



Title:	Control Systems	APPROVED
Long Title:	Control Systems	
Module Code:	INTR7016	
Credits:	5	
NFQ Level:	Intermediate	
Field of Study:	Interdisciplinary Engineering	
Valid From:	Semester 1 - 2014/15 (September 2014)	
Module Delivered in	1 programme(s)	
Module Coordinator:	JOSEPH CONNELL	
Module Author:	THOMAS O MAHONY	
Module Description:	This module focuses on key control systems concepts which are developed through the use of Laplace transforms. The module aims to develop an understanding of closed-loop systems and their importance to modern society. Learners will be introduced to modelling concepts, feedback systems, analysis techniques for assessing the performance and stability of feedback systems, popular feedback controllers and introductory design techniques for such systems.	
Learning Outcomes		
On successful completion of this module the learner will be able to:		
LO1	Determine the Laplace Transfer Function of first-order systems with or without time delay	
LO2	Calculate the closed-loop transfer function of first and second order systems, with or without time-delay	
LO3	Analyse the transient performance and steady-state error of closed-loop systems	
LO4	Use tuning rules to design proportional and proportional-plus-integral controllers.	
LO5	Use MATLAB-SIMULINK to assist the controller design process	
Pre-requisite learning		
Module Recommendations		
This is prior learning (or a practical skill) that is strongly recommended before enrolment in this module. You may enrol in this module if you have not acquired the recommended learning but you will have considerable difficulty in passing (i.e. achieving the learning outcomes of) the module. While the prior learning is expressed as named CIT module(s) it also allows for learning (in another module or modules) which is equivalent to the learning specified in the named module(s).		
8827	MATH7022	Maths for Electrical Eng
Incompatible Modules		
These are modules which have learning outcomes that are too similar to the learning outcomes of this module. You may not earn additional credit for the same learning and therefore you may not enrol in this module if you have successfully completed any modules in the incompatible list.		
10461	INTR7017	Control Systems Analysis
Co-requisite Modules		
No Co-requisite modules listed		
Requirements		
This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.		
No requirements listed		
Co-requisites		
No Co Requisites listed		

Module Content & Assessment

Indicative Content

Control Systems

Control systems terminology, open loop and closed loop systems, objectives of closed loop control, examples of control loops such as heating control and level control. ON-OFF, proportional, integral and proportional-plus-integral controllers.

Analysis Techniques

The forward path, the feedback path, block diagram algebra, closed-loop transfer functions. Stability, instability in practice, system characteristic equation, the s-plane, poles and zeros. Closed-loop performance including system disturbance, steady state gain, steady state error, settling time and percentage overshoot. Measuring transient and steady-state performance.

Modelling

First-order differential equations of physical systems, Laplace Transform, first-order transfer functions, time-delay, Padé approximation, identifying first-order transfer function with time-delay from data.

MATLAB/Simulink

Typical MATLAB commands would be tf, step, impulse, feedback, pole, zero, pzmap. Building closed-loop transfer functions in Simulink. Transferring data from Simulink to MATLAB. Plotting data in MATLAB

Assessment Breakdown	%
Course Work	50.00%
End of Module Formal Examination	50.00%

Course Work

Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Written Report	Brief laboratory reports that present results and summarise learning from practical laboratories	1,2,3,4,5	30.0	Every Second Week
Multiple Choice Questions	Mid-semester closed-book assessment covering ON-OFF control, proportional control, first-order transfer function, closed-loop transfer functions, transient and steady-state performance.	1,2,3	20.0	Week 7

End of Module Formal Examination

Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Formal Exam	End-of-Semester Final Examination	1,2,3,4	50.0	End-of-Semester

Reassessment Requirement

Repeat examination

Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.

The institute reserves the right to alter the nature and timings of assessment

Module Workload

Workload: Full Time

<i>Workload Type</i>	<i>Workload Description</i>	<i>Hours</i>	<i>Frequency</i>	<i>Average Weekly Learner Workload</i>
Lecture	Lectures to address learning outcomes	2.0	Every Week	2.00
Lab	using MATLAB & Simulink to explore and develop understanding of the Learning Outcomes	2.0	Every Week	2.00
Independent & Directed Learning (Non-contact)	Revision of lecture notes, complete revision problems, preparation for assessment	3.0	Every Week	3.00
Total Hours				7.00
Total Weekly Learner Workload				7.00
Total Weekly Contact Hours				4.00

Workload: Part Time

<i>Workload Type</i>	<i>Workload Description</i>	<i>Hours</i>	<i>Frequency</i>	<i>Average Weekly Learner Workload</i>
Lecture	Lectures to address Learning Outcomes	1.0	Every Week	1.00
Lab	using MATLAB & Simulink to explore and develop understanding of the Learning Outcomes	2.0	Every Week	2.00
Independent & Directed Learning (Non-contact)	Revision of lecture notes, complete revision problems, preparation for assessment	4.0	Every Week	4.00
Total Hours				7.00
Total Weekly Learner Workload				7.00
Total Weekly Contact Hours				3.00

Module Resources
Supplementary Book Resources
<ul style="list-style-type: none"> • Gene F. Franklin, J. David Powell, Abbas Emami-Naeini 2010, <i>Feedback control of dynamic systems</i>, 6th Ed., 15, Prentice Hall Upper Saddle River [N.J.] [ISBN: 978-0136019695] • Katsuhiko Ogata 2009, <i>Modern Control Engineering</i>, 5th Ed., Prentice Hall [ISBN: 978-0136156734] • Katsuhiko Ogata 2008, <i>Matlab for control engineers</i>, Pearson/Prentice Hall Upper Saddle River, N. J. [ISBN: 978-0136150770]
<i>This module does not have any article/paper resources</i>
Other Resources
<ul style="list-style-type: none"> • Website: University of Edinburgh 2013, <i>An interactive introduction to MATLAB</i>, UK http://www.eng.ed.ac.uk/teaching/courses/matlab/ • Website: Prof. Ming Tham, University of Newcastle Upon Tyne 2006, <i>Control Course Notes and Learning Resources</i>, UK http://lorien.ncl.ac.uk/ming/Dept/Swot/c_onnotes.htm • Website: Gordon 2013, <i>Introduction to Simulink</i>, MathWorks, Inc, Webinar, USA https://www.mathworks.co.uk/company/events/webinars/wbnr37271.html

Module Delivered in			
Programme Code	Programme	Semester	Delivery
CR_EELEC_7	Bachelor of Engineering in Electrical Engineering	6	Mandatory