MNE6114: CONTROL SYSTEMS AND INFORMATION PROCESSING

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Control Systems and Information Processing

Subject Code
MNE - Mechanical Engineering
Course Number
6114

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
MNE3049 Control Principles or Equivalent course on Control Principles or Theory

Precursors
BME4032/MNE4032 Robotics & Machine Vision

Equivalent Courses
BME6114 Advanced Control Systems

Exclusive Courses
Nil

Part II Course Details

Abstract

The aim of this course is to introduce principles of control systems, their design, modern perception and advanced information processing. The emphasis will be placed on:
- The theory of control system and engineering;
- Modern information processing and perception, including application of machine learning in modern control system and robotics;
- System integration of dynamic control system;
- The performance evaluation, programming and application of robotics systems;
- The development, anticipation, model selection and supervision of control systems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Inspire the interest of students in primary technical components in control systems and information processing.		x		
2	Generate a number of competing alternatives that may form fixed, programmable or flexible control systems and then hypothesise performance of implementing each of them to select the most promising alternative.			x	
3	Analyse possible partitioning of a control system into functional modules. Appraise how information processing techniques can benefit each module.			x	
4	Develop a prototype system by fusing control systems and information processing.			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	Weekly lectures	1, 2, 3, 4	2 hrs/ week
2	Tutorial	Case studies and practice / demonstration of solving problems	1, 2, 3, 4	1 hr/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3	20	2 times
2	Test	1, 2, 3	15	
3	Project (group)	2, 3, 4	25	

Continuous Assessment (%)

60

Examination (%)

40

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

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

Criterion

Capacity to solve theoretical questions and indication of mastering basic knowledge ranged in control theory, control engineering, machine learning, computer vision and robotics.

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

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

Criterion

Ability to solve questions in control theory, control engineering, machine learning, robotics and computer vision.

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

Criterion
Capacity to implement a particular system in simulated practice involving real equipment to accomplish an assumed task.

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 before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Ability to solve questions in control theory, control engineering, machine learning, robotics and computer vision. Clear representation of the results and the process of solving the questions.

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
Assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Capacity to solve theoretical questions and indication of mastering basic knowledge ranged in control theory, control engineering, machine learning, computer vision and robotics.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

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

Criterion
Ability to solve questions in control theory, control engineering, machine learning, robotics and computer vision.

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Part III Other Information

Keyword Syllabus

- Control Principles: Feedback Control System, Stability, Controllability, Observability, System Modelling, Convergence, etc.
- Machine Learning: Bayesian Reasoning, Parametric Learning, Non-parametric Learning, Supervised/un-supervised Learning, Neural Network, Boosting, Regression, SVM, etc.
- Sensors and Information Processing: Laser Range Finder, Vision, Visible Light Communication, Iterative Closest Point, Normal Distributions Transform, Data Compression, Bayesian Data-fusion, Middleware System, Robotics Operation System, etc.
- Computer Vision: Calibration, Multi-view Geometry, etc.
- Robotics: SLAM, Localization, UAV, UGV, etc.

Reading List

Compulsory Readings

	Title
1	Modern Control Engineering, Katsuhiko Ogata, Prentice Hall, 2010.
2	Bayesian reasoning and machine learning. Barber, David. Cambridge University Press, 2012.

Additional Readings

	Title
1	Introduction to autonomous mobile robots. Siegwart, Roland, Illah Reza Nourbakhsh, and Davide Scaramuzza. MIT press, 2011.

2	Pattern Recognition and Machine Learning (Information Science and Statistics), C. Bishop, 2nd printing edition. 2007.
3	Robotics, vision and control: fundamental algorithms in MATLAB. Corke, Peter. Springer, 2011.