University of the West of Scotland

Module Descriptor

Session: 2024/25

Title of Module: Process Design, Control and Safety			
Code: ENGG09036	**SCQF Level: 9** (Scottish Credit and Qualifications Framework)	**Credit Points: 20**	**ECTS: 10** (European Credit Transfer Scheme)
School:	School of Computing, Engineering and Physical Sciences		
Module Co-ordinator:	Li Sun		

Summary of Module

This module aims to extend the basic concepts studied so far into more detailed study of the design and costing of chemical plants and the control and safety of such plants Techniques such inherently safe design (ISD) and process intensifications (PI) will be introduced as part of the module. Calculation techniques learnt in earlier modules are now applied to fires and explosions, their effects and their prevention.

Sources of data on chemical processes and methods for data estimation will be discussed. Issues such as optimisation and design heuristics, plus process synthesis, a Gantt chart approach to batch processing and inherently safe design of process will be discussed.

The mathematics for dealing with large sets of algebraic and differential equations will be covered by the module. This will cover issues such as definition and mathematical formulation of optimisations problems, linear and non-linear programming, dynamic optimisation, constrained optimisation, unconstrained optimisation, cost function, constraints, solution methods and convergence.

Process and instrumentation diagrams will be introduced with the classic control loops and feedback control action (P, PI, PD, PID) and feedforward control as well.

The importance of the information gained from risk and hazard studies such as hazardous area classification and HAZOP will be illustrated and an introduction to safety management will be provided.

As part of this module, the students are expected to work in small groups on a mini project and in pairs on laboratory experiments.

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**	**HybridO**	**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)						
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	☐

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Learning Outcomes: (maximum of 5 statements)	
L1	Undertake and implement the techniques of conceptual process design and scheduling in batch and continuous operation as used in industry.
L2	To introduce the student to process control and have a student produce a feasible process and instrumentation diagram from a process flow diagram.
L3	Develop appreciation for the importance of process control in the fields of safety, environmental protection, quality control, loss prevention, plant costing and plant profitability.
L4	To enable a student to numerically optimise production and product quality and calculate both capital and running costs for chemical plants.
L5	Be able to appreciate the role of hazardous area classification and other regulations, plus ISD and PI in the safe operation of chemical plants.

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 9. Develop a broad understanding of the issues involved in chemical process design with the ability to critically examine a process flow diagram and to produce viable process and instrumentation diagrams

	for selected process equipment. The ability to carry out proper mass and energy balances for the system. Develop a broad understanding of the issues involved in chemical process design with the ability to critically examine a process and instrumentation diagram and to produce viable control and to complete the instrumentation diagrams for selected process equipment.	
Practice: Applied Knowledge and Understanding	SCQF Level 9. Develop the ability to critically examine a system and assess its safety features using HAZOP studies and take the appropriate steps to mitigate the consequences by proper control of the process.	
Generic Cognitive skills	SCQF Level 9. Critical analysis of situations involving process system and the ability to devise proper solutions for problems.	
Communication, ICT and Numeracy Skills	SCQF Level 9. The ability to identify the data needed for the process, locate it and use properly in the design process. Ability to use on-line databases and other electronic sources of information. Ability to convey information both written and orally in clear and proper technical formats. The ability to use spreadsheets and other mathematical software packages to prepare mass and energy balance for chemical processes.	
Autonomy, Accountability and Working with others	SCQF Level 9. Work autonomously and in teams when assessing processes. The ability to participate in group activity with distribution of responsibilities for both group and individual actions.	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code: ENGG08022	**Module Title:** Chemical Engineering Fundamentals
	Other:	or equivalent
Co-requisites	**Module Code:** ENGG09037	**Module Title:** Chemical Process Principles

* Indicates that module descriptor is not published.

Learning and Teaching	
This module covers a wide variety of theoretical, conceptual and practical areas, which require a range of knowledge and skills to be displayed and exercised. Delivery of its syllabus content therefore involves a diversity of teaching and assessment methods suitable to the learning outcomes of the module; these include formal lectures, structured tutorials (work closely integrated with the lecture material), practical skills in the assessment and enhancement of process safety, completion and submission of written coursework making use of appropriate forms of IT and VLE, and independent study. The hours for Lecture/Core Content Delivery include the exam and the class test.	
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	24
Tutorial/Synchronous Support Activity	12
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:
Seider, W. D., Seader, J. D., Lewin, D. R., Widagdo, S., Gani, R. and Ng, K.M., Product & Process Design Principles: Synthesis, Analysis and Evaluation, 4th Edition, Wiley, 2019

Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Process Dynamics and Control, 4th ed., Wiley, 2019.

Smith, R., Chemical Process Design and Integration, revised 2nd edition, Wiley, 2016

Turton et al, Analysis, Synthesis, and Design of Chemical Processes, 4th edition, Prentice-Hall, 2013

Richard M. Felder, Ronald M Rousseau and Lisa G Bullard, Felder's Elementary Principles of Chemical Processes, Wiley, revised 4th Edition, 2016

D. A. Cogan. Fundamentals of Industrial Control, ISA, 1992

Jonathan Love, Process automation handbook : a guide to theory and practice. [electronic book UWS], Springer, 2007

(**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.

Please ensure any specific requirements are detailed in this section. Module Co-ordinators should consider the accessibility of their module for groups with protected characteristics..
(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

Programme Board	Engineering
Assessment Results (Pass/Fail)	Yes ☐No ☒
Subject Panel	Engineering
Moderator	Mojtaba Mirzaeian
External Examiner	R Ocone
Accreditation Details	This module is part of the BEng(Hons) Chemical Engineering programme accredited by the IChemE.
Version Number	4 Assessment updated

Assessment: (also refer to Assessment Outcomes Grids below)
Assessment for the module includes both formative and summative assessment. Formative assessment is provided during lectures in the form of class exercise problems, during tutorial sessions, during laboratory sessions and as part of the preparation for written submissions. Summative assessment will be based on the following: (a) Unseen Closed Book Class Test worth 50% of the final mark, and
(b) The continuous assessment component in this module will consist of the following elements: (i) written mini project assignments worth 20% of the final mark, (ii) team presentation on the project worth 10% and (iii) practical lab reports worth 20% of the final mark. Further details, and the academic calendar when assessment is likely to feature, will be provided within the Module Information Pack.
(N.B. (i) **Assessment Outcomes Grids** for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed. (ii) An **indicative schedule** listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Handbook.)

Assessment Outcome Grids **(Footnote A.)**

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 Closed Book Class Test	✓	✓	✓		✓	50	2
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**
Case study					✓	20	0
Report of practical/ field/ clinical work		✓	✓	✓		20	6
Presentation	✓				✓	10	1
					Combined Total For All Components	100%	15 hours