ES97B-15 Bioenergy and Biotechnology

21/22

Department
School of Engineering
Level
Taught Postgraduate Level
Module leader
Volkan Degirmenci
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

ES97B-15 Bioenergy and Biotechnology

Module web page

Module aims

To impart a deep understanding of the principles of modern bioenergy and biotechnologies, including biofuels from a variety of sources, biomass chemistry and treatment, conversion of biomass and ethical and practical considerations. Students will gain a thorough understanding of the potential for sustainable biotechnologies for power production as well as the fundamental principles underlying biomass formation/production and energy conversion.

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.

1. Renewable energy technologies

a. Economic and societal background
b. Energy consumption, reserves, depletion and environmental issues

2. Biomass conversion methods
   a. Introduction to biomass resource types
   b. Classification of biomass conversion methods
   c. Life cycle analysis for biomass conversion routes
3. Introduction to chemical reaction engineering
   a. Chemical reaction kinetics
   b. Order of reactions, activation energy, reaction mechanisms
   c. Catalysis and enzyme kinetics
   d. Ideal reactor design equations
   e. Reactor design for enzymatic conversions
   f. Complex reaction mechanisms in enzymatic conversion processes
4. Biochemical engineering
   a. Fermentation processes
   b. Microbial growth
5. Thermal biomass conversion
   a. Torre faction, Pyrolysis and Liquefaction
   i. Fast pyrolysis, kinetics of pyrolysis
   ii. Bio oil upgrading
   b. Biomass gasification
   i. Gasification chemistry, gasification of dry and wet biomass, gas conditioning, syn-gas utilization.
   c. Biomass combustion
   i. Equipment and applications
6. Biochemical biomass conversion
   a. Bioethanol production
   b. Biodiesel from vegetable oils
   c. Biogas production by microbial processes
   d. Biofuels from algae
7. Biorefinery concept
   a. Hydrolysis of biomass for sugar monomer production
   b. Platform molecules and their conversion

Learning outcomes

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

- Appraise biomass chemistry technologies, and the different types of biomass for modern biotechnology applications. Critically evaluate the suitability and feasibility of biofuels for a given application.
- Critique the physical treatment and handling of biomass using advanced modern methods. Understand complex thermal biomass conversion processes, including gasification, combustion, pyrolysis, and liquefaction.
- Perform detailed analyses of the complex underlying principles of biochemical biomass conversion, including biogas and biofuel production from various sources. Perform economic analyses and critically assess the impact on the environment of biomass production and use.

- Critically evaluate the modern biorefinery concept.
- Evaluate logistical and ethical considerations in the context of the environment and be able to critically assess the feasibility of bio-chemical processes based on logistical and environmental constraints.

Indicative reading list

1. Introduction to Chemicals from Biomass, James H. Clark, Fabien Deswarte, John Wiley & Sons, 2014.
2. Catalysis for Renewables: From Feedstock to Energy Production, Gabriele Centi, Rutger A. van Santen (Eds.), Wiley, 2008.
3. Biomass Gasifiation and Pyrolysis Practical Design and Theory, Prabir Basu, Elsevier, 2010.
4. Biogas from Waste and Renewable Resources, Dieter Deublein and Angelika Steinhauser (Eds.), Wiley, 2008
5. Thermochemical Processing of Biomass: Conversion into Fuels, Chemicals and Power, Robert C. Brown, John Wiley & Sons, 2011.
6. Biorefinery: From Biomass to Chemicals and Fuels, Michele Aresta, Angela Dibenedetto, Franck Dumeignil, de Gruyter, 2012.

Subject specific skills

TBC

Transferable skills

TBC

Study

Study time

Type	Required
Lectures	28 sessions of 1 hour (9%)
Other activity	2 hours (1%)
Private study	120 hours (40%)
Assessment	150 hours (50%)
Total	300 hours

Private study description

Guided independent learning 120 Hours

Other activity description

2x1 hour Example classes

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time
Essay	100%	150 hours

Essay - This assignment consists of the critical technical assessment of an alternative renewable energy process/technology. It is a 7500 words essay.

Feedback on assessment

Individual level feedback on essay

Availability

Courses

This module is Core for:

- Year 1 of TESA-H1A0 Postgraduate Taught Sustainable Energy Technologies

This module is Option list C for:

- UESA-H311 MEng Mechanical Engineering
  - Year 4 of H30G Mechanical Engineering with Business Management
  - Year 4 of H30P Mechanical Engineering with Fluid Dynamics
  - Year 4 of H30H Mechanical Engineering with Sustainability