MNE6126: SENSORS FOR ROBOTICS, AI, AND CONTROL SYSTEMS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Sensors for Robotics, AI, and Control Systems

Subject Code
MNE - Mechanical Engineering
Course Number
6126

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
MNE8110 Sensors for Robotics, AI, and Control Systems

Exclusive Courses
Nil

Part II Course Details

Abstract

This course is intended for students with interests in learning about the applications of advanced sensing devices and techniques in robotics artificial intelligence (AI), and control systems. The objective of this course is to introduce the fundamental operational principles for sensors that are ubiquitous in modern robots, cyber-physical systems ("internet of things") and control systems. The sensing devices and techniques discussed in this course include microelectromechanical systems (MEMS) based inertial measurement units, soft tactile and pressure sensors, bio/chemical sensors, acoustic sensors, optical sensors, proximity sensing, collision avoidance, light detection and ranging (LIDAR), and simultaneous localization and mapping (SLAM). The course will also discuss how these sensors and techniques are used in robotics, control systems, and AI applications. Fundamental concepts in these application areas, including robot navigation, sensory feedback control, and wireless sensing networks will also be discussed.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	to give scientific explanations of the operating principles of various sensors, including motion sensors, optical sensors, acoustic sensors, and bio-sensors.		x	x	
2	to analyze and characterize different sensors and sensing methodologies in terms of resolution, sensitivity, precision, and accuracy.		x	x	
3	to design and integrate sensing and control technologies for robotics, cyber-physical systems, and AI applications.			x	x
4	to apply and implement different sensors and actuators for advanced scanning technologies such as LIDAR and SLAM.			x	x
5	to adapt different sensing and tracking methods in system design for applications in robots, cyber-physical systems, and control systems.			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	The main teaching activities will be in the form of lectures but the lectures are sometimes implemented with small group discussions where students work with their team-members before feeding back their results to the class.	1, 2, 3, 4, 5	2 hrs/week
2	Tutorial	Tutorials are problem-solving sessions and are sometimes broken up into small group discussions.	1, 2, 3, 4, 5	1 hr/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Mini-project	3, 4, 5	20	-	Yes
2	Assignment/ Homework	1, 2, 3	20	-	Yes
3	Mid-term and In-class Quiz	1, 2, 3	25	-	No

Continuous Assessment (%)

65

Examination (%)

35

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

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

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Written exam at the end of the semester.

Excellent

(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Mid-term and In-class Quiz (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
To test students' understanding of the topics discussed during the course of the lecture.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Assignment/ Homework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
To assess students' learning attitudes and ability in understanding the principles of the various signal transduction principles and analysing the performance of the sensors.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal

(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Mini-project (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
To assess students' ability to work in a team to design, apply, and adapt state-of-the-art sensing and tracking methods for applications in robots, cyber-physical systems, and control systems.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Written exam at the end of the semester.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Assessment Task
Mid-term and In-class Quiz (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
To test students' understanding of the topics discussed during the course of the lecture.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Assessment Task
Assignment/ Homework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
To assess students' learning attitudes and ability in understanding the principles of the various signal transduction principles and analysing the performance of the sensors.

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Assessment Task
Mini-project (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
To assess students' ability to work in a team to design, apply, and adapt state-of-the-art sensing and tracking methods for applications in robots, cyber-physical systems, and control systems.

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(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Motion sensors, tactile sensors, proximity sensors, vision-based tracking, light detection and ranging (LIDAR), simultaneous localization and mapping (SLAM) artificial intelligence (AI) feedback control, discrete-time systems, control system implementation, robot control.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	H.R. Everett, Sensors for Mobile Robots, Kindle Edition, 1995.
2	Gene F. Franklin, J. David Powell, Abbas Emami-Naeini, Feedback Control of Dynamic Systems, 7th Edition, Kindle Edition, 2015.