CTRL H4613: Dynamics and Control

Module Title:	Dynamics and Control
Language of Instruction:	English

Credits:	10

NFQ Level:	8

Module Delivered In	No Programmes

Teaching & Learning Strategies:	The module will be delivered using lectures, tutorials and laboratory sessions to illustrate the concepts under study.

Module Aim:	• To provide the student with a specialised knowledge of the vibration of mechanical systems. • To analyse the behaviour and control of dynamic systems. • To design control strategies to modify the responses of dynamic systems

Learning Outcomes	
On successful completion of this module the learner should be able to:	
LO1	Derive and apply formulae to solve design problems involving the vibration of a mechanical system with one degree of freedom.
LO2	Derive and apply formulae to solve design problems involving the vibration of a mechanical system with two degrees of freedom.
LO3	Specify the performance characteristics of a control system.
LO4	Analyse the operation and performance of a feedback control system.
LO5	Design a control strategy in order to achieve the required system specifications.

Pre-requisite learning
Module Recommendations *This is prior learning (or a practical skill) that is recommended before enrolment in this module.*
No recommendations listed
Incompatible Modules *These are modules which have learning outcomes that are too similar to the learning outcomes of this module.*
No incompatible modules listed
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.*
No requirements listed

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Module Content & Assessment

Indicative Content
• Vibrating Systems with one degree of freedom: o Free vibration of damped spring-mass systems; o Forced vibration of damped spring-mass systems; - excitation by harmonic force of constant amplitude; - excitation by rotating unbalance; - excitation by harmonic support vibration; - transmissibility of system; o Vibration isolation; whirling of shafts; o Vibration measurement.
• Vibrating Systems with two degrees of freedom: o Normal mode of vibration; o Undamped free vibration of two degree of freedom systems; o Undamped forced vibration of two degree of freedom systems; o Torsional vibration with two degrees of freedom; o Vibration Absorbers.
• Review of control systems o Applications of feedback control o Reasons for using feedback o The design process
• System modelling o Experimental methods o Mathematical modelling - Use of differential equations - Use of Laplace Transforms - Poles and zeros o Block diagrams - Block diagram reduction - Disturbance inputs - Transfer functions o Signal flow graphs
• Time response o Transient and steady state responses - First and higher order responses - Time delay - Specifications
• Frequency response o Introduction o Frequency response specifications - System gain in dB - Bandwidth - Effect of system order - Resonance o Frequency response diagrams - Bode diagrams. First & higher order systems. Time delay. - Closed loop
• System stability o The Bode Stability Criterion - Gain & phase margins o Nyquist Analysis o Transfer functions and pole _ zero plots - Closed loop response o The Routh-Hurwitz Criterion
• Servo Systems o Components of a servo control system - Specifications - Responses o System responses to standard inputs o Design examples and component selection o Application areas - Robot systems
• Sensitivity o Open and closed loop systems o Parameter variations

Assessment Breakdown	%
Continuous Assessment	15.00%
Practical	15.00%
End of Module Formal Examination	70.00%

Continuous Assessment

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Other	Students will be expected to sit a number of individual written assessments throughout the academic year, typically at the conclusion of one or more learning outcomes.	1,2,3,4,5	15.00	n/a

No Project

Practical

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Practical/Skills Evaluation	Students will carry out a number of laboratory sessions throughout the academic year and will produce written reports describing each one. Students will be assigned to groups for the execution of the laboratory practical work but reports must be submitted on an individual basis. Laboratory practical work will investigate the following topics: o Motor speed control o Magnetic suspension o Tandem pendulum o Tank level control o Computer simulation tools o Whirling of shafts	1,2,4	15.00	Sem 1 End

End of Module Formal Examination

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Formal Exam	A final written examination will assess the extent to which the student has achieved the module learning outcomes	1,2,3,4,5	70.00	End-of-Semester

SETU Carlow Campus reserves the right to alter the nature and timings of assessment

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Module Workload

Workload: Full Time		
Workload Type	*Frequency*	*Average Weekly Learner Workload*
Lecture	Every Week	2.50
Laboratory	Every Week	0.50
Estimated Learner Hours	Every Week	3.00
	Total Hours	6.00