Module Descriptor

Title	Advanced Reactor Design		
Session	2025/26	**Status**	Published
Code	ENGG11036	**SCQF Level**	11
Credit Points	20	**ECTS (European Credit Transfer Scheme)**	10
School	**Computing, Engineering and Physical Sciences**		
Module Co-ordinator	C Rodriguez		

Summary of Module

This module provides in-depth coverage of the safe and sustainable design of multiphase and biochemical reactors as well as the associated heat and thermal issues. The module revises chemical reactor fundamentals and reaction kinetics, then covers the design techniques of several types of industrially important reactors and related issues such as kinetics for multiphase reactors, transient behaviour, deviation from ideal behaviour and residence time distribution models, multiple steady states, stability, selectivity, sustainability and safety in the design of chemical and biochemical reactors.

The module discusses the modelling and design of Non-Catalytic Multiphase Reactors (mass transfer with chemical reactions, hydrodynamics of multiphase reactors, packed columns, plate columns, stirred tank reactors, bubble columns),Biochemical Reactors (operation in suspension and immobilized systems). Special attention will be paid to non-ideality in chemical reactors with mathematical treatment of residence time distribution in real reactors.

All students carry out and optimise a design on an assigned reactor to include materials of construction, its integration with other processes, the classification of hazardous areas, the procedure of its construction and decommission and of its control and dynamic behaviour in the face of various likely disturbances. In this design, students will familiarize themselves with the principles of sustainability, ethics, economy of process and the unknown.

Module Delivery Method	**On-Campus[1]**	**Hybrid[2]**	**Online[3]**	**Work -Based Learning[4]**
	☒	☐	☐	

[1] Where contact hours are synchronous/ live and take place fully on campus. Campus-based learning is focused on providing an interactive learning experience supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus contact hours will be clearly articulated to students.

[2] The module includes a combination of synchronous/ live on-campus and online learning events. These will be supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus and online contact hours will be clearly articulated to students.

[3] Where all learning is solely delivered by web-based or internet-based technologies and the participants can engage in all learning activities through these means. All required contact hours will be clearly articulated to students.

[4] Learning activities where the main location for the learning experience is in the workplace. All required contact hours, whether online or on campus, will be clearly articulated to students

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Campuses for Module Delivery	☐ Ayr ☐ Dumfries	☐ Lanarkshire ☐ London ☒ Paisley	☐ Online / Distance Learning ☐ Other (specify)	
Terms for Module Delivery	Term 1 ☐	Term 2 ☒	Term 3 ☐	
Long-thin Delivery over more than one Term	Term 1 – Term 2 ☐	Term 2 – Term 3 ☐	Term 3 – Term 1 ☐	

Learning Outcomes	
L1	Develop a critical understanding of advanced concepts of reactors, including multiphase and biochemical reactors design.
L2	Develop advanced and critical knowledge of the role played by reactors and the heat transfer effects in the chemical process industry.
L3	Develop advanced skills and competences required for the design and analysis of multiphase and biochemical reactors that will also take into consideration issues such as safety, environmental protection, resources conservation and sustainability.
L4	Develop the underlying knowledge that will enable the design and analysis of systems even in the cases of missing and incomplete data through research and innovation.
L5	Plan, develop and execute a relevant design based on advanced knowledge, research and innovation within a wide and often changeable variety of economic, legal and environmental constraints in the field of chemical and process engineering.

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 11** Demonstrate: •A Critical knowledge that covers and integrates most of relevant science and technology related to the design multiphase and biochemical reactors and their relevance and application in a chemical process context and at advance level. •A critical understanding of the principal theories, concepts and principles of advanced multiphase and biochemical reactors design. •A critical understanding of a range of specialised theories, concepts and principles applied to multiphase and biochemical reactors design. •Extensive, detailed and critical knowledge and understanding of the role of multiphase and biochemical reactors design in an integrated chemical process as in other areas such as the environment and resources minimisation. Develop a critical understanding of the implication of knowledge of multiphase and biochemical reactors design principles in the advancement of modern and innovative chemical processes design, conservation of resources and sustainability.

Practice: Applied Knowledge and Understanding	**SCQF 11** Use a significant range of the core chemical reactor engineering knowledge and skills to advance the knowledge of multiphase and biochemical reactors design and its application in chemical process context. Develop the ability to use a range of specialised skills, techniques, practices and/or materials that are informed by the recent advances in the fields of multiphase and biochemical reactors design. Apply a range of standard and specialised research and other techniques to advance the understanding of multiphase and biochemical reactors design. Plan, develop and execute a relevant design based on advanced knowledge, research and innovation. Demonstrate originality, creativity and critical thinking. Apply knowledge of multiphase and biochemical reactors design in a wide variety of chemical process applications that demand innovation.
Generic Cognitive skills	**SCQF 11** Apply critical analysis, evaluation and synthesis to forefront issues, or issues that are informed by forefront developments in the area of multiphase and biochemical reactors design and the interaction with the other aspects of chemical process design. Practice at a high level the ability to critically identify, analyse, conceptualise and define new and abstract problems related to multiphase and biochemical reactors design and the application of the concepts in a chemical engineering context. Develop and demonstrate original and creative thinking and responses in dealing with complex or novel problems and issues related to the design of multiphase and biochemical reactors. Critically review, consolidate and extend knowledge, skills, practices and thinking in the field of multiphase and biochemical reactors design. Deal with complex issues and make informed judgements in situations where there is absence of complete or consistent data/information through innovation and research./data in design studies.
Communication, ICT and Numeracy Skills	**SCQF 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.
Autonomy, Accountability and Working with Others	**SCQF 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.

Prerequisites	**Module Code**	**Module Title**
	Other Before undertaking this module, the student should have knowledge on reaction kinetics, mass and energy balances and reactor design.	
Co-requisites	**Module Code**	**Module Title**

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** (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	164
n/a	0
n/a	0
n/a	0
TOTAL	200

Indicative Resources
The following materials form essential underpinning for the module content and ultimately for the learning outcomes: H. Scott Fogler (2020) Elements of chemical reaction engineering. Prentice Hall, 5th ed. Hill, Charles G., Root, Thatcher W. (2014) An introduction to chemical engineering kinetics & reactor design. Hoboken, N.J. : John Wiley, 2nd ed. Froment, Gilbert F.; De Wilde, Juray.; Bischoff, Kenneth B. (2011) Chemical reactor analysis and design. Hoboken, N.J. : Wiley, 3rd ed.

Michael L. Shuler, Fikret Kargi, Matthew DeLisa (2017) Bioprocess engineering: basic concepts. Boston : Prentice Hall, 3rd ed.
(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. **For the purposes of this module, academic engagement equates to the following:** The School of Computing, Engineering and Physical Sciences considers attendance and engagement to mean a commitment to attending, and engaging in, timetabled sessions. You will scan your attendance via the scanners each time you are on-campus and you will login to the VLE several times per week. Where you are unable to attend a timetabled learning session due to illness or other circumstance, you should notify the Programme Leader that you cannot attend. Across the School an 80% attendance threshold is set. If you fall below this, you will be referred to the Student Success Team to see how we can best support your studies.

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. Aligned with the University's commitment to equality and diversity, this module supports equality of opportunity for students from all backgrounds and learning needs. Using the VLE, material will be presented electronically in formats that allow flexible access and manipulation of content. This module complies with University regulations and guidance on inclusive learning and teaching practice. Specialist assistive equipment, support provision and adjustment to assessment practice in accordance with the University's policies and regulations.
(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 Physical Sciences**
Overall Assessment Results	☐ **Pass / Fail** ☒ **Graded**
Module Eligible for Compensation	☐ **Yes** ☒ **No** **If this module is eligible for compensation, there may be cases where compensation is not permitted due to programme accreditation requirements. Please check the associated programme specification for details.**
School Assessment Board	Design
Moderator	L Sun
External Examiner	P Weston
Accreditation Details	Pending accreditation

Module Appears in CPD catalogue	☒ **Yes** ☐ **No**
Changes / Version Number	V4.2 Updated Indicatives Resources, Attendance and Engagement Procedure, Equality and Diversity, and Assessment sections. Apperars in CPD catalogue

Assessment (also refer to Assessment Outcomes Grids below)
Assessment 1
Open book examination worth 50% of the final mark.
Assessment 2
Coursework: Presentation (10%): LO2, LO3 Design (40%): LO4, LO5
Assessment 3
N/A
(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.)

Component 1							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Open book examination	☒	☒	☐	☐	☐	50	3

Component 2							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Coursework	☐	☒	☒	☒	☒	45	1

Component 3							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Coursework	☐	☐	☐	☒	☒		
Combined total for all components						100%	4 hours

Change Control

What	When	Who
Updated Indicatives Resources, Attendance and Engagement Procedure, Equality and Diversity, and Assessment sections. Apperars in CPD catalogue	March 2025	Cristina Rodriguez