IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	
Long title	Control Systems		
New code	ELEC50004	New short title	

Brief description of module *(approx. 600 chars.)*

The aim of this module is to provide you with the basic elements of the theory of dynamic systems and of the basic techniques to design automatic control systems meeting functional and performance specifications and taking into account technological constraints.

Dynamic models in the state-space and in the frequency domain are dealt with as well as basic time-behaviour analysis of closed-loop systems.

Static and dynamic design of the control system is addressed and links are established with the experimental validation on a selected hardware test benchmark in the laboratory of the dynamic models and the satisfaction of the closed-loop requirements

Available as a standalone module/ short course? N

Statutory details

	ECTS	CATS	Non-credit	
Credit value	7.5	15	N	HECOS codes
FHEQ level	Level 5			

Allocation of study hours

	Hours	
Lectures	16	
Group teaching	8	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	12	
Other scheduled		*Incl. project supervision, fieldwork, external visits.*
Independent study	151.5	*Incl. wider reading/ practice, follow-up work, completion of assess*
Placement		*Incl. work-based learning and study that occurs overseas.*
Total hours	187.5	
ECTS ratio	25.00	

Project/placement activity

Is placement activity allowed? No

Module delivery

Delivery mode	Taught/ Campus	Other	
Delivery term	Term 2	Other	

Ownership

Primary department: Electrical and Electronic Engineering

Additional teaching departments	
Delivery campus	South Kensington

Collaborative delivery

Collaborative delivery?	N

External institution	N/A
External department	N/A
External campus	N/A

Associated staff

Role	CID	Given name	Surname
Module Leader		Thomas	Parisini

Learning and teaching

Module description

Learning outcomes	Upon successful completion of this module, you will be able to: 1. Construct linear dynamic models of engineering systems of practical relevance in the frequency and in the state-space domain 2. Recognise the basic principles governing the behaviour of a closed-loop control system including the modes of behaviour of its basic components 3. Evaluate, among several options, how to configure and structure the architecture and the controller of an automatic control system starting from functional requirements and considering technological constraints 4. Analyse the static and dynamic performance of basic linear feedback control systems and design controllers such that the overall control system behaves according to pre-specified requirements. 5. Analyse and quantify the impact of digital implementation of the control system on the closed-loop performance 6. Validate experimentally the dynamic models and the satisfaction of the closed-loop requirements on a selected hardware test benchmark in the laboratory

Module content	1. Introduction to control problems Objectives of closed-loop automatic control. Examples in the engineering and industrial context of automatic control problems. Transient and steady-state performances of control systems. Types and elements of an automatic control system (open-loop, closed-loop, compensation, regulators, sensors, actuators). Motivations for the use of discrete-time control systems. 2. Dynamic models Continuous-time and discrete-time linear systems: time-domain and transfer function models, stability. Step-response (with emphasis on first and second-order systems), block schemes. Mathematical description of significant engineering systems in continuous- and discrete-time. Relations between frequency response and time response. Interpretation of linear systems as filters. 3. Sampled-data systems Sampling process, aliasing, choice of sampling time. Continuous-discrete conversion approximate techniques: implicit Euler method, Tustin transform. 4. Analysis and design of automatic control systems Control systems requirements: stability, precision, disturbance compensation, robustness. Stability analysis: Nyquist and Bode criteria. Performance analysis and relation with loop-transfer function characteristics. Design of continuous time regulators using the Bode and root-locus methods. Design of sampled-data controllers by discretization of continuous-time controllers: use of continuous-discrete conversion approximate techniques. PID controllers
Learning and Teaching Approach	You will be taught through lectures in a large lecture theatre to the whole year group using PowerPoint presentation and interactive teaching technology supported question and answer sessions. These lectures will be recorded. Exercise classes consist of thirty-sixty students will focus on applying the techniques covered in lectures to a variety of problems ranging from the easy to the difficult, with the chance to ask questions and get one-to-one help. These classes will involve both individual as well as group work. In tutorial groups of 3-4 students you will have the opportunity to solve a selection of problems with your personal tutor. Laboratory exercises will link the topics taught directly to their applications. Simulations will be part of the learning in applied settings.
Assessment Strategy	There will be a computer based test furing midterm week. The laboratory work is a part of the module assessment. This assessment will be based on an oral exam that evaluates your understanding of the concepts and your ability to explain and build the experimental set-up. The final exam will cover all the topics in the module.
Feedback	Feedback will be given in the exercise classes. The computer-based test will generate automatic feedback. Feedback on the oral laboratory exam will be given after the assessments. Feedback on the exams will be giving in after re-assessments have been given. This feedback will come in the form of annotated example answers. The annotations will highlight where the student cohort did well and where general problems in understanding were observed.
Reading list	
Required equipment/ software	NA

Quality assurance

Date of first approval	
Date of last revision	
Date of this approval	July 2025
Module leader	Thomas Parisini
Notes/ comments	

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Template version

Assessment details

Grading method	Numeric	Pass mark	40%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Practical	laboratory practicals	30%	40%	N
Examination	Spring mid-term computer based test	10%	40%	N
Examination	exam at start of summer term	60%	40%	N
		100%		