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MODULE DESCRIPTOR

Module Title

Introduction To Solar Energy Systems

Reference	ENM291	Version	1
Created	August 2017	SCQF Level	SCQF 11
Approved	January 2018	SCQF Points	15
Amended		ECTS Points	7.5

Aims of Module

This module aims to develop a strong ability to describe the design of different technologies used to harvest the solar energy: solar thermal systems and photovoltaic (PV) systems. The module provides a comprehensive understanding of the essential theoretical background needed for the design of system to harvest, convert, store and deliver solar energy.

Learning Outcomes for Module

On completion of this module, students are expected to be able to:

1	Apply critical analysis and discussion on the physical processes that determine the output of different types of solar PV cells
2	Critically review, consolidate and extend knowledge on the operation of the components of PV systems, including solar modules, power control components, and the balance of system components.
3	Demonstrate extensive, detailed and critical knowledge and understanding of physical processes that determine the output of a solar thermal collector.
4	Design a solar thermal system for given boundary conditions and load parameters and relate this to mathematical models that can be used to calculate this output.
5	Undertake critical evaluations and assess the potential energy-cost savings over the lifetime of the solar thermal systems.

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Indicative Module Content

Solar photovoltaic (PV) cells, basic operation/the principles of solar cells, various semiconductor materials and their suitability for solar cell manufacturing. Mathematical model, I-V and P-V characteristics. PV system?s components, and how they are assembled in PV modules. Different types of batteries, regulators and inverters. Identification and minimization of losses and degradation issues. Understanding module datasheets as well as manufacturing of photovoltaic modules. Discuss the use of photovoltaic modules in both off-grid and grid-connected systems. Solar thermal systems. Radiation exchange and heat transfer in solar collectors, theoretical performance of the solar collectors, thermal storages linked to solar collectors, solar thermal in buildings and passive solar gain, components of solar thermal systems, solar thermal applications in different climates, and Economic Analysis (PV and thermal).

Module Delivery

This module is delivered by means of lectures, tutorials and student-centred learning activities.

Indicative Student Workload	Full Time	Part Time
Contact Hours	50	60
Non-Contact Hours	100	90
Placement/Work-Based Learning Experience [Notional] Hours	N/A	N/A
TOTAL	150	150
Actual Placement hours for professional, statutory or regulatory body		

ASSESSMENT PLAN

If a major/minor model is used and box is ticked, % weightings below are indicative only.

Component 1

Type:	Coursework	Weighting:	30%	Outcomes Assessed:	1, 3
Description:	Individual assignment. Problem solving (PV and thermal)				

Component 2

Type:	Examination	Weighting:	50%	Outcomes Assessed:	2, 4
Description:	Final Exam.				

Component 3

Type:	Coursework	Weighting:	20%	Outcomes Assessed:	5
Description:	Group project. A group of students has to search and present about the energy-cost savings of one of the solar energy systems in industrial applications.				

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MODULE PERFORMANCE DESCRIPTOR

Explanatory Text

In order to pass the module, students should achieve a mark of at least 40% in each component (which has a weighting of 30% or more) and an overall grade of D or greater. Non Submission for any assessment component will result in an overall grade of NS for the module.

Module Grade	Minimum Requirements to achieve Module Grade:
A	Greater than or equal to 70%
B	In the range 60% to 69%
C	In the range 55% to 59%
D	In the range 50% to 54%
E	In the range 40% to 49%
F	Less than 40%
NS	Non-submission of work by published deadline or non-attendance for examination

Module Requirements

Prerequisites for Module	Normally a UK honours degree, or equivalent, in Engineering or related discipline at class 2.2 or above and proficiency in English language for academic purposes (IELTS minimum score of 6.5 or equivalent).
Corequisites for module	None.
Precluded Modules	None.

INDICATIVE BIBLIOGRAPHY

1	LUQUE, A. and HEGEDUS,S., 2010. Handbook of Photovoltaic Science and Engineering, 2nd Edition. Wiley. ISBN: 978-0-470-72169-8.
2	Krauter S.C.W., 2007. Solar Electric Power Generation - Photovoltaic Energy Systems: Modeling of Optical and Thermal Performance, Electrical Yield, Energy Balance, Effect on Reduction of Greenhouse Gas Emissions. Springer Science & Business Media. ISBN 978-3-540-31346-5.
3	DUFFIE, J. A. and BECKMAN, W.A., 2013. Solar Engineering of Thermal Processes. John Wiley & Sons. ISBN: 978-1-118-13924-0.
4	CABEZA, L.F., 2015.Advances in Thermal Energy Storage Systems. Elsevier. ISBN: 978-1-78242-088-0.
5	LUQUE, LOPEZ A. and ANDREEV, V. M., 2007. Concentrator Photovoltaics. Springer Series in Optical Sciences ISBN 978-3-540-68798-6.
6	SERRANO, M.I.R., 2017. Concentrating Solar Thermal Technologies. Springer.
7	ZHENG, H. 2017. Solar Energy Desalination Technology. Elsevier.
8	PRAKASH, O. and KUMAR, A., 2017. Solar Drying Technology. Springer.