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Wrexham glyndŵr UNIVERSITY

MODULE SPECIFICATION PROFORMA

Module Title:	**Renewable Energy Engineering**	**Level**:	5	**Credit Value**:	**40**

Module code:	ENG53F	**Is this a new module?**	Yes	**Code of module being replaced**:	ENG52Q

Cost Centre:	GAME	JACS3 **code** HECoS **code**	H221/100175

Trimester(s) in which to be offered:	1, 2	**With effect from:**	September 18

School:	Faculty of Arts, Science and Technology	**Module Leader:**	David Sprake

Scheduled learning and teaching hours	120 hrs
Guided independent study	280 hrs
Placement	0 hrs
Module duration (total hours)	400 hrs

Programme(s) in which to be offered	Core	Option
BEng (Hons) Renewable and Sustainable Engineering	✓	☐
BEng (Hons) Low Carbon Energy, Efficiency and Sustainability	✓	

Pre-requisites
None

Office use only

Initial approval February 17
APSC approval of modification Sept 18
Approved on 21/09/20 for addition of BEng Low Carbon Energy, Efficiency and Sustainability

Version 2

Have any derogations received Academic Board approval? Yes ✓ No ☐

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Module Aims
To develop a modern framework for the Engineering evaluation and selection of the production renewable energies. This module aims to: Provide an up-to-date overview of all the major renewable sources and the engineering skills associated with selecting, designing and installing the apparatus to capture its energy and convert it into useful forms. Develop an understanding of energy storage. To provide an overview of the methods used to predict energy production from various renewable sources and the basic economic value of that energy. Develop techniques to allow a student to apply this knowledge in real world situations.

Intended Learning Outcomes

Key skills for employability

KS1	Written, oral and media communication skills
KS2	Leadership, team working and networking skills
KS3	Opportunity, creativity and problem solving skills
KS4	Information technology skills and digital literacy
KS5	Information management skills
KS6	Research skills
KS7	Intercultural and sustainability skills
KS8	Career management skills
KS9	Learning to learn (managing personal and professional development, self-management)
KS10	Numeracy

At the end of this module, students will be able to		Key Skills	
1	Demonstrate an engineering knowledge of the theory, practice and functionality of different renewable energy systems	KS1	KS5
2	Demonstrate a knowledge and understanding of the integration of energy into existing grids and batteries.	KS1	KS5
3	Analyse ways in which energy sources can be assessed to predict output in a variety of situations.	KS5	KS6
		KS4	KS7
		KS10	
4	Apply knowledge gained to select solutions for real world scenarios and to evaluate the environmental factors of different energy systems.	KS3	KS7
5	Develop knowledge and skills for energy project case studies, project proposal, planning, management and evaluation.	KS3	KS5
		KS7	KS9

Derogations

A derogation from regulations has been approved for this programme which means that whilst the pass mark is 40% overall, each element of assessment (where there is more than one assessment) requires a minimum mark of 30%.

Assessment:

Coursework will take the form of a group project covering real world design challenges in renewable energies.

Assessment No.	Learning Outcomes to be met	Type of assessment	Weighting	Duration (if exam)	Word count or equivalent if appropriate
One	1,2,3,4,5	Group Coursework	100 %	N/A	8,000

Learning and Teaching Strategies:

The learning and teaching strategy has been developed to ensure that students are able to build up knowledge of different systems and technologies.

Assessment will be summative and will enable the student to demonstrate their learning over the whole module.

There will be a combination of teaching and learning strategies used:

Key lectures will impart relevant theory and identify best practice examples of renewable energy systems in use

Directed study and feedback to the peer group will be used to reinforce learning.

A site visit to a suitable installation will enable students to more easily visualise the demands of renewable energy systems

Guest lecturers (where possible) will deliver individual sessions according to their expertise.

Syllabus outline:

Resource understanding: Relative abundance of natural energy and its sources. Renewable energy supply vs. demand and the importance of storage.

A ***basic*** overview the extraction of energy from the following sources:

- **Wind Energy:** Introduction. Components. Wind variation statistical analyses. Aerodynamics. Prediction of potential energy. Betz limit. Turbine Types. On/ offshore.
- **Hydro power:**
  a) Hydroelectric power. Introduction. Components. High verses low head. Prediction of potential energy.

  b) Wave energy. Introduction. Components. Principles and nature of wave energy, types of devices, prediction of energy production. Theoretical and practical design considerations.

  c) Tidal power. Principles and nature of tidal energy, Components. Prediction of energy production.
- **Laws of mechanics,** Bernouilli's equation and the momentum equation to the flow of incompressible fluids: continuity equation and total energy in terms of the various heads; also expressions for flow work and Bernoulli's equation; various flow measuring devices; rate of change of momentum of a fluid between two sections;

pressure, kinetic and potential head; orifice plates, Venturi meters and Pitot tubes; force exerted on a stationary or moving flat plate or curved vane by a jet; relates the force exerted by a jet to the power developed by a water turbine.

- **Solar**
  a) Thermal. Introduction. Principles nature and availability of solar thermal energy, rooftop water heaters, active and passive solar heating, Components. Prediction of energy production.

  b) Photovoltaic Introduction**.** Principles and nature of solar PV, Prediction of energy production. Components.
- **Bioenergy.** Introduction, types. Primary/ secondary, processing. Theoretical and practical design considerations. Components.
- **Geothermal** Introduction. Components. Theoretical and practical design considerations.
- **The relationship between ideal and actual power plant cycles:** terms associated with thermodynamic cycles, thermal efficiency; the first and second laws applied to thermodynamic cycles; constant volume, diesel, gas turbine, Carnot, Rankine and Stirling cycles; comparison of efficiencies of actual and ideal cycles.
- **Grid connections/ integration:** Understanding of engineering. National grid. Smart grids.
- **Energy Storage:** basic understanding of how energy can be stored. Pumped storage hydro, flywheel, battery, compressed air, hydrogen etc.
- **Analysis of heat pump and refrigeration cycles**: reversed Carnot and Rankine cycles; use of property diagrams. Refrigerants R12 and ammonia; comparison of ideal and actual cycles.
- **Analyse business cases for energy projects, project proposal, planning, and management**: social, economic, legal, environmental constraints; systematic problem solving; reliability, sustainability and maintainability of energy production process; energy project evaluation.

Bibliography:

Essential reading

Boyle G et al (2012) Renewable Energy: Power for a Sustainable Future (Oxford University Press)

Other indicative reading

Boyle G et al (2012) Energy Systems and Sustainability: Power for a Sustainable Future (Oxford University Press)

David J.C. MacKay (2008)Sustainable Energy - Without the Hot Air (Download free http://www.withouthotair.com/)

http://www.renewableuk.com/

www.edie.net