Module Descriptor

Title	Advanced Heat Transfer and Energy Recovery		
Session	2025/26	**Status**	Published
Code	ENGG11055	**SCQF Level**	11
Credit Points	20	**ECTS (European Credit Transfer Scheme)**	10
School	**Computing, Engineering and Physical Sciences**		
Module Co-ordinator	M Mirzaeian		

Summary of Module

The course will review boundary layer flow and its influence on rates of heat transfer.

The module also develops the coverage of heat transfer and discusses topics such as convection from first principles, and numerical methods for modelling conduction in two and three dimensions.

The module tackles the concepts of the “Pinch” technology and discusses topics such as thermodynamic and economic targets of heat exchanger networks based on the second law of thermodynamics, hot and cold composite curves, number of units for maximum energy recovery, stream splitting for maximum energy recovery, problem table algorithms and grand composite curves, multiple utilities and their optimal use, as well as threshold problems. Aspen software is used to simulate these problems. Boilers and furnaces will be covered and the selection of fuels with reference to their environmental impact will be discussed.

Design and performance calculations of heat exchanger based on the effectiveness-NTU method will be presented.

Sample industrial applications will be used to illustrate the topics.

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 - knowledge of heat integration modelling software; Successful : autonomous, driven and resilient.

Module Delivery Method	On-Campus[1] ☒	Hybrid[2] ☐	Online[3] ☐	Work -Based Learning[4] ☐
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 heat transfer that covers both depth and breadth of the subject.
L2	Develop advanced and critical knowledge of the role played by heat transfer in the design and analysis of equipment that will also take into consideration issues such as environmental protection, resources conservation and sustainability as well as 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 published research and innovation.
L4	Develop the advanced skill required to use modern tools such as Aspen Energy Analyser in the design of heat transfer equipment and critical understanding of their scope and limitations.
L5	N/A

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 the main areas of the discipline of heat transfer and their relevance and application in engineering context and at advance level.

[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

	• A critical understanding of the principal theories, concepts and principles of advanced heat transfer. • A critical understanding of a range of specialised theories, concepts and principles applied to heat transfer. • Extensive, detailed, and critical knowledge and understanding of the role of heat transfer in engineering applications as well as in other related areas. • Develop a critical understanding of the implication of knowledge of heat transfer principles in the advancement of modern and innovative engineering design, conservation of resources and sustainability.
Practice: Applied Knowledge and Understanding	**SCQF 11** • Use a significant range of the core engineering knowledge and skills to advance the knowledge of heat transfer and its application in engineering context. • The ability to use a range of specialised skills, techniques, practices and/or materials that are informed by the recent advances the field of heat transfer. • Apply a range of standard and specialised research and other techniques to advance understanding of heat transfer. • Plan, develop and execute a relevant design based on advanced knowledge, research and innovation. • Demonstrate originality, creativity and critical thinking. • Apply knowledge of heat transfer in a wide variety of engineering 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 heat transfer and the interaction with the engineering aspects of the profession. • Practice at a high level the ability to critically identify, analyse, conceptualise and define new and abstract problems related to heat transfer and the application of the concepts in the contexts of both engineering and established technology. • 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 heat transfer. • Deal with complex issues and make informed judgements in situations in the absence of complete or consistent data/information through innovation and research.
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 Suitable engineering or physics undergraduate level study in heat transfer.	
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	9
Laboratory / Practical Demonstration / Workshop	3
Independent Study	164
n/a	0
n/a	0
TOTAL	200 Hours Total

Indicative Resources

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

Reay, David, C Ramshaw & A Harvey (2013) Process Intensification, 2nd Edition, Butterworth-Heinemann.

F N Incropera, D P DeWitt, T. L. Bergman and A. S. Lavine (2011) Fundamentals of heat and mass transfer, 7th Edition, Wiley.

Cengel, Yunus A and Afshin J. Ghajar (2014) Heat and Mass Transfer: Fundamentals & Applications. 5th edition. McGraw-Hill Higher Education.

Kemp, I. C. and Lim, J.S., (2020) Pinch Analysis and Process Integration. 3rd Edition. Butterworth-Heinemann.

Holman J. P. (2018) Heat Transfer. 10th Edition. Upper Saddle River, N.J. : Prentice Hall PTR.

R K Sinnott and G Towler (2019) Chemical Engineering Design: SI Edition, Butterworth-Heinemann 6th Edition.

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

(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	C Rodriguez
External Examiner	P Weston
Accreditation Details	N/A
Module Appears in CPD catalogue	☐ **Yes** ☒ **No**
Changes / Version Number	1.16 - Updated module summary. - Updated Attendance and Engagement Procedure. - Updated Equality and Diversity. - Updated accreditation. - Updated external examiner. - Updated Assessment section.

Assessment (also refer to Assessment Outcomes Grids below)
Assessment 1
Heat Transfer continuous assessment worth 70% of the final mark. This continuous assessment includes two written assignments with design and calculations each worth 35% of the final mark. Further details, and the academic calendar when assessments are likely to feature, will be provided within the Module Information Pack.
Assessment 2
Energy Recovery continuous assessment worth 30% of the final mark. This continuous assessment will consist of the submission of two written assignments with calculations each worth 15% of the final mark. Further details, and the academic calendar when assessments are likely to feature, will be provided within the Module Information Pack.
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**

Design/ Diagram/ Drawing/ Photograph/ Sketch	☒	☒	☐	☒	☐	70	0

Component 2							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Design Report	☐	☒	☒	☐	☐	30	0

Component 3							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
N/A	☐	☐	☐	☐	☐		
Combined total for all components						100%	0 hours

Change Control

What	**When**	**Who**
- Updated module summary. - Updated Attendance and Engagement Procedure. - Updated Equality and Diversity. - Updated accreditation. - Updated external examiner. - Updated Assessment section.	March 2025	M Mirzaeian