MNE3120: MEASUREMENT AND INSTRUMENTATION

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Measurement and Instrumentation

Subject Code
MNE - Mechanical Engineering
Course Number
3120

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MNE2109/BME2109 Engineering Mechanics or equivalent AND
MNE2029/BME2029 Electrical and Electronic Principles I or equivalent

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Additional Information
Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

Abstract

The demand for precise measurement and instrumentation are increasing day by day for modern industries. This course will provide a coherent and comprehensive introduction to the fundamental concepts, design, fabrication methods underpinning the measurement and instrumentation systems, in the context with applications in various engineering settings. Various approaches to model, analyse, and optimize the measurement and instrumentation systems will also be covered. The state of the art in the integration and assembling of the measurement and instrument systems will be discussed.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the static and dynamic characteristics of measurement and instrumentation systems as well as the working principles of various important components (transducers including pressure, motion, temperature, flow, et al) underpinning in measurement and instrumentation systems.			x	
2	Describe the analytical methods and scaling law for the design of measurement and instrumentation systems and important methods for the manufacturing of measurement and instrumentation systems.			x	
3	Compare the advantages and drawbacks of various measurement and instrumentation systems based on the specific application.			x	x
4	Apply the system-level integration and scaling principles to develop measurement and instrumentation systems.		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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Explain the fundamental concepts, design, fabrication methods as well as the analytical methods related with the measurement and instrumentation.	1, 2, 3, 4	2 hrs/week
2	Laboratory Work	Practical experience is an important part of this course. There will be about 4 three-hour laboratory sessions. Possible topics to be included are response characteristics of transducers / instruments, application of transducers (such as thermometers, strain gauges).	1, 2, 3, 4	3 hrs/week for 4 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Mid-term Test	2, 3, 4	25	
2	Laboratory Reports	1, 2, 3, 4	25	Reports to be submitted on each lab exercise

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 both coursework and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

Mid-term Test

Criterion

Ability to grasp fundamental knowledge related with the static and dynamic characteristics of instrumentation and testing systems.

Excellent (A+, A, A-)

Strong evidence of critical thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter;evidence of extensive knowledge base

Good (B+, B, B-)

Significant evidence of grasp of subject; some evidence of critical capacity of analytic ability; reasonable understanding of issues; evidence of familiarity with course matter

Fair (C+, C, C-)

Student who is profiting from the university experience; understanding of the subject; ability to develop solutions to simple measurement problems

Marginal (D)

Basic familiarity with the subject matter to enable the student to progress without repeating the course

Failure (F)

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills; very limited demonstration of correctly using knowledge regarding measurement and instruments.

Assessment Task

Laboratory Reports

Criterion

Ability to design experiment, conduct proper measurement by applying the learned knowledge to specific problems, and perform data analysis.

Excellent (A+, A, A-)

Strong evidence of critical thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter;evidence of extensive knowledge of the experimental matters concerned

Good (B+, B, B-)

Evidence of grasp of subject; some evidence of critical capacity of analytic ability; reasonable understanding of issues;evidence of familiarity with experiment

Fair (C+, C, C-)

Student who is profiting from the laboratory class; understanding of the subject; ability to develop solutions concerning the experiment

Marginal (D)

Sufficient familiarity with the laboratory content to enable the student to move onto other laboratory materials

Failure (F)

Little evidence of familiarity with the laboratory class materials; weakness in critical and analytic skills; limited or irrelevant use of data

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Assessment Task

Examination

Criterion

Ability to understand basic concepts related with the measurement instrumentation.

Excellent (A+, A, A-)

Strong evidence of critical thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter;evidence of extensive knowledge base

Good (B+, B, B-)

Significant evidence of grasp of subject; some evidence of critical capacity of analytic ability; reasonable understanding of issues; evidence of familiarity with course matter

Fair (C+, C, C-)

Student who is profiting from the university experience; understanding of the subject; ability to develop solutions to simple measurement problems

Marginal (D)

Basic familiarity with the subject matter to enable the student to progress without repeating the course

Failure (F)

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills; very limited demonstration of correctly using knowledge regarding measurement and instruments

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Additional Information for AR

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Part III Other Information

Keyword Syllabus

- Static and dynamic characteristics of measurement and instrumentation
- Errors and uncertainties
- Signal processing
- Measurement of mechanical / electrical / chemical / biological parameters
- Transducers / Sensors and actuators
- Automation devices
- Pneumatics
- Logic controller
- Scaling law
- MEMS/BioMEMS
- Microfabrication
- Integration and assembling
- Nanotechnology

Reading List

Compulsory Readings

	Title
1	Webster, John G., Medical Instrumentation: Application and Design, 3rd Ed or later.

Additional Readings

	Title
1	Morris, A.S., Measurement and Instrumentation Principles, Butterworth-Heinemann, 3rd Ed or later.
2	Nakra, B.C. and Chaudhry, K.K., Instrumentation, Measurement and Analysis, McGraw-Hill, 1st Ed or later.