University of the West of Scotland

Module Descriptor

Session: 23/24

Title of Module: Separation Processes			
Code: ENGG11039	**SCQF Level: 11 (Scottish Credit and Qualifications Framework)**	**Credit Points: 20**	**ECTS: 20 (European Credit Transfer Scheme)**
School:	School of Computing, Engineering and Physical Sciences		
Module Co-ordinator:	Mojtaba Mirzaeian		

Summary of Module

The module reviews the principles of transport processes relevant to separation processes, discusses the different types of separation techniques used and the principles underlying their operations. It also discusses the design principles of equipment and their economic integration into the overall process. Distillation: This provides an in-depth analysis of advanced and emerging distillation technologies such as azeotropic, reactive, extractive, adsorption, membrane, pressure-swing, cyclic, and dividing-wall column distillation. Batch distillation, Ponchon-Savarit techniques, heat integration, and distillation operations economics, are among the topics to be covered.

Ion Exchange: Sorbents properties and structure, physicochemical description of the process, equilibrium, kinetics, applications, equipment and equipment design operating in both batch and continuous modes.

Adsorption: Adsorbent and adsorption isotherms, equilibrium, kinetics, breakthrough curve, temperature and pressure swing adsorption principles and models, equipment design.

Large Scale Chromatographic Separations: Principles and applications, techniques, retention theory and elution chromatography, applications, separation performance and equipment.

Leaching: Principles and equilibrium relations, mass transfer between soluble solids and liquid, multistage design with both constant and variable underflow, applications, modes of operation and equipment design.

Membrane processes: Advanced membrane separation processes and types of membranes, mechanisms, applications, equipment design.

- During the course of this module students will develop their UWS Graduate Attributes (https://www.uws.ac.uk/current-students/your-graduate-attributes/). Universal: Academic attributes - critical thinking and analytical & inquiring

mind; Work-Ready: Academic attributes - integration of processes to give more efficient use of resources; Successful : autonomous, driven and resilient.

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	Develop a critical understanding of advanced concepts of separation processes that covers both depth and breadth of the subject.
L2	Develop advanced and critical knowledge of the role played by separation processes in the design and analysis of equipment that will also take into consideration the separation of substances with complex behaviour azeotropic distillation and issues such as environmental protection, resources conservation and sustainability and economic viability.
L3	Develop the underlying knowledge that will enable the analysis and design of equipment even in the cases of missing and/or incomplete data through research and innovation
L4	Develop the advanced skill required to use modern tools such as process simulators in the design of complex separation processes with critical

	understanding of their scope and limitations and also the use of software and digital technologies for problem solving in separation processes
L5	Develop critical understanding of emerging technologies in separation processes and their fit for purpose and limitations and understand how to combine and adapt different aspects of systems thinking to complex and novel processes

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 **11** Demonstrate: • A critical knowledge that covers and integrates most of the main areas of the discipline of separation processes and their relevance and application in chemical engineering context and at advance level. • A critical understanding of the principal theories, concepts and principles of separation processes. • A critical understanding of a range of specialised theories, concepts and principles applied to separation processes. • Extensive, detailed and critical knowledge and understanding of the role of separation processes in chemical engineering applications. • Develop a critical understanding of the implication of knowledge of separation processes principles in the advancement of modern and innovative chemical engineering design, conservation of resources and sustainability
Practice: Applied Knowledge and Understanding	SCQF Level **11** • Use a significant range of the core chemical engineering knowledge and skills to advance the knowledge of separation processes and their application in chemical engineering context. • The ability to use a range of specialised skills, techniques, practices and/or materials that are informed by the recent advances in the field of separation processes. • Apply a range of standard and specialised research and other techniques to advance understanding of separation processes. • Plan, develop and execute a relevant design based on advanced knowledge, research and innovation. • Demonstrate originality, creativity and critical thinking. • Apply knowledge of separation processes in a wide variety of chemical engineering applications that demand innovation
Generic Cognitive skills	SCQF Level **11** • Apply critical analysis, evaluation and synthesis to forefront issues, or issues that are informed by forefront developments in the area of separation processes and the interaction with the aspects of the Chemical Engineering profession. • Practice at a high level the ability to critically identify, analyse, conceptualise and define new and abstract problems related to separation processes and the application of the concepts in chemical engineering context.

	• Develop and demonstrate original and creative thinking and responses in dealing with complex or novel problems and issues. • Critically review, consolidate and extend knowledge, skills, practices and thinking in the field of separation processes. • Deal with complex issues and make informed judgements in situations in the absence of complete or consistent data/information through innovation and research. • Develop knowledge, employability skills and attributes relevant to their future careers.	
Communication, ICT and Numeracy Skills	SCQF Level **11** • Communicate, using appropriate methods, to a range of audiences with different levels of knowledge/expertise. • Communicate with peers, more senior colleagues and specialists. • Use a wide range of ICT applications to support and enhance work at this level and show critical understanding of the scope and limitations of the tools used and their underlying theoretical basis. • Undertake critical evaluations of a wide range of numerical and graphical data with the ability to deal with situations involving missing data and lack of information using research. • Communicate results accurately and reliably in a variety of formats and settings.	
Autonomy, Accountability and Working with others	SCQF Level **11** • Exercise high level of autonomy and initiative in professional and equivalent activities with the ability to work independently on significant and demanding tasks. • Take responsibility for own work and/or significant responsibility for the work of others providing leadership. • Take responsibility for a significant range of resources. • Demonstrate leadership and/or initiative and make an identifiable contribution to change and development. • Practise in ways which draw on critical reflection on own and others' roles and responsibilities. • Deal with complex ethical and professional issues in engineering context and make informed judgements on issues not addressed by current professional and/or ethical codes or practices.	
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	24
Tutorial/Synchronous Support Activity	12
Independent Study	152
	Hours Total 200

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

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

Henley, E. J., J. D. Seader and D. K. Roper (2016) Separation Process Principles. 4th Edition. Hobeken, N.J.: Wiley.

Kiss, A. A. (2013) Advanced Distillation Technologies: Design, Control and Applications. Chichester: Wiley.

Petlyuk, F. B. (2011) Distillation Theory and Its Application to Optimal Design of Separation Units. Cambridge: Cambridge University Press.

Smith R. (2016) Chemical process design and integration, 2nd edition, Wiley-Blackwell

McCabe, W, J. C. Smith and P. Harriott (2014) Unit Operations of Chemical Engineering, 7th edition, McGraw Hill

Backhurst, J. R.; Harker, J. H.; Richardson, J. F.; Coulson, J.(2002) Chemical Engineering Volume 2, 5th Edition, Butterworth-Heinemann.

(**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	Cristina Rodriguez
External Examiner	R Ocone
Accreditation Details	This module is part of Chemical Engineering MSc programme accredited by IChemE.
Changes/Version Number	1.11

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 quizzes and exercise problems, during tutorial sessions, during CAD sessions and as part of the preparation for written submissions. Summative assessment is provided by written assessment elements as well as a final exam.
Assessment 1 – Final exam worth 70% of the final mark.
Assessment 2 – Continuous assessment assignments worth 30% of the final mark.
(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 Module Handbook.)

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**
	X	X			X	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**
			X	X		30	0
Combined Total for All Components						**100%**	**3 hours**

Change Control:

What	**When**	**Who**
Further guidance on aggregate regulation and application when completing template	16/01/2020	H McLean
Updated contact hours	14/09/21	H McLean
Updated Student Attendance and Engagement Procedure	19/10/2023	C Winter
Updated UWS Equality, Diversity and Human Rights Code	19/10/2023	C Winter
Guidance Note 23-24 provided	12/12/23	D Taylor
General housekeeping to text across sections. .	12/12/23	D Taylor

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