CONTROL - 2024/5

Module code: ENG2123

Module Overview

Control and its application spans across all areas of engineering and beyond. Examples of control systems can be found in automotive, biomedical, aerospace and mechanical engineering. Furthermore, industrial automation leverages control systems to improve efficiency, quality, safety while reducing production costs. This control module introduces to students foundational concepts in control engineering and provide methods for analysing linear dynamic systems and linear control systems that can be applied to different engineering domains. This module gives to students also the foundation for the design of standard control solutions.

Module provider

Mechanical Engineering Sciences

Module Leader

MONTANARO Umberto (Mech Eng Sci)

Number of Credits: 15

ECTS Credits: 7.5

Framework: FHEQ Level 5

Module cap (Maximum number of students): N/A

Overall student workload

Independent Learning Hours: 65

Lecture Hours: 33

Tutorial Hours: 11

Guided Learning: 8

Captured Content: 33

Module Availability

Semester 2

Prerequisites / Co-requisites

None.

Module content

Indicative content includes:

Introduction: terminology, the concept of control, the feedback control mechanism, and examples of dynamic systems;

Laplace transform: definition, derivation of simple Laplace Transforms; properties of the Lapalce Transform; application to solution of systems of linear differential equations.

Process modelling: concept, the transfer function and its characteristics, system response from the transfer function, block diagrams and system simplification;

Linear system analysis in the time domain: system response and step response, system response versus pole location;

Design of control systems in time domain: closed loop vs. open loop systems, general requirements of control systems, standard controllers (e.g., P, PI, and PID controllers);;

Frequency domain analysis: concept, frequency response and Bode diagrams.

Assessment pattern

Assessment type	Unit of assessment	Weighting
Online Scheduled Summative Class Test	Online Test (1 hour)	20
Examination	Closed Book Exam (2 hours)	80

Alternative Assessment

None.

Assessment Strategy

The assessment strategy is designed to provide students with the opportunity to demonstrate understanding of scientific principles, methodologies and mathematical methods associated with system analysis and control systems as well as the ability to analyse and design particular systems in the final examination. The inter-semester test amplifies awareness and ability to devise control concept and to analyse systems from their response.

Thus, the summative assessment for this module consists of:

- In-semester test [Learning outcomes 2, 3]
- Examination [Learning outcomes 1, 3, 4, 5]

The Formative assessment consists in active discussion during the lectures and tutorials, either triggered by the module conveyer or directly by the student. Moreover, tutorials solutions are provided after tutorial sessions.

Feedback is given verbally via weekly supported tutorial work.

Module aims

- Expose students to a systematic understanding and critical awareness of the importance of control in engineering;
- Provide students with the knowledge of how to analyse linear dynamic systems;
- Provide students with the knowledge of techniques used to analyse linear and time-invariant control systems;
- Equip students with an understanding of transform methods for solving engineering problems.

Learning outcomes

		Attributes Developed
001	Provide, identify and compose: the specification of the dynamics and control requirements of systems; the general concept, the types and the structure of control systems;	K
002	Effectively interpret and employ definitions of common terms including feed-forward, feedback, linear and non-linear models, and time and Laplace domain;	KP
003	Select and use appropriate Laplace Transform techniques and results in solving control problems and initial value engineering problems;	K
004	Formulate simple dynamic models rigorously, tune a controller using simple rules, employ Laplace transform and represent dynamics as block diagrams;	C
005	Recognise the importance and relevance of process dynamics and control, especially the behaviour of linear, time-invariant and single loop feedback systems.	PT

Attributes Developed

C - Cognitive/analytical

K - Subject knowledge

T - Transferable skills

P - Professional/Practical skills

Methods of Teaching / Learning

The learning and teaching strategy is designed to familiarize students with the methods for the analysis of linear dynamic systems and linear control systems, as well as the design of basic standard controllers. This is attained by combining theoretical instruction and practical application by using worked examples. The primary methods of delivering this strategy involve lectures (supported by captured content) and tutorial sessions.

The learning and teaching methods include:

- Lectures (supported by captured content) aim to present and enable discussion on fundamental topics, methods and theories.

- Tutorials provide students with an opportunity to review and strengthen their grasp of concepts covered in lectures. By working collaboratively in groups, students can actively participate in discussions, inquire questions, and grow their comprehension of the subject.

- Guided Learning provide students with an opportunity to consolidate methods and theories.

Indicated Lecture Hours (which may also include seminars, tutorials, workshops and other contact time) are approximate and may include in-class tests where one or more of these are an assessment on the module. In-class tests are scheduled/organised separately to taught content and will be published on to student personal timetables, where they apply to taken modules, as soon as they are finalised by central administration. This will usually be after the initial publication of the teaching timetable for the relevant semester.

Reading list

https://readinglists.surrey.ac.uk
Upon accessing the reading list, please search for the module using the module code: ENG2123

Other information

The School of Mechanical Engineering Sciences is committed to developing graduates with strengths in Employability, Digital Capabilities, Global and Cultural Capabilities, Sustainability, and Resourcefulness and Resilience. This module is designed to allow students to develop knowledge, skills, and capabilities in the following areas:

Employability:Nowadays, control systems and automation are becoming more and more important and are used in all areas of engineering and beyond. This module equips students with the necessary knowledge and skills for analysing linear control systems and designing basic controllers, which have broad applicability in numerous engineering fields. Acquiring these abilities is essential for achieving success in professional engineering careers.

Resourcefulness & Resilience: Throughout the module, students will foster their ability to effectively tackle problem-based questions by demonstrating resourcefulness. Through active participation in tutorials, they will actively contribute ideas and problem-solving techniques, thereby fostering confidence and collaborative skills. This collaborative approach will contribute to achieving successful outcomes.

Programmes this module appears in

Programme	Semester	Classification	Qualifying conditions
Aerospace Engineering BEng (Hons)	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Aerospace Engineering MEng	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Automotive Engineering (Dual degree with HIT) BEng (Hons)	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Automotive Engineering BEng (Hons)	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Automotive Engineering MEng	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Biomedical Engineering BEng (Hons)	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module

Programme	Semester	Classification	Qualifying conditions
Biomedical Engineering MEng	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Mechanical Engineering BEng (Hons)	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Mechanical Engineering MEng	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module