SDSC3008: SYSTEMS DYNAMICS AND CONTROL

Effective Term
Semester A 2023/24

Part I Course Overview

Course Title
Systems Dynamics and Control

Subject Code
SDSC - School of Data Science
Course Number
3008

Academic Unit
School of Data Science (DS)

College/School
School of Data Science (DS)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2508 Multi-variable Calculus and MA1503 Linear Algebra with Applications

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract
This course provides the basic knowledge of dynamic systems and introduces controller design methods to students with background in control, signal processing, artificial intelligence and machine learning, power systems and financial

engineering. It equips students with computing algorithms and techniques of applying taught methods to solve practical problems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain clearly basic concepts in dynamic systems and control.	10	x		
2	Solve some problems of system modelling and controller design with fundamental mathematical methods.	25	x	x	
3	Explain and apply the theories of dynamic systems and controller design.	25	x	x	
4	Explain methods of controller design in the context of data science.	20		x	x
5	Apply mathematical and computational methods of dynamic systems and control in formulating and solving real-life problems	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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5	39 hours in total
2	Take-home assignments	Learning through take-home assignments helps students understand techniques of basic methods in as well as their applications in solving control problems.	1, 2, 3, 4	after-class

3	Online applications	Learning through online examples for applications helps students create and formulate mathematical models and apply to a range of practical problems in engineering/ science.	4	after-class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test	2, 4	25	Questions are designed for the part of the course to see how well the students have learned basic concepts of methods in dynamic systems and control and recognized their applications in solving problems. (15-30%)
2	Hand-in assignments	2, 3, 4	15	These are skills based assessment to enable students to demonstrate the understanding of theories and the ability of applying controller design methods in a diversity of problems. (0-15%)
3	Formative take-home assignments	2, 3, 4	0	The assignments provide students chances to demonstrate their achievements on techniques of dynamic system modeling and control learned in this course.

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

Note: To pass the course, apart from obtaining a minimum of 40% in the overall mark, a student must also obtain a minimum mark of 30% in both continuous assessment and examination components.

Assessment Rubrics (AR)

Assessment Task
Test

Criterion
Ability to understand the basic concepts of methods and recognize their applications in solving application problems

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
Hand-in assignments

Criterion
Ability to apply the techniques in a diversity of problems

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
Formative take-home assignments

Criterion
Ability to demonstrate students' achievements on techniques learned in this course

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
Ability to solve control problems with fundamental methods.

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

Part III Other Information

Keyword Syllabus
Differential equation models, Laplace transform, Block diagram models, State variable models, Transfer function, Transient response analysis, Feedback control systems, Stability analysis, PID controllers, Basic controller design methods, Model predictive control, IIoT.

Reading List

Compulsory Readings

	Title
1	“Modern Control Systems”, by Richard C. Dorf, Robert H. Bishop. 2017.

Additional Readings

	Title
1	Feedback systems by K. J. Åström and R. M. Murray. Princeton University Press. 2010.
2	Modern Control Engineering by K. Ogata. Prentice Hall. 2010.
3	Feedback Control of Dynamics Systems by G. F. Franklin, J. D. Powell, & A. Emami-Naeini. London: Pearson. 2015.