ES4A8-15 Design for Sustainability

21/22

Department
School of Engineering
Level
Undergraduate Level 4
Module leader
Stuart Coles
Credit value
15
Module duration
10 weeks
Assessment
30% coursework, 70% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

ES4A8-15 Design for Sustainability

Module web page

Module aims

Ecological and ‘green’ constraints weigh significantly on engineering designers already and these pressures are likely to increase very significantly during the careers of today’s students. This module examines the need for significant change in the design philosophy employed in industrialised manufacture and civil construction in terms of energy and resource use. It then examines responses to those pressures including legislation and standards, alternative processes and materials and design for resource economy at small and large scale.

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.

Energy and the environment: global warming and pollutions, present energy use patterns, trends over period of industrial development.

Resources and the environment: embodied energy, reserves and resources, trade off between energy and material resources, environmental damage from materials extraction, materials substitution. Water wars. Industrial, commercial and domestic water economy.
Responses – energy: alternative fuels and fuel burning technologies, renewable energies.
Responses – law/ standards, life cycle analysis: ISO 14001, EU Directives – packaging, buy-back, electrical and electronic goods, automotive products.
Materials – embodied energy and alternatives: small product materials recycling/ re-use, waste disposal – materials hierarchy. Building and civil scale materials alternatives.
Holistic approach to design and construction. Sustainable development policies.
Design for the environment – small scale: corporate v consumer product lives, design for recycling, design for disassembly (fishbones/ recyclability maps), design for re-use, design for repair.
Design for the environment – large scale: building energy use (space heating and air-conditioning and refrigeration), passive and active solar heating, vernacular buildings. Building design for re-use/ conversion.
Design for occupancy – occupational energy, comfort, insulation and infiltration, facades as climate moderators, cooling and air conditioning, ventilation and passive design.
Contaminated land use and issues.

Learning outcomes

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

- Demonstrate advanced understanding of the significance and importance of material resource and energy limitations to professional design engineers.
- Systematically apply lower energy and resource demanding materials and technologies for small scale products and large scale projects.
- Critically assess the significance of environmental law and other standards for large and small businesses.
- Evaluate the environmental impact of engineering decisions on factors such as global warming
- Show systematic understanding of the effect of location, orientation and form on environmental economies, adaptability and flexibility of use or reuse.

Indicative reading list

Sustainability in Engineering Design. Johnson A, Gibson A. Elsevier 2014. ISBN 9780080993690.
Engineering for Sustainability: A Practical Guide for Sustainable Design. Jonker G, Harmsen J. Elsevier 2012. ISBN 9780444538475.
Sustainability in Engineering Design and Construction. Yates JK, Castro-Lacouture D. CRC Press 2015. ISBN 9781498733915.
Green Building with Concrete: Sustainable Design and Construction. Sabnis GM. CRC Press 2015. ISBN 9781498704106.
Sustainability Engineering: A Design Guide for the Chemical Process Industry. Perl J. Springer 2016. ISBN 978-3-319-32495-1.
Design for Sustainability: a practical approach for Developing Economies. Crul MRM, Diehl JC (eds). CPC 2006. Free download: http://www.d4s-de.org/manual/d4stotalmanual.pdf

EcoDesign. Barbero S, Cozzo B, Tamborrini P. H.F.Ullmann 2012. ISBN: 9783833163081.
Design and Environment - a global guide to designing greener goods. Lewis H, Gertsakis J. Greenleaf. 2001.
ISO 14001 - case studies and practical experiences. Hillary R (ed). Greenleaf 2001.
Green Biorenewable Biocomposites: From Knowledge to Industrial Application. Thakur VK, Kessler M. CRC Press 2015. ISBN 9781771880329.
Bio-Based Plastics: Materials and Applications. Kabasci S (ed). Wiley 2013. ISBN 9781119994008.
Introduction to Peak Oil. Bentley R.W. Springer 2016. ISBN 978-3-319-26372-4.
Sustainable Energy – without the hot air. MacKay D. UIT Cambridge 2009. ISBN-10: 0954452933. ISBN-13: 978-0954452933. Free download: https://www.withouthotair.com/
Our renewable future; Laying the path for one hundred percent clean energy. Heinberg R, Fridley D. Island Press 2016. ISBN 978-1610917797.
Energy Beyond Oil. Mobbs P. Matador 2005. ISBN 1905237006.

Research element

Students are tasked with research on how to improve the sustainability of a product or process of their choice.

Subject specific skills

Sustainable Engineering
Sustainable Design
Materials & Process Selection

Transferable skills

Critical thinking: Make informed decisions on the value of a range of sources allowing an evidence-based conclusion based on this analysis.
Problem-solving: Use rational and logical reasoning to deduce appropriate and well-reasoned conclusions
Communication - Verbal: Communicate orally in a clear and sensitive manner which is appropriately varied according to different audiences.
Communication - Written: Present arguments, knowledge and ideas, in a range of formats.
Teamwork: Operate within, and contribute to, a respectful, supportive and cooperative group climate.
Sustainability: Understands the climate emergency and committed to an active contribution to a sustainable world.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Other activity	2 hours (1%)
Private study	118 hours (79%)
Total	150 hours

Private study description

118 hours of guided independent learning

Other activity description

Guided revision sessions at the start of Term 3, used to catch up/refresh material taught in Term 1.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group D3

	Weighting	Study time
Case Study Group Presentation	10%	
Group case study presentation, including peer assessment		
Group Report	20%	
Group report, including peer assessment (5000 words/18-20 pages).		
Online Examination	70%	
QMP online examination		

~Platforms - QMP

- Online examination: No Answerbook required
- Students may use a calculator
- Engineering Data Book 8th Edition

	Weighting	Study time

- Graph paper

Feedback on assessment

Written individual feedback on essay submissions and cohort level feedback on the oral presentation and written exam.

Past exam papers for ES4A8

Availability

Courses

This module is Option list A for:

- Year 4 of UESA-H217 MEng Civil Engineering
- Year 5 of UESA-H218 MEng Civil Engineering with Intercalated Year
- Year 4 of UESA-H114 MEng Engineering
- Year 4 of UESA-HH76 MEng Manufacturing and Mechanical Engineering
- Year 5 of UESA-HH77 MEng Manufacturing and Mechanical Engineering with Intercalated Year
- Year 4 of UESA-H311 MEng Mechanical Engineering

This module is Option list B for:

- Year 4 of UESA-H336 MEng Automotive Engineering
- Year 4 of UESA-H311 MEng Mechanical Engineering

This module is Option list C for:

- UESA-H311 MEng Mechanical Engineering
  - Year 4 of H311 Mechanical Engineering
  - Year 4 of H30L Mechanical Engineering with Automotive Engineering
  - Year 4 of H30M Mechanical Engineering with Robotics
  - Year 4 of H30N Mechanical Engineering with Systems Engineering
- Year 4 of UESA-H316 MEng Mechanical Engineering
- Year 5 of UESA-H317 MEng Mechanical Engineering with Intercalated Year