SYE4003: ARTIFICIAL INTELLIGENCE AND ADVANCED TECHNOLOGY IN MANUFACTURING AND OPERATIONS

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Artificial Intelligence and Advanced Technology in Manufacturing and Operations

Subject Code
SYE - Systems Engineering
Course Number
4003

Academic Unit
Systems Engineering (SYE)

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
SYE3003 Design and Analysis of Manufacturing Processes and Systems &
SYE3004 Production Planning and Control

Precursors
Nil

Equivalent Courses
ADSE4003 Artificial Intelligence and Augmented Reality in Manufacturing and Operations

Exclusive Courses
Nil

Part II Course Details

Abstract

In the evolving landscape of Industry 4.0, students in this course will actively engage with the transformative technologies of Artificial Intelligence (AI) and emerging advanced technology. By leveraging data learning, AI advances the development of sophisticated models. Through engaging learning experiences, students will understand the basic concept of AI and explore the application of AI and advanced technologies in manufacturing and operations. The curriculum is designed to empower students with the ability to integrate machine learning and data analytics into smart manufacturing processes. This integration is critical for real-time monitoring of orders, procedures, and external influences. By the end of the course, students will be equipped with the knowledge and skills to not only understand but also apply AI and new technologies to enhance efficiency and innovation in the manufacturing sector.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the difference among various AI techniques and advanced technologies, which can be used in manufacturing and operations	20	x	x	
2	Understand the principles and concepts of applying AI and other advanced technologies to manufacturing and operations.	30		x	
3	Apply the knowledge of different AI and advanced techniques to achieve smart manufacturing, process control and product design.	30	x	x	
4	Analyse all information collected and draw a consolidated conclusion for making decisions and planning in enterprise operation.	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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Learning through teaching is primarily based on lectures. Small-group exercises will be used to facilitate conceptual understanding of the AI and advanced technology application to smart manufacturing.	1, 2, 3, 4	39 hours/semester

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Mid-term Exam	1, 2, 3, 4	30	
2	Mini-Project Work	1, 2, 3, 4	10	

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 should be obtained.

Assessment Rubrics (AR)

Assessment Task

Mid-term

Criterion

It assesses students' understanding of basic concepts in applying AI and AR applied to manufacturing and operations.

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 Report

Criterion
It reflects students' ability to understand and apply the concepts and theories taught in class.

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

Criterion
Examination questions are designed to assess students' level of achievement of the intended learning outcomes, with balanced emphasis placed on conceptual understanding of the technology for applying AI and AR to manufacturing and operations.

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

Additional Information for AR
Examination and test will be numerically marked, and grades awarded accordingly.

Part III Other Information

Keyword Syllabus

- Concepts and Principles of AI, Metaverse and Digital Twin
- Concepts and Principles of Intelligent/Smart Manufacturing

- Large Language Model, GPT, and Prompt Engineering
- Application of AI to Smart Manufacturing
- Machine Learning and Advanced Data Analysis
- Advanced technologies emerging in recent years
- Quality control and process optimization

Reading List

Compulsory Readings

	Title
1	Lecture notes and slides will be provided by the instructor

Additional Readings

	Title
1	ISAK KARABEGOVI, AHMED KOVAEVI, LEJLA BANJANOVI-MEHMEDOVI, PREDRAG DAI, Handbook of Research on Integrating Industry 4.0 in Business and Manufacturing (Advances in Business Information Systems and Analytics (Abisa)), IGI Global, 2020
2	S.K. ONG and A. Y. C. NEE, Virtual and Augmented Reality Applications in Manufacturing, Springer-Verlag, 2004.
3	FEI TAO, MENG ZHANG and A.Y.C. NEE, Digital Twin Driven Smart Manufacturing, Academic Press Elsevier, 2019.
4	MIKEL ARMENDIA, ERDEM OZTURK, MANI GHASSEMPOURI, FLAVIEN PEYSSON, Twin-Control: A Digital Twin Approach to Improve Machine Tools Lifecycle, Springer, 2019.