science and technology using physics principles covered in the course.		x	x	x
3	Apply physical principles and mathematical methods learn in this course to analyze and solve basic problems in nuclear science and technology.		x	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	Basic Theories and concepts	1, 2, 3	2 hours/ week
2	Tutorials	Additional experiments and exercises	1, 2, 3	10 hours/13 weeks
3	Laboratories	Demonstrations of principles	1, 2, 3	10 hours/13 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Mid-term test	1, 2, 3	30	
2	Assignments	1, 2, 3	10	
3	Lab Reports	1, 2, 3	10	

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
1. Assignments

Criterion
The student completes all assessment task/activities and the work demonstrates excellent understanding of the scientific principles and the working mechanisms

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not reaching marginal level

Assessment Task
2. Lab reports

Criterion
The student does the laboratory task and writes the report.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not reaching marginal level

Assessment Task
3. Mid-term test

Criterion
The student can thoroughly identify and explain how the principles are applied to science and technology for solving physics and engineering problems.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not reaching marginal level

Assessment Task
4. Examination

Criterion
The student can thoroughly identify and explain how the principles are applied to science and technology for solving physics and engineering problems.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not reaching marginal level

Part III Other Information

Keyword Syllabus

- Electromagnetism
  Electric charges and Coulomb interaction; Electric field and potential; Charge movement and electric current; Magnetic field and magnetic forces; sources of magnetic field and electromagnetic induction; Electromagnetic waves.
- Special Relativity
  Basic principles, Michelson-Morley experiment, speed of light. Time dilation, length contraction and Relativity of simultaneity, Lorentz transformation. Relativistic mass energy, momentum.
- Radiation: Particles and waves
  Ultraviolet catastrophy and quantization; Photoelectric effect, Compton scattering, energy-mass relation, photon and its energy and momentum; De Broglie relation, and matter wave.
- X-rays and Atomic structure
  Rutherford scattering, Bohr model, quantum numbers, energy level, Schrodinger equation. Wavefunctions, quantum states, and quantum orbitals. Ground state and excited states, emission spectrum of molecules. Generation, X-ray spectra, characteristic lines, minimum wavelength, application of X-ray.
- Nucleus, nuclear power and irradiation damage
  Nuclear structure and properties, radioactivity, decay law, fission and fusion, nuclear power; irradiation damage..

Reading List

Compulsory Readings

	Title
1	H.D. Young, Sears and Zemansky’ s University Physics with Modern Physics Technology Update, Pearson (latest edition).

Additional Readings

	Title
1	J. Walker, Halliday and Resnick, Principles of Physics, Wiley (latest edition)