MNE3049: CONTROL PRINCIPLES

Effective Term
Semester A 2023/24

Part I Course Overview

Course Title
Control Principles

Subject Code
MNE - Mechanical Engineering
Course Number
3049

Academic Unit
Mechanical Engineering (MNE)

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
MBE2109/BME2109/MNE2109 Engineering Mechanics AND
MBE2029/BME2029/MNE2029 Electrical and Electronic Principles I or equivalent

Precursors
MA2177 Engineering Mathematics and Statistics/
MA2172 Applied Statistics for Sciences and Engineering

Equivalent Courses
MBE3049 Control Principles

Exclusive Courses
Nil

Additional Information
#Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing. Instead, those students are required to sit for a remedial workshop in engineering mathematics prior to taking this course.

Part II Course Details

Abstract

This is an introductory course in feedback control. It is designed for second year students who have completed their foundation courses in mathematics, mechanics and electronics. It covers control theory fundamentals and equips students with basic skills to analysis and design control systems. Control experiments are incorporated in this course to enable students to explore control concepts in practice. After this course, students may proceed to higher level courses such as motion control design and computer controlled systems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe with the components of automatic control systems.		x		
2	Recognise and formulate time domain / frequency domain rep resentation of control systems.			x	
3	Categorise control systems and evaluate their responses to external inputs.			x	
4	Apply stability concepts to systems.			x	
5	Apply PID control.			x	
6	Analyse and design control systems using root-locus and / or frequency response methods / state-space approach.			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	Explain and illustrate theory and practice.	1, 2, 3, 4, 5, 6	3 hrs/week
2	Laboratory Work	Experiment with control systems.	1, 2, 3, 4, 5, 6	3 hrs/week for 4 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests	1, 2, 3, 4, 5, 6	24	2-3 tests spread over the semester

2	Laboratory Reports	1, 2, 3, 4, 5, 6	16	3-4 reports to be developed by the students

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2.5

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

1. Tests

Criterion

Basic understanding and use of control principles.

Excellent (A+, A, A-)

Strong evidence of original thinking; excellent capacity to analyse and synthesize; superior grasp of subject matter; clear evidence of extensive knowledge base in related control theory and methods.

Good (B+, B, B-)

Evidence of grasp of subject topics, and some evidence of critical capacity and analytic ability in control systems; reasonable understanding of essential control issues; evidence of familiarity with the literature of control engineering.

Fair (C+, C, C-)

Student who is profiting from the university experience; understanding of the main control topics; ability to develop solutions to simple problems in control engineering.

Marginal (D)

Sufficient familiarity with the subject matter in control principles to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the control essential methods; weakness in critical and analytic skills in using control methods; limited or irrelevant use of taught control theory.

Assessment Task

2. Laboratory Reports

Criterion

Application of control principles. Explain differences between theory and practice.

Excellent (A+, A, A-)

Strong evidence of original thinking; excellent capacity to analyse and synthesize experimental data and systems; superior grasp of hand-on skills; clear evidence of extensive knowledge base in data interpretation, system integration, analysis skills, and/or technical trends.

Good (B+, B, B-)

Evidence of grasp of subject topics, and some evidence of critical capacity and analytic ability in control systems; reasonable understanding of basic control theory and methods; evidence of familiarity with the literature of control engineering.

Fair (C+, C, C-)

Student who is profiting from the university experience; understanding of the main control topics; ability to develop solutions to simple problems in control system integration.

Marginal (D)

Sufficient familiarity with the subject matter in control system integration to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the control essential methods; weakness in critical and analytic skills in using control methods; limited or irrelevant use of taught control theory or methods in experiments.

Assessment Task

3. Examination

Criterion

In depth understanding and use of control principles.

Excellent (A+, A, A-)

Strong evidence of original thinking; excellent capacity to analyse and synthesize; superior grasp of subject matter; clear evidence of extensive knowledge base in related control theory and methods.

Good (B+, B, B-)

Evidence of grasp of subject topics, and some evidence of critical capacity and analytic ability in control systems; reasonable understanding of essential control issues; evidence of familiarity with the literature of control engineering.

Fair (C+, C, C-)

Student who is profiting from the university experience; understanding of the main control topics; ability to develop solutions to simple problems in control engineering.

Marginal (D)

Sufficient familiarity with the subject matter in control principles to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the control essential methods; weakness in critical and analytic skills in using control methods; limited or irrelevant use of taught control theory.

Additional Information for AR

Note: For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Part III Other Information

Keyword Syllabus

Introduction to automatic control. Time domain and Frequency domain representation of control systems. Systems and their response to inputs. Control performance specifications. PID control. System stability. Root-locus. Frequency response. State-space approach

Reading List

Compulsory Readings

	Title
1	Franklin, G.F., Powell, J.D., and Emami-Naeini, A., Feedback Control of Dynamic Systems, Pearson.

Additional Readings

	Title
1	Ogata, K., Modern Control Engineering, Pearson.
2	Dorf, R.C. and Bishop, R.H., Modern Control Systems, Pearson.
3	Phillips, C.L., Parr, J., Feedback Control Systems, Pearson.
4	Nise, N.S. Control Systems Engineering, Wiley.
5	Ogata, K., MATLAB for Control Engineers, Pearson.