PHY3231: ADVANCED INSTRUMENTATION LAB

Effective Term
Semester A 2023/24

Part I Course Overview

Course Title
Advanced Instrumentation Lab

Subject Code
PHY - Physics
Course Number
3231

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
AP2212/PHY2212 Measurement and Instrumentation *

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

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

Part II Course Details

Abstract

To introduce the students to modern measurement and characterization techniques used in current physics research. The aim of the class is to focus on use and principles of operation of small-scale-facility synthesis, characterizations, and measurement systems common to university and applied research. The equipment students are exposed represent that being utilized in current ongoing research.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Acquire knowledge of advanced measurement equipment relevant to modern experimental research and development.	25	x	x	
2	Understand the operation, limitations and compromises of the analytical instruments and measurement methods.	25	x	x	
3	Understand the principles of operation and structure of the advanced instruments.	25	x		
4	Observe specific case-studies for better understanding of applications.	25	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 self-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	Lecture	Explain key concepts and theory of the topics of the course.	1, 2, 3, 4	2
2	Tutorial	Provide in-depth practical examples on how the techniques are used	1, 2, 3, 4	1
3	Laboratory	Hands-on experience with equipment operation.	1, 2, 3, 4	8 hours/13 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks
1	Assignments	1, 2, 3, 4	20	
2	Laboratory reports	1, 2, 3, 4	30	Including the final report

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

1. Demonstrate Correct understanding of key concepts.
2.Expand on learned concepts via self-learning.

Excellent (A+, A, A-)

Student completes all assignments, and demonstrates excellent understanding of the scientific principles governing the behaviour. Student is able to communicate ideas effectively and clearly via text and visual aids.

Good (B+, B, B-)

Student completes at least 80% of assignments, and demonstrates understanding of the scientific principles governing the behaviour. Student is generally able to communicate ideas via text and visual aids.

Fair (C+, C, C-)

Student completes at least 70% of assignments, and shows some of the scientific principles governing the behaviour. Student is able to communicate ideas via text and visual aids accurately but in a simple manner.

Marginal (D)

Student completes at least 60% of assignments, but can only demonstrate brief understanding of the scientific principles governing the behaviour. Student is able to poorly, but accurately to communicate ideas via text and visual aids.

Failure (F)

Student completes less than 50% of assignments. Or, fails to accurately describe the scientific principles governing the behaviour.

Assessment Task

2. Laboratory Report

Criterion

1. Demonstrate Correct understanding of key concepts.
2. Expand on learned concepts via self-learning.

Excellent (A+, A, A-)

Demonstrates excellent understanding of the scientific principles governing the behaviour. Is able to effectively apply the knowledge to complete a task. Student is able to communicate ideas effectively via text and visual aids.

Good (B+, B, B-)

Demonstrates understanding of the scientific principles governing the behaviour. Is able to apply the knowledge to complete a task. Student is generally able to communicate ideas via text and visual aids.

Fair (C+, C, C-)

Shows some of the scientific principles governing the behaviour. Is able to apply the knowledge to complete a task with minor aid. Student is able to communicate ideas via text and visual aids.

Marginal (D)

Can only demonstrate brief understanding of the scientific principles governing the behaviour. Is able apply the knowledge to complete a task only after significant aid. Student is able to poorly, but accurately to communicate ideas via text and visual aids.

Failure (F)

Fails to accurately describe the scientific principles. Is not able to apply the knowledge to complete a task. Student' s work shows evidence of plagiarism. Student fails to complete the assignment.

Assessment Task

3. Examination

Criterion

1. Capacity for using physics knowledge and theory to solve Problems.
2. Demonstrate Correct understanding of key concepts.

Excellent (A+, A, A-)

Student can thoroughly identify and describe how the principles are applied towards successful completion of experiments.

Good (B+, B, B-)

Student can identify and describe how the principles are applied towards successful completion of experiments.

Fair (C+, C, C-)

Student provides simple but accurate evaluations of how the principles are applied towards successful completion of experiments.

Marginal (D)

Student can provide only brief descriptions how the principles are applied to towards successful completion of experiments.

Failure (F)

Student fails to demonstrate how the principles are applied towards successful completion of experiments.

Part III Other Information

Keyword Syllabus

Small-scale-facility synthesis, characterization, measurement systems.
Access to equipment used in currently ongoing research.
May include, but not is limited to:

- cleanroom facilities
  Basic cleanroom operation/theory. Nanofabrication processes and equipment.

- advanced electronic measurement
  Measurement beyond the basic voltage measurement. Low level signal, high frequency signal. Statistical. Noise.
- pressure/vacuum systems
  Applications of pressure/vacuum systems. Principles of operation.
- low/high temperature systems
  Cryogenics and temperature controls.
- non-linear optics
  Measurement techniques at optical frequencies.
  Optical characterization: RAMAN, ARPES
- electon/ion imaging
  Electron and ion microscopy
  Scanning probe microscopy

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Nil