ES99F-15 Renewable Energy

23/24

Department
School of Engineering
Level
Taught Postgraduate Level
Module leader
Angeles Rivero Pacho
Credit value
15
Module duration
1 week
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This is a five-day intensive module; including lectures and workshops that will be delivered by specialists in bioenergy, biotechnology and renewable energy.

Module web page

Module aims

To impart advanced understanding of the principles of modern renewable energy technologies, including biofuels from a variety of sources, wind power, solar energy, geothermal, ocean and hydro power and ethical and practical considerations. The particular focus will be given to the limitations and restrictions in developing countries.
Students will gain a diverse theoretical understanding of the future and current renewable technologies for power production, evaluate the fundamental principles underlying the energy production/conversion and interrogate the social and environmental impacts of renewable energy technologies.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be

covered. Actual sessions held may differ.

The module will consist of 5 major topics listed as below. The module leader will attend all of each session, to integrate and stimulate the interdisciplinary learning.

The core design is that the module leader and subject specialists will choose how they wish to deliver a combination of discipline or application grounded material with activities that will allow the students (with the module leader) to develop their learning in an interdisciplinary style that will help them to explore and deepen their knowledge of the theories and set texts/materials. Active learning methods (i.e. Team Based Learning; Open Space Learning) will be implemented in order to heighten student engagement and understanding of the topic.

1. Sustainability and Energy use
   This lecture will present and assess the current resources, energy use and production scale and their availability. It will then follow a brief outline of existing and proposed renewable energy sources and assess their economic and societal impacts and challenges. An interactive workshop session will be done to critically discuss the pros and cons of different renewable energy technologies for a sustainable society.

2. Solar & hydrogen energy and energy storage
   In this lecture solar thermal and solar photovoltaics will be introduced. Their current technology and setbacks for large scale applications will be presented. Novel approaches, new trends and future potential will be discussed by using examples from recent research. Hydrogen economy concept will be introduced. Batteries, their working principles, energy storage options and challenges will be covered. An interactive workshop session will cover the critical assessment of local small-scale applications for developing countries.

3. Hydro, wind and geothermal energy
   Principles of hydro power technology, ocean current, tidal & wave energy: technology, economics, challenges and current research and projects will be discussed. Ground source and geothermal energy: principles, operation, future scope will be discussed. Wind energy will be introduced; wind turbines and power generating technologies will be thoroughly presented and technical challenges will be discussed. An interactive workshop session will cover the assessment of the technology for the context of developing countries.

4. Biomass and Bioenergy
   This part will look at the principles of modern bioenergy; obtaining biofuels from a variety of biomass resources, i.e. agricultural waste, municipal waste, industrial food waste etc. Biomass chemistry, biomass treatment methods and design for the conversion of biomass will be critically evaluated. Students will gain a thorough understanding of the potential for sustainable biotechnologies for power generation as well as the fundamental thermodynamic principles underlying biomass formation/production and energy conversion. Production of biopolymers from biomass will be touched upon. An interactive workshop session will cover the critical assessment of local small-scale applications for developing countries.

5. Circular economy and Life cycle analysis.
   The concept of circular energy and resource management will be introduced. This day will describe the principals of analysing the existing or proposed technologies from cradle to grave. We will look at how to conduct an overall Carbon Footprint/Life Cycle Analysis with various renewable energy technology examples. Ethical issues surrounding the

implementation of different technologies will be critically assessed. An interactive session will cover an example in developing country context.

Learning outcomes

By the end of the module, students should be able to:

- Develop a critical understanding of renewable energy technologies and a research-informed knowledge of some of the key promising developments in the field.
- Demonstrate an advanced knowledge and comprehensive understanding of design processes and methodologies for renewable energy systems and the ability to apply them to new situations.
- Interpret concepts from a range of areas such as engineering, economics, legislation, health and safety, environmental and social impacts for assessment of renewable energy technologies and systems in order to evaluate their suitability and efficacy.
- Critique current practice and its limitations as well as likely new and advanced developments at the forefront of renewable energy technology.
- Apply their skills in problem solving, communication (written and oral; to technical and non-technical audiences), and information retrieval.
- Demonstrate a comprehensive understanding of and an ability to interpret, apply and resolve the scientific concepts and principles underpinning renewable energy technologies.

Indicative reading list

Essential reading:

1. Alternative Energy Systems and Applications, 2nd Edition, B. K. Hodge, John Wiley & Sons, 2017.
2. Renewable Energy: Sustainable Energy Concepts for the Energy Change, 2nd Edition, Roland Wengenmayr and Thomas Buhrke (Editors), John Wiley & Sons, 2012.
3. Essentials of Energy Technology: Sources, Transport, Storage, Conservation, Jochen Fricke, Walter L. Borst, John Wiley & Sons, 2013.
4. Transition to Renewable Energy Systems, Detlef Stolten (Editor), Viktor Scherer (Editor), John Wiley & Sons, 2013.
5. Renewable Energy and Climate Change, Volker Quaschning, John Wiley & Sons, 2010.

Recommended/Further reading:

1. Electricity from Sunlight: An Introduction to Photovoltaics, Paul A. Lynn, John Wiley & Sons, 2010.
2. Photovoltaics System Design and Practice, Heinrich Haberlin, John Wiley & Sons, 2012.
3. Zero Waste Engineering: A New Era of Sustainable Technology Development, 2nd Edition, M. M. Khan, M. R. Islam, John Wiley & Sons, 2016.
4. Sustainable Energy Conversion for Electricity and Coproducts: Principles, Technologies, and Equipment, Ashok Rao, John Wiley & Sons, 2015.
5. Wind Energy Essentials: Societal, Economic, and Environmental Impacts
   Richard P. Walker, Andrew Swift, John Wiley & Sons, 2015.

6. Understanding Wind Power Technology: Theory, Deployment and Optimisation Alois Schaffarczyk (Editor), John Wiley & Sons, 2014.
7. Energy Efficient Buildings with Solar and Geothermal Resources, Ursula Eicker, John Wiley & Sons, 2014.
8. Offshore Wind Energy Generation: Control, Protection, and Integration to Electrical Systems, Olimpo Anaya-Lara, David Campos-Gaona, Edgar Moreno-Goytia, Grain Adam, John Wiley & Sons, 2014.
9. Photovoltaic Solar Energy: From Fundamentals to Applications, Angèle Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, John Wiley & Sons, 2017.
10. Geothermal Energy: Sustainable Heating and Cooling Using the Ground, Marc A. Rosen, Seama Koohi-Fayegh, John Wiley & Sons, 2017.
11. Integration of Renewable Sources of Energy, 2nd Edition, Felix A. Farret, Marcelo Godoy Simões, John Wiley & Sons, 2017.
12. Introduction to Chemicals from Biomass, James H. Clark, Fabien Deswarte, John Wiley & Sons, 2014.
13. Catalysis for Renewables: From Feedstock to Energy Production, Gabriele Centi, Rutger A. van Santen (Eds.), Wiley, 2008.
14. Biomass Gasifiation and Pyrolysis Practical Design and Theory, Prabir Basu, Elsevier, 2010.
15. Biogas from Waste and Renewable Resources, Dieter Deublein and Angelika Steinhauser (Eds.), Wiley, 2008
16. Thermochemical Processing of Biomass: Conversion into Fuels, Chemicals and Power, Robert C. Brown, John Wiley & Sons, 2011.
17. Biorefinery: From Biomass to Chemicals and Fuels, Michele Aresta, Angela Dibenedetto, Franck Dumeignil, de Gruyter, 2012.

View reading list on Talis Aspire

Interdisciplinary

The module adopts an interdisciplinary teaching approach. Students from a wide variety of disciplinary and professional backgrounds will attend this module, enabling them to explore topics from a range of different perspectives.

Subject specific skills

1. Critique current practice and its limitations as well as likely new and advanced developments at the forefront of renewable energy technology.
2. Demonstrate a comprehensive understanding of and an ability to interpret, apply and resolve the scientific concepts and principles underpinning renewable energy technologies.

Transferable skills

1. Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions
2. Apply problem solving skills, information retrieval, and the effective use of general IT facilities
3. Communicate (written and oral; to technical and non-technical audiences) and work with

others
4. Exercise initiative and personal responsibility, including time management, which may be as a team member or leader
5. Awareness of the nature of business and enterprise in the creation of economic and social value
6. Overcome difficulties by employing skills, knowledge and understanding in a flexible manner
7. Appreciation of the global dimensions of engineering, commerce and communication
8. Be professional in their outlook, be capable of team working, be effective communicators, and be able to exercise responsibility and sound management approaches.

Study

Study time

Type	Required
Lectures	25 sessions of 1 hour (18%)
Practical classes	1 session of 5 hours (4%)
Private study	10 hours (7%)
Assessment	100 hours (71%)
Total	140 hours

Private study description

Pre-module preparation and reading.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A1

Assessment component	Weighting	Study time	Eligible for self-certification

	Weighting	Study time	Eligible for self-certification
Group Written Report	50%	50 hours	No

Students will work in groups (2-3 people) to produce a written report that has an innovative design concept with justification that focuses on affordable and high-performing off-grid appliances and supportive technologies.
Regardless of chosen technology, students should demonstrate how their design: addresses a need someone or a community is experiencing, and provides an improvement in terms of innovation compared to existing alternatives while ensuring it is a sustainable solution and with consideration given to scaling up to market.
Due to small group sizes peer assessment will not be used.

Reassessment component

Individual Written Report			Yes (extension)

Students will produce a written report that has an innovative design concept with justification that focuses on affordable and high-performing off-grid appliances and supportive technologies.
Regardless of chosen technology, students should demonstrate how their design: addresses a need someone or a community is experiencing, and provides an improvement in terms of innovation compared to existing alternatives while ensuring it is a sustainable solution and with consideration given to scaling up to market.

Assessment component

Group Video	50%	50 hours	No

Students will work in groups (2-3 people) to demonstrate that they understand the technological context that they targeted in their report through a 3-minute video.
Their video should answer questions related to themes of Innovation (How does your design compare and improve on solutions that are currently available to your target end-user?); Sustainability (How does your design contribute to a positive impact on the environment?), Social Impact (What difference does your design make to people’s lives?); and Scalability (How feasible is it that your design could get to market at scale?).

Reassessment component

Individual poster presentation			Yes (extension)

The students will produce a poster and deliver a presentation to demonstrate that they understand the technological context that they targeted in their report.
The poster should answer questions related to themes of Innovation (How does your design compare and improve on solutions that are currently available to your target end-user?); Sustainability (How does your design contribute to a positive impact on the environment?), Social

	Weighting	Study time	Eligible for self-certification

Impact (What difference does your design make to people's lives?); and Scalability (How feasible is it that your design could get to market at scale?).
Size A1.

Feedback on assessment

Essay
Detailed written feedback will be provided to each student online via Tabula. Feedback will be given in accordance to the University Policy on the Timing of the Provision of Feedback to Students on Assessed Work.

Video
Detailed written feedback will be provided to each student online via Tabula. Feedback will be given in accordance to the University Policy on the Timing of the Provision of Feedback to Students on Assessed Work

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Availability

Courses

This module is Core for:

- TESA-H1C1 Postgraduate Taught in Humanitarian Engineering
  - Year 1 of H1C1 Humanitarian Engineering
  - Year 1 of H1C3 Humanitarian Engineering (with Management)
  - Year 1 of H1C2 Humanitarian Engineering (with Sustainability)
  - Year 2 of H1C1 Humanitarian Engineering
  - Year 2 of H1C3 Humanitarian Engineering (with Management)
  - Year 2 of H1C2 Humanitarian Engineering (with Sustainability)
- Year 1 of TESA-H1C4 Postgraduate Taught in Humanitarian Engineering