SYE4008: COMPUTER-AIDED PROBLEM SOLVING FOR MANUFACTURING AND SYSTEMS ENGINEERS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Computer-Aided Problem Solving for Manufacturing and Systems Engineers

Subject Code
SYE - Systems Engineering
Course Number
4008

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
Nil

Precursors
MA1201 Calculus and Basic Linear Algebra II or MA1301 Enhanced Calculus and Linear Algebra II

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

Industries seek manufacturing and systems engineering graduates equipped with advanced computational tools to streamline processes, cut costs, and improve decision-making across diverse sectors (e.g., manufacturing, healthcare, and supply chain management). In this course, students learn versatile general problem-solving techniques—heuristic search, constraint programming, and automated planning—that are widely applicable to diverse manufacturing and systems engineering challenges (e.g., scheduling, resource allocation, process optimization, and dynamic system planning). These techniques form a vital part of the engineering problem-solving toolkit, complementing traditional approaches like operations research and data-driven techniques such as big data and machine learning. Through this course, students gain added skills to tackle complex industrial problems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Apply heuristic search methods (e.g., breadth-first, depth-first, A*) to solve optimization problems such as facility layout or routing.	35	x		
2	Apply constraint satisfaction techniques (e.g., constraint propagation, backtracking, local search) and use tools like MiniZinc for applications such as production scheduling.	35	x		
3	Apply automated planning techniques (e.g., classical planning, hierarchical planning) for problems like efficient resource allocation in supply chains.	30	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	Lectures	Students will engage in lectures and discussions to gain knowledge about the key concepts described in CILOs 1-3.	1, 2, 3	39 hours/semester

2	Computer laboratories	In these computer laboratories, students implement the techniques discussed in CILOs 1-3 via open-source software platforms.	1, 2, 3	3 laboratory sessions × 3 hours/session = 9 hours per semester

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignments	1, 2, 3	10	-	No
2	Project	1, 2, 3	15	-	No
3	Test	1, 2, 3	15	-	No

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Assessment Rubrics (AR)

Assessment Task

Assignment sets, and test and/or project

Criterion

Submitted written work.

Excellent (A+, A, A-)

Strong evidence of capacity to analyse and synthesize; superior grasp of subject matter.

Good (B+, B, B-)

Evidence of grasp of subject, some evidence of critical capacity and analytic ability.

Fair (C+, C, C-)

Student who is profiting from the university experience; understanding of the subject; ability to develop solutions to simple problems in the material.

Marginal (D)

Sufficient familiarity with the subject matter to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills.

Assessment Task

Examination

Criterion

2-hr final examination (either open or closed book based on instructor's discretion)

Excellent (A+, A, A-)

Strong evidence of capacity to analyse and synthesize; superior grasp of subject matter.

Good (B+, B, B-)

Evidence of grasp of subject, some evidence of critical capacity and analytic ability.

Fair (C+, C, C-)

Student who is profiting from the university experience; understanding of the subject; ability to develop solutions to simple problems in the material.

Marginal (D)

Sufficient familiarity with the subject matter to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills.

Part III Other Information

Keyword Syllabus

* Uninformed search strategies (e.g., breadth-first, depth-first) and heuristic search strategies (e.g., A* search, designing heuristic functions) and their applications to manufacturing/systems engineering problems.
* Constraint programming techniques (e.g., problem formulation, constraint propagation, backtracking, local search) and their applications to manufacturing/systems engineering problems.
* Automated planning techniques (e.g., classical planning, heuristics for planning, hierarchical planning) and their applications to manufacturing/systems engineering problems.

Reading List

Compulsory Readings

	Title
1	Lecture notes and slides provided by the instructor.

Additional Readings

	Title
1	Principles of Constraint Programming, by Krzysztof R. Apt, Cambridge University Press (2009)
2	Search Methods in Artificial Intelligence, by Deepak Khemani, Cambridge University Press (2024)
3	Automated Planning and Acting, by Ghallab, Nau and Traverso, Cambridge University Press (2016)
4	Online learning material is provided via University computer network