

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

ADSE3003 / SYE3003 Design and Analysis of Manufacturing Processes and Systems &
ADSE3004 / 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	40	
2	Mini-Project Work	1, 2, 3, 4	10	

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 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.