PHY2212: MEASUREMENT AND INSTRUMENTATION

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Measurement and Instrumentation

Subject Code
PHY - Physics
Course Number
2212

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) MA1200 Calculus and Basic Linear Algebra I or equivalent
(4) MA1201 Calculus and Basic Linear Algebra II or equivalent

Precursors
Nil

Equivalent Courses
AP2212 Measurement and Instrumentation

Exclusive Courses
Nil

Additional Information

* This pre-requisite requirement is waived for Advanced Standing I students (admitted in 2015/16 and thereafter) and Advanced Standing II student.

Part II Course Details

Abstract

To introduce the basic understanding of physical measurement, the working principles of various transducers, and the knowledge of signal processing and data analysis. To develop skills to design and analyse measurement systems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify the basic components of measurement system.	20		x	
2	Principle of Measurement, including signal, noise and errors analysis. Signal modulation and system performance analysis.	20	x		
3	Understand instrumentation technique and familiar with commonly-used electrical instruments	20	x		
4	Understand the principle of computer aided measurement.	20		x	
5	Able to apply knowledge and develop skills for computer aided measurement and analysis	20		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	Present basic theories, concepts and examples	1, 2, 3, 4, 5	2 hours/week
2	Tutorials	Provide additional explanations and help the students to apply the knowledge in lectures	1, 2, 3, 4, 5	1 hour/week
3	Laboratory Exercise	Provide laboratory exercises on the related topics	1, 2, 3, 4, 5	8 hours/13 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3	10	
2	Mid-term	1, 2, 3	15	
3	Laboratory Reports	4, 5	15	

Continuous Assessment (%)

40

Examination (%)

60

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 tasks/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. Laboratory reports

Criterion

The student completes all assessment tasks/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
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

- Introduction to instrumentation
- Measurement system: Signal sensing, conditioning, data processing, display and recording. Input-output configuration: Signal modulation, AM, FM, PTM, deflection and null instruments, active and passive instruments, analog and digital instruments, Decibel notation, bandwidth, -3dB point. Static and dynamic measurements: Sensitivity, resolution, precision, threshold, hysteresis, drift, zero-order system, input impedance and output impedance, loading effect, noise, measurement errors.
- Measurement principles and basic instruments
- Computer aided measurement method.
  - Concept of computer aided control.
  - Communication algorithm between computer and measurement unit.
  - Data acquisition approach.
  - Basic programming knowledge using LabVIEW.
  - Development of measuring algorithm using LabVIEW on a physical unit.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	B C Nakra and K K Chaudhry, “Instrumentation Measurement and Analysis”, 2nd edition, Tata McGraw-Hill (2004).
2	A S Morris, “Measurement and Instrumentation Principles”, 3rd edition, Butterworth-Heinemann (2001).
3	D E Johnson, J R Johnson and J L Hilburn, “Electric Circuit Analysis”, 3rd edition, Upper Saddle River, N J: Prentice Hall (1997).
4	J J Brophy, “Basic Electronics for Scientists”, 5th edition, McGraw- Hill (1990).
5	E O Doebelin, “Measurement Systems: Application and Design”, 4th edition, McGraw- Hill (1998).
6	B A Gregory, “An Introduction to Electrical Instrumentation and Measurement Systems”, 2nd edition, Macmillan (1996).
7	J A Haslam, G R Summers and D Williams, “Engineering Instrumentation and Control”, Edward Arnold (1995).
8	A F P van Putten, “Electronic Measurement Systems”, Prentice Hall (1988).
9	R E Simpson, “Introductory Electronics for Scientists and Engineers”, 2nd edition, Prentice-Hall (1987).
10	Robert H. King, “Introduction to data acquisition with LabVIEW”, 2nd edition, (2013)
11	Robert H. Bishop, “Learning with LabVIEW 2009” (2010)