Undergraduate Course: Control and Instrumentation Engineering 3 (SCEE09002)

Course Outline

School	School of Engineering	College	College of Science and Engineering
Credit level (Normal year taken)	SCQF Level 9 (Year 3 Undergraduate)	Availability	Available to all students
SCQF Credits	10	ECTS Credits	5
Summary	This is a first course in the design and analysis of instrumentation and control systems. The course starts with an introduction to instrumentation, covering the basics of sensor technology and measurement techniques, including the characteristics and real-world limitations of transducers as well as their interfacing with the control system. It then goes on to introduce Control Theory, providing a basic understanding and building the mathematical background for the modelling, design and analysis of linear single-input single-output feedback systems. It then introduces the concept of stability as well as the available methods for its assessment. It develops the analytical tools for the design of appropriate controllers to improve system performance. It allows students to appreciate the interdisciplinary nature and universal application of control engineering. Finally it introduces modern approaches including application of artificial intelligence to control systems. The course also has a hands-on laboratory (3 hours in total split into 2 sessions) which allows the students to get practical experience in working with a dynamic system and designing a simple controller.		
Course description	Topics covered (and indicative no. of lectures for each): Instrumentation (3 lectures): main types of transducers including flow, pressure, temperature, position, force, velocity and acceleration transducers; signal conditioning and interfacing. Mathematical Models of Dynamic Systems (5 lectures): open and closed-loop systems; static and dynamic response; modelling of linear systems; linearisation; Laplace transform; transfer functions; block diagrams.		

Navigation

Help & Information
Home
Introduction
Glossary
Search DPTs and Courses
Regulations
Regulations
Degree Programmes
Introduction
Browse DPTs
Courses
Introduction
Humanities and Social Science
Science and Engineering
Medicine and Veterinary Medicine
Other Information
Combined Course Timetable
Prospectuses
Important Information

	Feedback Systems (5 lectures): error signals; sensitivity; disturbance rejection; steady-state and transient response; performance of 1st and 2nd order systems; stability; Routh-Hurwitz stability criterion. Control Systems in Frequency Domain (5 lectures): Bode plots; gain and phase margins; frequency domain performance specifications; relative stability; controller design using frequency response methods. Controller Design (4 lectures): Proportional-Integral-Derivative controllers; Phase-lead and lag compensators; introduction to Artificial Intelligence for Control (Neural Networks, Fuzzy Controllers).

Entry Requirements (not applicable to Visiting Students)

Pre-requisites		**Co-requisites**	
Prohibited Combinations		**Other requirements**	None
Additional Costs	None		

Information for Visiting Students

Pre-requisites	Any visiting student registering to this course should possess the following: - Solid knowledge of basic engineering mathematics including partial derivatives, integrals, complex numbers and matrices; - Familiarity with methods for the solution of ODEs; - Understanding of eigenvalues and eigenvectors; - Familiarity with dynamic mechanical systems (kinematics and oscillatory systems), and/or electrical systems (DC/AC analysis of circuits).
High Demand Course?	Yes

Course Delivery Information

Academic year 2019/20, Available to all students (SV1)	**Quota: None**
Course Start	Semester 2
Course Start Date	13/01/2020
Timetable	Timetable
Learning and Teaching activities (Further Info)	Total Hours: 100 (Lecture Hours 22, Seminar/Tutorial Hours 11, Supervised Practical/Workshop/Studio Hours 3, Formative Assessment Hours 1, Summative Assessment Hours 4, Programme Level Learning and Teaching Hours 2, Directed Learning and Independent Learning Hours 57)
Assessment (Further Info)	Written Exam 80 %, Coursework 20 %, Practical Exam 0 %
Additional Information (Assessment)	Assignment (Lab Report) (20%) Final Exam (80%)
Feedback	Formative feedback is given in the form of an exam-level question answered by the students

	during a tutorial session. The solution is then discussed, indicating the common errors made by students and presenting a marking template for the students to self- or peer-mark.

Exam Information

Exam Diet	Paper Name	Hours & Minutes
Main Exam Diet S2 (April/May)		1:30
Resit Exam Diet (August)		1:30

Learning Outcomes

On completion of this course, the student will be able to:

1. Understand how transducers work and interface with a control system and appreciate the theoretical and practical limitations in any measurement;
2. Derive the transfer function of a linear (or linearised) dynamic system;
3. Understand the concept of feedback in control systems;
4. Analyse the behaviour of a linear SISO system in both time and frequency domains and assess its stability;
5. Design appropriate controllers for simple control systems to meet performance specifications;

Reading List

Main textbook:
Dorf, R. C. and Bishop, R. H., Modern Control Systems, 12th ed., Pearson Education, 2011, ISBN-10: 0131383108

Additional bibliography:
Ogata, K., Modern Control Engineering, 5th ed., Pearson Education, 2008, ISBN-10: 0137133375

Nise, N. S., Control Systems Engineering, 6th ed., Willey International, 2011, ISBN-10: 0470646128

Golnaraghi, F. and Kuo, B. C., Automatic Control Systems, 9th ed., John Wiley & Sons, 2009, ISBN-10: 0470048964

Additional Information

Graduate Attributes and Skills	Not entered
Additional Class Delivery Information	22 lectures; 10 tutorial/example sessions 2 lab sessions (1.5 hour each)
Keywords	Control Systems,Control Engineering,Instrumentation

Contacts

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