Session: 2022/23
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Title of Module: Renewable Energy and Energy Storage Systems			
Code: ENGG11038	**SCQF Level: 11** **(Scottish Credit and Qualifications Framework)**	**Credit Points: 10**	**ECTS: 5** **(European Credit Transfer Scheme)**
School:	School of Computing, Engineering and Physical Sciences		
Module Co-ordinator:	Cristina Rodriguez		

Summary of Module

It has been widely acknowledged that fossil fuels which are the main source of energy for the world today are highly unsustainable, and directly related to air pollution, land and water degradation and climate changes. Alternatively, the use of renewable energy is already growing. Working on renewable energy will often include working with different renewable sources like wind, solar, hydro, and biomass. Moreover, this must be associated with applying different techniques to store the generated energy in different forms. Storage systems include fuel cells, supercapacitors, and batteries.
The main aim of this module is to outline the fundamentals and the up-to-date technologies associated mainly with Biomass and Energy storage systems. Also renewable energy such as wind, solar, bio-energy, and hydro energy will be included. As mentioned before an overview of the storage systems that are popularly linked to the renewable energy resources and different types of fuel cells systems, supercapacitors and batteries will be studied.Different applications and case studies will be investigated and strength and weakness of each case will be clarified. The cases studies include diverse geographical and economic situations. Discussion regarding common technical and non-technical barriers and issues limiting the wide spread use and dissemination of renewable energy will also be covered. The limits of available technology and of the potential of new and emerging technology will be discussed.

- During the course of this module students will develop their UWS Graduate Attributes (https://www.uws.ac.uk/current-students/your-graduate-attributes/). Universal: critical thinking and analytical & inquiring mind and reserach-minded. Successful : autonomous, driven and resilient. Work-ready: effective comunicator.

Module Delivery Method

Face-To-Face	Blended	Fully Online	HybridC	HybridO	Work-based Learning
✓	✓				

Face-To-Face
Term used to describe the traditional classroom environment where the students and the lecturer meet synchronously in the same room for the whole provision.
Blended
A mode of delivery of a module or a programme that involves online and face-to-face delivery of learning, teaching and assessment activities, student support and feedback. A programme may be considered “blended” if it includes a combination of face-to-face, online and blended modules. If an online programme has any compulsory face-to-face and campus elements it must be described as blended with clearly articulated delivery information to manage student expectations
Fully Online
Instruction that is solely delivered by web-based or internet-based technologies. This term is used to describe the previously used terms distance learning and e learning.
HybridC
Online with mandatory face-to-face learning on Campus
HybridO
Online with optional face-to-face learning on Campus
Work-based Learning
Learning activities where the main location for the learning experience is in the workplace.

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:
✓						

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

Learning Outcomes: (maximum of 5 statements)
On successful completion of this module the student will be able to: L1. Outline the fundamentals associated with the renewable energy resources and the storage systems linked to them. L2. Critically evaluate each one of the studied renewable energy technologies and compare them to each other in term of capacity, durability and cost. L3. Critically evaluate the different storage systems and compare them to each other in term of capacity, durability and cost. L4. Evaluate the limits of available technology and of the potential of new and emerging technologies in different geographical and socioeconomic environments. L5. Evaluate the technical and non-technical barriers that are limiting the wide spread of renewable energy.

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. • Critical understanding of renewable energy in the global context and the underlying key theoretical positions, principles and concepts. • Critical understanding of the inherent challenges faced by environmental issues. • Extensive, detailed and critical knowledge and understanding of the benefits of renewable energy. • Critical awareness of challenges facing renewable energy.
Practice: Applied Knowledge and Understanding	SCQF Level 11. • Understanding of renewable energy and energy storage systems principles, methodologies and techniques. • Developing leadership awareness on the environmental related issues. • Practice the use-case utilisation of digital technologies in a predefined context and library resources.
Generic Cognitive skills	SCQF Level 11. • Apply critical analysis, evaluation and synthesis to issues which are at the forefront of, or informed by, developments at the forefront of renewable energy.

	• Identify, conceptualise and define new and abstract problems and issues related to renewable energy. • Critically review, consolidate and extend knowledge, skills practices and thinking in renewable energy. • Understand complex issues regarding renewable energy and storage systems and relate these issues to environmental protection.	
Communication, ICT and Numeracy Skills	SCQF Level 11. • Use of appropriate computer software for written and oral presentation. • Discussion of appropriate use of ICT in support of research objectives (e.g. data collection and analysis of renewable energy project).	
Autonomy, Accountability and Working with others	SCQF Level 11. • Responsibility of leading research topic (Continuous Assessment Energy Project) , ownership of renewable energy project process including integrity of ource usage (e.g. literature, ethical practice).	
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	
Teaching in this module is research-led and students are learning about the latest research and development from the key academic staff and industry practitioners involved in renewable energy led by those academics (including resources). In addition, the module also benefits from research-based teaching since students as participants in research undertake inquiry based learning. The module will thus be taught by a combination of lectures, online and class-based group-work tutorials, practical's, guided independent study and through a flipped classroom with pre-recorded lectures but will also involve specialist experts in a variety of aspects of renewable energy and energy storage systems.	
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	16
Tutorial/Synchronous Support Activity	16
Asynchronous Class Activity	4
Independent Study	64
	100 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:
Aldo Vieira da Rosa (2021) Fundamentals of Renewable Energy Processes. 4th Edition.

Zhang, Jianlu, H. Zhang, J. G Wu and Jiujun Zhang (2013) PEM Fuel Cell Testing and Diagnosis. Burlington: Elsevier Science.

Stefan Emeis (2018) Wind Energy Meteorology: Atmospheric Physics for Wind Power Generation. 2nd Edition, Springer.

Plante, Russell H. (2014) Solar Energy, Photovoltaics, and Domestic Hot Water: A Technical and Economic Guide for Project Planners, Builders and Property Owners. San Diego, CA : Elsevier Science.

Wanger, Herman-Josef and J Mathur (2011) Introduction to Hydro Energy Systems: Basics, Technology and Operation. Berlin; Heidelberg : Springer-Verlag.

(**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)

Engagement Requirements

In line with the Academic Engagement Procedure, Students are defined as academically engaged if they are regularly engaged with timetabled teaching sessions, course-related learning resources including those in the Library and on the relevant learning platform, and complete assessments and submit these on time. Please refer to the Academic Engagement Procedure at the following link: Academic engagement procedure

Supplemental Information

Programme Board	Engineering
Assessment Results (Pass/Fail)	No
Subject Panel	Engineering
Moderator	Mojtaba Mirzaeian
External Examiner	R Ocone
Accreditation Details	This module is part of the MSc Chemical Engineering programme accredited by the?IChemE.
Version Number	1.12

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 peer-assessed teamwork, end of class 5-minute quizzes with response cards and immediate feedback and during tutorial sessions, during laboratory sessions and as part of the preparation for written submissions.
Summative assessment is provided by written assessment and presentation elements as well as a final exam.

Assessment Category 1: 60% Final exam.

Assessment Category 2: 40 % Continuous Assessment.
Project on renewable energy and energy storage systems (includes report and MS Power Point presentation).

(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 open book	✓	✓	✓			60	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
Report of practical/ field/ clinical work				✓	✓	40	0
					Combined Total For All Components	100%	2 hours

Footnotes
A. Referred to within Assessment Section above
B. Identified in the Learning Outcome Section above

Note(s):

1. More than one assessment method can be used to assess individual learning outcomes.
2. Schools are responsible for determining student contact hours. Please refer to University Policy on contact hours (extract contained within section 10 of the Module Descriptor guidance note).
   This will normally be variable across Schools, dependent on Programmes &/or Professional requirements.

Equality and Diversity

The programme team have considered how the programme meets the requirements of potential students irrespective of age, disability, political belief, race, religion or belief, sex, sexual orientation, social background or any other protected characteristic.
Students/participants with special needs (including additional learning needs) will be assessed/accommodated and any identified barriers to particular groups of students/participants discussed with the Enabling Support Unit (for further details, please refer

to the UWS Equality, Diversity and Human Rights policy). Further guidance is available from UWS Health and Safety Services, CAPLeD, Student Services, School Disability Co-ordinators or the University's Equality and Diversity Co-ordinator. UWS Equality and Diversity Policy
(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)