SYE6101: ESTIMATION AND CONTROL OF RANDOM DYNAMIC SYSTEMS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Estimation and Control of Random Dynamic Systems

Subject Code
SYE - Systems Engineering
Course Number
6101

Academic Unit
Systems Engineering (SYE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
SEEM6101 Estimation and Control of Random Dynamic Systems (offered until 2021/22) / ADSE6101 Estimation and Control of Random Dynamic Systems (offered until 2023/24)

Exclusive Courses
Nil

Additional Information

The course is self contained, but requires motivated students, interested in learning mathematical techniques for systems control.

Part II Course Details

Abstract

This course aims to teach the students the basic concepts and methods related to random dynamic systems. They apply to dynamic systems originated from Engineering as well as from Economics. General principles as well as more specific techniques will be presented.
The state representation approach will be used. The way decisions are taken will be explained, in relation with the available information. The concept of feedback control will be discussed.
The course will develop estimation techniques, for identification as well as for forecasting. In particular the Kalman filter will be fully presented.
Particular attention will be devoted to the Dynamic Programming approach to define optimal control. We will also present the idea of reinforcement learning as a technique for solving complex dynamic optimization problems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Model dynamic systems with uncertainties	20	x		
2	Forecast the behaviour of the system in the future	10	x		
3	Decide control variables according to objectives	15		x	
4	Define prototypes with increasing complexity	10	x		
5	Apply mathematical techniques for dynamic systems analysis	45		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	Presentation and discussion	1, 2, 3, 4, 5	26 hours/sem
2	Tutorial	Help to assignments	1, 2, 3, 4, 5	13 hours/sem

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignment	1, 2, 3, 4, 5	20	-	No
2	Midterm	1, 2, 3, 4, 5	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 (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Correctness and clarity of concepts and results

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

Criterion
Correctness and clarity of concepts and results

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

Criterion
Correctness and clarity of concepts and results

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

Criterion
Correctness and clarity of concepts and results

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate/Basic

Failure
(F) Not even reaching marginal levels

Assessment Task

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

Criterion
Correctness and clarity of concepts and results

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate/Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Final exam (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Correctness and clarity of concepts and results

Excellent
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Part III Other Information

Keyword Syllabus

- Dynamic Systems
- Uncertainty
- Control Theory
- Dynamic Programming
- Estimation
- Filtering
- State of System
- Decision Variables
- Optimization

Reading List

Compulsory Readings

	Title
1	Lecture Notes

Additional Readings

	Title
1	Supplementary Reading: A. Bensoussan, Dynamic Programming and Inventory Control (IOS Press 2011)
2	Supplementary Reading: F. Lewis, D. Vrabie, V. Syrmos Optimal Control (John Wiley and Sons 2012)
3	Supplementary Reading: D. Bertsekas, Dynamic Programming and Optimal Control, Vol. I (Athena Scientific 2017)