MA4544: INTRODUCTION TO CONTROL THEORY

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Introduction to Control Theory

Subject Code
MA - Mathematics
Course Number
4544

Academic Unit
Mathematics (MA)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2503 Linear Algebra

Precursors
MA3511 Ordinary Differential Equations

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to provide students with a fundamental background on control theory and its applications. It will help students to understand how control theory is related to practical engineering problems and train them to solve these problems by creating appropriate mathematical models.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	analyze dynamics of a linear system by solving system model/equation or applying domain transformation.	15		x	
2	understand the principle of feedback and its role in regulating system behaviour.	15	x		
3	identify a system for its transient and steady-state behaviour, and stability.	15	x	x	
4	evaluate system stability with time and frequency domain techniques.	15		x	
5	apply basic principles and techniques to design linear control systems.	25		x	x
6	apply knowledge of control theory to create and solve mathematical models for practical problems in engineering.	15		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	Lectures	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5, 6	39 hours in total
2	Take-home assignments	Learning through take-home assignments helps students implement mathematical theory and techniques in analyzing linear control systems and their applicability to engineering problems.	1, 2, 3, 4, 5, 6	after-class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test	1, 2, 3, 4	15	Questions are designed for the first part of the course to see how well students have learned mathematical formulation of modeling and designing linear control and discrete time systems.
2	Hand-in assignments	1, 2, 3, 4, 5, 6	15	These are skills based assessment to help students manipulate control theory and related mathematical techniques in analyzing linear control systems and their applications to practical problems of engineering science.

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

3

Additional Information for ATs

30% Coursework
70% Examination (Duration: 3 hours, at the end of the semester)
For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task

1. Test

Criterion

Ability in problem solving

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
2. Hand-in assignments

Criterion
Understanding of concepts and applications

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
3. Examination

Criterion
Comprehensive ability in independent problem solving

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

Modelling of physical systems. Linear control systems. Laplace transformation. Control system design. System stability.

Reading List

Compulsory Readings

	Title
1	Modern Control Systems, Global Edition 14e by Richard Dorf and Robert Bishop , 2021, Pearson

Additional Readings

	Title
1	Linear System Theory and Design, Chi-Tsong Chen, 2012, Oxford press