UNIVERSITY of BRADFORD

Module Descriptor

Module Details	
Module Title	Low-Carbon Industrial Energy and Materials
Module Code	ENG7016-B
Academic Year	2024/5
Credits	20
School	School of Engineering
FHEQ Level	FHEQ Level 7

Contact Hours	
Type	Hours
Directed Study	156
External Visits	2
Lectures	20
Tutorials	20

Availability	
Occurrence	Location / Period
BDA	University of Bradford / Semester 2

Module Aims

The Low Carbon Industrial Energy and Materials module will introduce learners to new concepts and corporate strategies for minimising energy use and carbon footprints for both industrial manufacturing processes and the products that are created.

The module will provide the learners with tools and approaches to allow them to evaluate energy use and associated carbon footprints for complex industrial processes. They will learn how to employ energy-saving strategies to increase efficiencies and how new forms of energy supply can be integrated to move towards Net Zero.

The module will consider materials use and the cohort will learn techniques for optimising material choices for products based on performance, carbon footprint, global location and recyclability. They will learn how to use industry standard Life Cycle Analysis (LCA) software tools and systems modelling packages to accurately predict carbon footprints for a wide range of product types.

The module will also provide a wider societal context for the work and show the value of calculating accurate carbon footprint data for effective decision-making for a carbon-neutral future. It will also show the importance of critical analysis of data and statistics to prevent misleading public audiences which could lead to poor climate change outcomes or unethical practices.

Outline Syllabus
* Introduction to industrial energy and materials * Energy footprints, costs, regulations, and trade pressures * Driving efficiencies for legacy equipment, infrastructure and with digital innovation * On-site energy generation * Carbone capture strategies in industrial processes * Decision marking in a volatile energy market * Low-carbon materials: Metals, glass, polymers, cement, wood, natural materials * Batteries, materials for lightweighting road vehicles, aircraft * Recycling and reuse * Case studies & site visits

Learning Outcomes	
Outcome Number	Description
01	Develop methods for quantitative assessment of carbon footprints. Calculating actual energy budgets/costs for a range of processes using actual data and calculating efficiencies resulting from contingency measures. (AHEP4 M1).
02	Perform industrial data analysis for informed decision making. Using data analysis methods of actual production data to highlight areas for improvement. Demonstrated by building strategies to calculate carbon footprints for buildings and products using a combination of recorded and estimated data sources (AHEP4 M2, M3, M4).
03	Develop design strategies for sustainable manufacturing. Creating design solutions to minimise carbon emissions for processes and products. Demonstrated by the requirement to combine data and calculations for accurate carbon footprint profiling of products (AHEP4 M5 M6 M7 M13).
04	Choose appropriate materials using carbon footprint calculations in parallel with PESTEL considerations. Critically assessing the use of low-carbon materials with respect to other ethical considerations and global challenges (water, waste plastics etc) (AHEP4 M8, M13).
05	Effectively communicate Net Zero challenges for manufacturing industries and discuss potential solutions to a diverse audience. Discussion in a scientific, engineering and commercial context. Working in teams and communicating ideas using a range of relevant media (AHEP4 M15 M16 M17).

Learning, Teaching and Assessment Strategy

Teaching will consist of a one-hour lecture using multimedia methods to deliver content to the cohort with questions invited during delivery to promote conversations. Where possible, we will include examples from our own research areas where we are driving technology and change for new approaches and products.

These sessions will be immediately followed by a one-hour individual or group activity to explore an aspect of the subject area. These will be broad and varied, but some examples will include:

1) Group discussions about how a publicly available data set could have been calculated, likely assumptions or estimates that may have to be taken into account and how accurate the group feels it may be. These can be selected by the groups from a pool of pre-prepared data, to choose a subject of particular importance to a member of the cohort, or a potential avenue for future professional interest.
2) Q and A session with a professional from a local business to discuss the challenges associated with accurate carbon footprint calculations in the real world
3) A visit to the world leading Polymer IRC labs at Bradford to see real manufacturing processes and discuss challenges and opportunities for plastics in future societies.
4) A session with a Life Cycle Assessment software toolkit to learn the main functions and perform a modest study of the carbon footprint dependency of material choices for a simple device which the learners can choose, such as a water bottle, mobile phone case, etc.
5) A site visit to a local body ? perhaps the new Bradford District Heating facility.
6) A short redesign activity to deconstruct an existing product and suggest improvements to enable recycling and/or reuse of the main components.

Progress will be monitored in the sessions weekly with active Academic participation and discussion. To monitor progress and achievement, we will provide weekly Canvas quizzes for the students to check their progress for formative (or possibly summative) assessment. These methods have proven to be very effective in improving engagement, learning and attendance in other modules delivered by the proposed programme team.

The Assessment strategy will consist of regular formative tests combined with two summative assessments. The formative elements will be delivered throughout the course in the form of short Canvas Quizzes to test student learning following the activity sessions after each lecture. Tutors will play an active role in the activities to steer student learning, which will also provide formative feedback.

Summative assessment will be in the form of a presentation and a written report in a professional style to mimic that which would be required in a potential role in an engineering firm. The learners will put in the position of an engineering manager employed to monitor and control sustainability aspects of the operation of an engineering company delivering goods or services.
For Assessment 001, the cohort will work in small groups to deliver a presentation to a panel representing a company senior management team, or board of directors (actually made up of tutors and energy engineering professionals). The presentation will put forward the current status for energy usage of the company using generated data sets supplied to them. They will highlight areas of concern within the data and make recommendations for strategies to reduce energy consumption and shift toward more carbon neutral energy sources or implement carbon capture methods. This will test the analytical and team working skills of the cohort and aim to develop their ability to present at a professional level and satisfies the LOs as described in the Assessments table.

The second assessment will be in the form of a professional report describing the method and results for life cycle analysis of a specific product from raw materials to end-of-life using a variety of data types. The learners will be using industry-standard software tools to process data, provide justification for estimates and generate data to demonstrate the various carbon costs associated with each stage of the process, and recommend material changes or new manufacturing strategies to reduce them. The report will require adept use of data visualisation tools and will test the student's ability to present it concisely and accurately in an executive summary. This will test the individual?s key engineering and communication skills and satisfies LOs as described in the Assessments table.

Mode of Assessment			
Type	Method	Description	Weighting
Summative	Presentation	?Board of Directors? presentation describing current carbon footprint for an Industrial manufacturing facility	30%
Summative	Coursework - Written	Individual report describing software-predicted carbon footprint for product/process combination (3000 words)	70%
Formative	Computer-based assessment	Canvas Quiz assortment (15 mins)	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.
