UNIVERSITY of BRADFORD

Module Descriptor

Module Details	
Module Title	Advanced Sustainable Energy
Module Code	ENG7014-B
Academic Year	2024/5
Credits	20
School	School of Engineering
FHEQ Level	FHEQ Level 7

Contact Hours	
Type	Hours
Directed Study	156
Seminars	2
Lectures	22
Tutorials	20

Availability	
Occurrence	Location / Period
BDA	University of Bradford / Semester 1

Module Aims

The Advanced Sustainable Energy (ASE) module will introduce and quantify the Climate Crisis using a range of recent data linking increased atmospheric carbon levels to global warming. The potential effects of further increasing carbon levels will be explored based upon predictions from a range of sources including the IEA, IPCC, IRENA, COP. The proposed move to Net Zero emissions by 2050 will be introduced and discussed.

The concepts of sustainable and renewable energies will be explored prior to a global overview of world energy usage and needs, both at the present and into the future, being presented.
The key technologies likely to be involved in the move to NZE2050 will be studied in some engineering detail over a number of weeks ? generation of electricity through water, wind, solar, heat and nuclear power will be explored along with the important associated topics of energy storage and distribution.

Students will be encouraged to critically evaluate a range of source materials, both individually and in groups, enabling them to present a net-zero carbon energy diet for a specified country / area.

Outline Syllabus
1. Global warming, effects of climate change, World Energy Outlook and Net Zero 2050, Energy and Society, carbon and CO2 budgets. 2. Energy usage, key definitions, energy principles (primary, heat, thermodynamics). 3. Sustainable energy ? types, outlook, fossil fuels and historical context. 4. Energy demand in buildings, industry and transport. 5. Electricity and energy storage ? batteries, pumped, grids. 6. Energy from water ? hydropower, tidal power, wave power. 7. Introduction to wind energy and solar photovoltaics. 8. Nuclear energy ? principles, fission and fusion, controversies, fission reactor designs. 9. Solar thermal and geothermal energies. 10. Bioenergy.

Learning Outcomes	
Outcome Number	Description
01	Apply a comprehensive knowledge of mathematics and engineering principles to the solution of Energy futures. Evaluate the environmental and societal impact of solutions in energy systems and minimise adverse impacts. Much of the knowledge will be at the forefront of energy studies. (AHEPs4 M1 and M7).
02	Formulate and analyse complex problems in energy studies. This will involve evaluating available data using first principles of mathematics and engineering principles and using engineering judgment to work with information that may be uncertain or incomplete, discussing the limitations of the techniques employed (AHEP4 M2).
03	Select and apply appropriate computational and analytical techniques to model energy systems, discussing the limitations of the techniques employed (AHEP4 M3).
04	Select and critically evaluate technical literature and other sources of information to solve complex problems (AHEP4 M4).
05	Design solutions for energy systems that evidence some originality and meet a combination of societal, user, business and customer needs. This will involve consideration of applicable health and safety, diversity, inclusion, cultural, societal, environmental and commercial matters, codes of practice and industry standards (AHEP4 M5).
06	Function effectively as an individual, and as a member or leader of a team. Evaluate effectiveness of own and team performance and communicate effectively on complex engineering matters with technical and non-technical audiences (AHEP4 M16 and M17).

Learning, Teaching and Assessment Strategy

Teaching methods will include interactive lectures twice a week (<1 hr) to deliver content followed by small group student-led discussion of key technologies, controversies and outlook for energy type. These sessions will develop students? critical thinking and analysis. There exists a large number of stakeholders bidding to take their place in the future energy environment: from environmental NGOs to fossil fuel companies, from pressure groups to lobbies for particular industries. Students will be encouraged to view a topic from more than one point of view and to use data to draw conclusions. A very recent example might be to explore just how ?green? the ?first transatlantic sustainable aviation fuel flight? actually is.

Following lecture 1, pre-reading on recent general energy topics will be required (e.g. Paris agreement, COP statements, IEA and IRENA state-of-play documents) providing a broader context for the ongoing climate crisis and use of potential technologies for different energy scenarios.

Real-world case studies based upon energy diets for different scenarios/countries will be provided and linked to assessment.

Extensive use of the Canvas virtual learning environment is proposed with formative Canvas quizzes used to provide stimulus and encourage attendance. Formative feedback will also be provided through answers to self-paced tutorial questions.

External speakers (from industry and research institutes) will be invited to deliver at least two sessions on this module to further link teaching to research.

The Assessment strategy will consist of regular formative tests combined with two summative assessments. Formative assessment will be provided through self-paced tutorial questions, Canvas quizzes, and discussions with tutor(s) at weekly sessions following each week?s lectures.

Summative assessment will be in the form of a mid-semester group presentation (30%) and an individual portfolio with an included presentation critically evaluating the energy diet of a selected country/jurisdiction.

For assessment 001 the cohort will work in small groups (approx. 4 students per group) to produce a presentation based upon recent developments in potential carbon production. Students will collaboratively review and critically evaluate key policy data and documents from NGOs, as well as explore sources from stakeholders within the energy industry including energy suppliers (both sustainable and fossil fuel), governmental sources, charities, pressure groups. Quantitative estimation/modelling of future carbon production and global warming based upon a given future energy scenario will be presented to peers and academics. Groups will be student-led and self-selected depending on students? interests.

For assessment 002 the students will produce an individual portfolio report detailing and critically evaluating the energy diet of a selected country/jurisdiction. This will include the quantification of potential energy resources, discussion of currently embedded technologies as well as calculations/modelling of future energy scenarios. Students will propose a sustainable roadmap (or roadmaps) for future migration to NetZero 2050 targets and compare this to current policies. Students will be encouraged to present their ideas to their cohort at multiple stages encouraging dissemination of ideas and increasing confidence in communicating ideas while also allowing differing points of view to be explored. Multiple methods of delivery, chosen by individuals, are possible for these formative sessions.

Mode of Assessment			
Type	Method	Description	Weighting
Summative	Presentation	Group presentation with peer review, based upon recent developments in potential carbon production.	30%
Summative	Coursework - Written	Individual portfolio detailing and critically evaluating energy diet of a selected country/jurisdiction. (3000 words)	70%
Formative	Coursework	Self-paced tutorial questions (5 hours)	N/A
Formative	Computer-based assessment	In Class Canvas Quizzes (1 hour)	N/A

Reading List
To access the reading list for this module, please visit https://bradford.rl.talis.com/index.html

Please note:
This module descriptor has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but minor changes may occur given the interval between publishing and commencement of teaching. Upon commencement of the module, students will receive a handbook with further detail about the module and any changes will be discussed and/or communicated at this point.

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