SYE8204: PROCESS MODELLING AND CONTROL

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Process Modelling and Control

Subject Code
SYE - Systems Engineering
Course Number
8204

Academic Unit
Systems Engineering (SYE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
R8 - Research Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
University level mathematics (calculus math, differential equations, linear algebra, complex math, etc) and computer programing.

Precursors
Knowledge of automatic control is highly desirable and recommended

Equivalent Courses
SEEM8204 Process Modelling and Control (offered until 2021/22)
ADSE8204 Process Modelling and Control (offered until 2023/24)

Exclusive Courses
Nil

Part II Course Details

Abstract

This course is designed for research students to develop advanced knowledge of system engineering. The aim is to teach research students to analyse dynamics of industrial processes, design the proper method to model these processes, and control these processes using different kind of approaches. The fundamental contents include fundamental analysis of linear/nonlinear processes, process modelling and simulation, and advanced control methods for both linear and nonlinear processes. This course requires preliminary knowledge of control systems, linear algebra, differential equations, complex mathematics, computer programming, etc.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand fundamental theories for process analysis, basic techniques for process simulation, and process control.	15	x	x	
2	Design modelling methods for linear dynamic processes.	15		x	
3	Design advanced modelling methods for nonlinear dynamic processes.	35		x	x
4	Design control methods for linear processes, and analyse the stability of the controlled system.	15		x	
5	Design advanced methods to control nonlinear process and maintain the system stability	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	Large Class Activities	Take place in classroom setting and consist of lecturing and student activities in between. Students will be grouped in the large classroom to work on mini-tasks.	1, 2, 3, 4, 5	2 hours/week
2	Tutorial	Students will do exercise in the class with assistance of teacher and tutors.	1, 2, 3, 4, 5	1 hour/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Individual assignment Students need work independently to complete the exercises, which include understanding basic fundamentals, and applying learned knowledge for problems solving.	1, 2, 3, 4, 5	80	-	No
2	Mid-term test Students will be assessed in the mid-term test for their understanding of fundamentals in the topics covered and problems solving taught in the lectures.	1, 2, 3, 4	20	-	No

Continuous Assessment (%)

100

Examination (%)

0

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

0

Assessment Rubrics (AR)

Assessment Task

Individual assignment (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Each assignment has 5-10 big problems for students to complete. Each problem may include several small questions. Every questions and problems will be graded numerically in 100% scale.

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
Mid-term test (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Every CILO taught will be examined to have an immediate feedback of the learning performance. The results are marked numerically in 100% scale.

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
Individual assignment (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Each assignment has 5-10 big problems for students to complete. Each problem may include several small questions. Every questions and problems will be graded numerically in 100% scale.

Excellent
(A+, A, A-) Excellent

Good
(B+, B) Good

Marginal
(B-, C+, C) Marginal

Failure
(F) Failure

Assessment Task

Mid-term test (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Every CILO taught will be examined to have an immediate feedback of the learning performance. The results are marked numerically in 100% scale.

Excellent

(A+, A, A-) Excellent

Good

(B+, B) Good

Marginal

(B-, C+, C) Marginal

Failure

(F) Failure

Additional Information for AR

Course work will be numerically marked and grades awarded accordingly.

Part III Other Information

Keyword Syllabus

Dynamics of processes
- Linearization and state-space model representation
- Laplas transformation and transfer functions
- Ordinary differential equations and partial differential equations

Process modelling
- Linear regression method
- Nonlinear regression method including neural network modelling
- Space/time separation based intelligent method

Process control
- PID controller design and tuning rules
- Lyapunov stability analysis
- Sliding mode control
- Internal model control

Reading List

Compulsory Readings

	Title
1	Lecture notes

Additional Readings

	Title
1	B. Wayne Bequette, Process Control- modeling, design and simulation, Prentice Hall, 2003
2	J.J. E. Slotine, & W. LI, Applied Nonlinear Control, Prentice Hall, 1991
3	Richard C. Dorf, Modern Control Systems Addision-Wesley 2016