MNE3059: INTELLIGENT ROBOT DESIGN

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Intelligent Robot Design

Subject Code
MNE - Mechanical Engineering
Course Number
3059

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
Nil

Precursors
EE2917 Electronic Engineering I AND
EE2918 Electronic Engineering II or
MBE2029/BME2029/MNE2029 Electrical and Electronic Principles I or equivalent

Equivalent Courses
MBE3059 Intelligent Robot Design

Exclusive Courses
Nil

Part II Course Details

Abstract

Robot is an advanced form of mechatronic products. Robotics can offer an excellent basis for students to learn the essential engineering technologies and practical skills needed for developing typical mechatronic products. This course aims to facilitate the students to learn the essential elements of mechatronic design principles through a series of Problem Based Learning activities in designing mobile robots to tackle some given problems. An emphasis is placed on giving an opportunity to students to put in practice and integrate what they have learnt about electronic circuit, mechanical design, software programming and control theory in the classroom. Besides learning the aforementioned engineering concepts, students would also develop other valuable skills such as creativity, teamwork and problem solving abilities through a final competition.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the basic mechatronic elements and major issues involved in developing an autonomous robot.		x	x	
2	Design robotic systems conceptually and theoretically for tackling given problems.			x	x
3	Develop hardware and software systems for the robots for achieving given tasks.			x	x
4	Adapt the design of the robots e.g. by adding machine intelligence to cope with uncertainties in the working environment.			x	
5	Demonstrate reflective practice in an engineering context.		x	x	
6	Demonstrate effective team work.		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	Tutorial	Small Class Activities would include lectures, group discussion, and PBL activities.	1, 2, 3, 4, 5	1 hrs/week

2	Laboratory Work	Laboratory Work would include workshop training, robot construction and practical skill training.	2, 3, 4, 5, 6	3 hrs/week for 12 weeks
3	Student-Led Learning Activities	Student-Led Learning Activities could include PBL activities, components/parts sourcing, peer group meetings, project management activities, literature search and contest.	3, 4, 5, 6	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Laboratory Work	3, 4, 5, 6	20	
2	Project Report and Presentation	1, 2, 3, 5	20	
3	System Demonstration	3, 4, 6	15	Conformance with problem statement; feasibility of developing it for ROBOCON or similar competitive events
4	Test	1, 2, 3	30	
5	Contest	3, 4, 6	15	Final contest among groups

Continuous Assessment (%)

100

Examination (%)

0

Assessment Rubrics (AR)

Assessment Task

Laboratory Work

Criterion

1.1 Ability to Achieve the desired tasks during the lab sessions.

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 Report and Presentation

Criterion
2.1 Ability to Design and Describe issues related to the development of mobile robot.
2.2 Ability to Draw conclusions beyond the text or classroom experience and Make connections to the knowledge which the student has learnt previously.

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
System Demonstration

Criterion
3.1 Ability to Develop hardware subsystem and control software system to tackle a given task and to handle uncertainties in the working environment.

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

Criterion
4.1 Ability to Understand the basic mechatronic elements and major issues involved in developing an autonomous robot.

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
Contest

Criterion
5.1 Ability to Demonstrate the effectiveness of the developed solution for tacking a given 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

Part III Other Information

Keyword Syllabus

- Mechanical Mechanism Design – Pulley Systems, Three-bar Linkages, Four-bar Linkages, CAM Systems.
- Actuator Technologies – Pneumatic Systems, DC Servo Motors, Brushless DC Motors.
- Sensory Technologies – Incremental Encoders, Infra-Red Sensors, Cameras, Ultrasonic Sensors.
- Microcontroller Design and Development – Embedded C Programming, Circuit Design.

- Computer Interfaces – PWM, ADC, DAC, Digital Input/Output, SPI, UART, Digital Signal Processing.
- Robot Navigation – Line Tracking, Dead Reckoning, Landmark Recognition, Sensor Triangulation.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Christopher T. Kilian, Modern Control Technology Components and Systems, Thomson Delmar Learning, 3rd Ed., 2006.
2	Richard Barnett, Larry O' Cull and Sarah Cox, Embedded C programming and the Atmel AVR, Clifton Park, NY: Delmar, 2nd Ed., 2006.
3	Gadre Dhananjay V., Programming and customizing the AVR microcontroller, McGraw-Hill, 2001.
4	Online Resources: 1. ATMega16 data sheet http://www.atmel.com/dyn/resources/prod_documents/doc2466.pdf 2. General information of AVR processors http://www.atmel.com/products/AVR 3. WinAVR - GNU AVR GCC compiler for C and C++. http://winavr.sourceforge.net/ 4. Robot Store Website for components http://www.robotstorehk.com/ http://hk.farnell.com/jsp/home/homepage.jsp http://www.rshongkong.com/