University of the West of Scotland

Module Descriptor

Session: 2024/25

Title of Module: Process Dynamics and Control			
Code: ENGG10044	**SCQF Level: 10 (Scottish Credit and Qualifications Framework)**	**Credit Points: 20**	**ECTS: ECS (European Credit Transfer Scheme)**
School:	School of Computing, Engineering and Physical Sciences		
Module Co-ordinator:	Luc Hughes Rolland		

Summary of Module

This module is intended to provide students with dynamics and controls of chemical engineering processes as they are relevant in the contemporary engineering profession.

This module brings together the knowledge gained in previous years in the fields of process modelling, process safety, process monitoring and process control (regarding L1).

It develops students' ability to carry out the calculations necessary to design control systems using both the Laplace domain, transfer functions, time domain analysis and the frequency analysis techniques (regarding L3).

It reviews the process modelling principles then discusses linearization of non-linear models, system response (1^{st}, 2^{nd} and more complicated systems), the effect of time delay and the phenomena of inverse response (regarding L3).

The module provides a detailed discussion of the different control strategies and control modes employed in the process industry such as feedback control, feed-forward control, ratio control, cascade control, as well as stability and controller design and tuning relations (regarding L4). Advanced control techniques, multi-loop and multivariable control, and process monitoring using machine learning will be covered, as will an appreciation of cyber security for the protection of commercial and control data (regarding L5).

The module discusses plant-wide control and the use of information gained from HAZOP and other hazard assessment and identification techniques in the design of control systems and individual equipment operational control loops (regarding L2). Systems for start-up and shut-down form an integral part of the course. Control valves with their actuators, alarms, relief valves and relief systems are also covered in the module.

- I am UWS (https://www.uws.ac.uk/current-students/your-graduate-attributes/): Upon completing this module the students will be equipped with tools that will help them in their journey to be work-ready, successful and universal. The module develops critical thinking and analytical skills that enhance the students' ability to deal with complicated issues and make them problem solvers. It encourages them to become motivated, innovative, autonomous, inquisitive, creative and imaginative. The module and the teaching approach encourage collaborative working, effective communications, resilience and perseverance, and development of research and inquiry skills. The aim is to produce graduates who are knowledgeable with excellent digital skills fit for the 21st century and aware of the global context in which they operate and the challenges that face humanity in the 21st century

in the areas of water, food, energy, environment and well-being, who strive to lead, influence and dare to make transformational changes while being ethically-minded, socially responsible, critically aware of the environmental and social impacts of their decisions and actions, and culturally sensitive.

Module Delivery Method					
Face-To-Face	**Blended**	**Fully Online**	**HybridC**	**Hybrid 0**	**Work-Based Learning**
☒	☐	☐	☐	☐	☐
See Guidance Note for details.					

Campus(es) for Module Delivery						
The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit) (tick as appropriate)						
Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
☒	☐	☐	☐	☐	☐	Add name

Term(s) for Module Delivery					
(Provided viable student numbers permit).					
Term 1	☐	Term 2	☒	Term 3	☐

Learning Outcomes: (maximum of 5 statements) **These should take cognisance of the SCQF level descriptors and be at the appropriate level for the module.** At the end of this module the student will be able to:	
L1	Demonstrate a critical understanding of chemical processes dynamics and their related control systems while grasping the impacts, benefits and risks of digitalisation including the role they play in the safe and economic operation of the process industry.
L2	Demonstrate critical understanding of the role of hazard assessment techniques in the safe operation and control of chemical plants. Adopt a holistic and proportionate approach to the mitigation of security risks using measurement, controls and automation.
L3	Derive process models and manipulate them to enable the deduction of the steady-state and transient behaviours and transient behaviours of a system quantitatively.
L4	Critically understand the different control modes and control strategies and the basis for selection, specification, implementation and field tuning of control systems.

L5	Identify and implement control strategies for specific equipment and systems.

Employability Skills and Personal Development Planning (PDP) Skills		
SCQF Headings	During completion of this module, there will be an opportunity to achieve core skills in:	
Knowledge and Understanding (K and U)	SCQF Level **10** Demonstrate a critical knowledge of control systems and their operation. Develop a critical and analytical approach to control systems and their role in the safe operation of chemical processes.	
Practice: Applied Knowledge and Understanding	SCQF Level **10** Apply process control techniques in the design of safe operations. Use a range of skills in solving problems in proces control.	
Generic Cognitive skills	SCQF Level **10** Critically conceptualise the details of a control system and the role process control plays in the safe operation chemical plants and their role in safety and environmental protection.	
Communication, ICT and Numeracy Skills	SCQF Level **10** Be able to explain and communicate all the details of a control system clearly, precisely and without any ambiguity to the team, the management and other concerned parties such as the authority and the public.	
Autonomy, Accountability and Working with others	SCQF Level **10** Deal with complex issues related to process control in teams within and out with the organisation. To present information about a process control system in clear precise scientific and engineering manner.	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code:	**Module Title:**
	Other:	
Co-requisites	**Module Code:**	**Module Title:**

*Indicates that module descriptor is not published.

Learning and Teaching
In line with current learning and teaching principles, a 20-credit module includes 200 learning hours, normally including a minimum of 36 contact hours and maximum of 48 contact hours.

Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	18
Tutorial/Synchronous Support Activity	18
Laboratory/Practical Demonstration/Workshop	12
Independent Study	152
	200 Hours Total

****Indicative Resources: (eg. Core text, journals, internet access)**

The following materials form essential underpinning for the module content and ultimately for the learning outcomes:

Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Process Dynamics and Control, 4th ed., Wiley, 2019. King, M. (2016) Process Control: A Practical Approach. Chichester: Wiley. 2nd edition.

Luyben, Tyreus and Luyben (1998) Plantwide Process Control. McGraw Hill.

Thomas Marlin, Process Control, Designing Processes and Control, System Dynamics Performance, 2nd edition, McGraw-Hill 2014

IChemE Knowledge Hub (various articles)

(**N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Attendance and Engagement Requirements

In line with the Student Attendance and Engagement Procedure: Students are academically engaged if they are regularly attending and participating in timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time.

Equality and Diversity

The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code.

(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)

Supplemental Information

Divisional Programme Board	Engineering
Assessment Results (Pass/Fail)	Yes ☐No ☒
School Assessment Board	Engineering
Moderator	Li Sun
External Examiner	R Ocone
Accreditation Details	This module is part of the BEng(Hons) Chemical Engineering programme accredited by the IChemE.
Changes/Version Number	1.06

Assessment: (also refer to Assessment Outcomes Grids below)
Assessment 1: final written exam worth 70% of the final mark,
Assessment 2: continuous assessment worth 30% of the final mark and it consist of a written assignment and a laboratory report.

Assessment Outcome Grids (See Guidance Note)

Component 1							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Unseen open book			✓	✓		70	3

Component 2							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Design/ Diagram/ Drawing/ Photograph/ Sketch	✓	✓		✓	✓	15	0
Laboratory/ Clinical/ Field notebook	✓			✓		15	0
Combined Total for All Components						**100%**	**3 hours**