SYE4008: SMART PRODUCTION SYSTEMS ENGINEERING

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
Smart Production Systems Engineering

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

The purpose of this course is to expose students to novel and computationally efficient methods for analysis, design, and improvement of smart production systems in large volume manufacturing. The emphasis is the rigorous engineering study of practical issues related to parts flow in production systems with unreliable machines and finite buffers. The course material is based on long time industrial studies and experiences by the instructor and his colleagues in various manufacturing plants. Every problem considered in this course is originated on the factory floor and, after appropriate conceptualization and analysis, ended up as an application on the factory floor; the case studies included in this course describe some of these applications.

The topics include: Computationally efficient methods for analysis of production systems, designing lean in-process and finished goods buffering, and selecting carriers carriers in closed loop systems; Digitalization methods for identification, monitoring, and elimination of production system bottlenecks; Analytical methods for satisfying product quality requirement and customer demand in production systems; Smart analysis of transient behavior of production system; and system-theoretic properties of production lines. These topics will be addressed in the framework of stochastic models of production systems.

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

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignments	1, 2, 3	20	-	No
2	Project	1, 2, 3	30	-	No

Continuous Assessment (%)

50

Examination (%)

50

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

* Performance analysis (e.g., aggregation, Markov chain, machine reliability, iteration, transient) of smart production systems (e.g., serial lines, assembly systems, closed loop systems).
* Design (e.g., in-process buffer, finished goods buffer, carriers, lean) of smart production systems.
* Continuous improvement (e.g., bottleneck, improvability, constrained, quality, rework) of smart production systems.

Reading List

Compulsory Readings

	Title
1	Lecture notes and slides provided by the instructor.

Additional Readings

	Title
1	Production Systems Engineering by Li and Meerkov, Springer, 2009