

# ES4E4-15 Fuels and Combustion

**22/23**

**Department**

School of Engineering

**Level**

Undergraduate Level 4

**Module leader**

Jennifer Wen

**Credit value**

15

**Module duration**

10 weeks

**Assessment**

100% exam

**Study location**

University of Warwick main campus, Coventry

---

## Description

### Introductory description

ES4E4-15 Fuels and Combustion

[Module web page](#)

### Module aims

This module will provide engineers with an opportunity to develop their understanding of fuels and combustion technologies. The first part of the course will discuss the fundamentals of fuels; and provide context into the necessity for sustainable development of conventional fuel use and options for alternative fuels and technologies to augment and replace these. The main content of the module will focus on the principles of combustion, covering both theories and basic calculation methods for combustion equations, different flame types and emission index. The module also aims to facilitate understanding of practical combustion systems and their applications including the introduction of renewable fuels in some practical applications.

### 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. Conventional Fuels – physical properties of fuel oil, coal and gas, storage, handling and preparation of fuels, the case for the continued exploitation of fossil fuels and their long-term availability.
2. Novel / Emergent Fuels – the case for the development of alternative fuels, physical properties, storage, handling and preparation, availability and multi-fuel options.
3. Principle of Combustion – combustion modes and flame types, reactant and product mixtures, adiabatic flame temperatures, equilibrium products of combustion, some important chemical mechanisms, reacting systems and conservation equations.
4. Premixed and non-premixed laminar and turbulent flames.
5. Novel Combustion Technology – some applications, pollutant formation and reduction, low-temperature combustion.
6. Safety Issues and Accidental Combustion – accidental releases, fire and explosions in the production, storage and utilization of both conventional and alternative fuels.

## Learning outcomes

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

- Evaluate novel combustion technologies and identify the benefits over conventional combustion techniques in: reduced pollutant formation; and lower-temperature combustion.
- Critically evaluate the properties of different conventional fuels, and describe, compare, and evaluate key fuel properties such as energy density, polluting effect, cost and availability. Analyse the various advantages and disadvantages of each, forming hypotheses on the likelihood of continued usage.
- Investigate novel and emergent alternatives to fossil fuels, interpreting current fuel trends and evaluating the likelihood of future usage.
- Appraise the principles of combustion, and critique the following: combustion modes; equilibrium products of combustion; economy-emissions compromises; pollutant compromises; important chemical mechanisms and conservation equations.
- Interpret the effects of accidental release, fire and explosion in the production, storage and utilization of fuels, being able to cite significant incidents; evaluate the practical implications associated with fuel handling of conventional and novel fuels; evaluate relevant codes and legislation such as DSEAR / ATEX and consider implications on fuel use in industry.

## Indicative reading list

1. An Introduction to Combustion: Concepts and Applications (Int'l Ed) Paperback – 1 May 2011 , Stephen R. Turns, McGraw-Hill Higher Education; 3rd edition (1 May 2011), ISBN-10: 0071086870, ISBN-13: 978-0071086875.
2. Fundamentals of Combustion Processes, Chen, Jyh-Yuan, Fernandez-Pello, A. Carlos, 2011, XXIV, 304 p.
3. Combustion: Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation by Warnatz, J., Maas, Ulrich, Dibble, Robert W., 2006. ISBN-13: 978-3540259923 ISBN-10: 3540259929.
4. Novel Combustion Concepts for Sustainable Energy Development, Agarwal, A.K., Pandey, A., Gupta, A.K., Aggarwal, S.K., Kushari, A. (Eds.), 2014, XIII, 562 p. ISBN: 978-81-322-

2210-1.

## Subject specific skills

Fuel and combustion

## Transferable skills

TBC

---

## Study

### Study time

Type	Required
Lectures	30 sessions of 1 hour (21%)
Seminars	1 session of 1 hour (1%)
Tutorials	(0%)
Demonstrations	(0%)
Practical classes	(0%)
Other activity	3 hours (2%)
Private study	112 hours (77%)
Total	146 hours

### Private study description

Guided Independent Learning 112 hours.

### Other activity description

Advice and feedback hours are available for answering questions on the lecture material (theory and examples) in the form of 6 hours tutorial support to be delivered by a post-doctoral researcher, Dr Chandra Vendra, experienced in combustion, including 2 hours about half-term and 4 hours after the Easter break before the exam.

N.B. The 1 hour seminar should be time tabled in the computer lab to be delivered by Dr Chandra Vendra

### Costs

No further costs have been identified for this module.

---

## Assessment

You must pass all assessment components to pass the module.

### Assessment group BB

	Weighting	Study time
Online Examination	100%	
QMP 2 x 1 hour		
~Platforms - AEP,QMP		

---

- Online examination: No Answerbook required

### Feedback on assessment

- Worked examples in revision class;
- Written feedback on assignment;
- Model solutions to exam type questions;
- Support through advice and feedback hours.
- Cohort level feedback on examinations.

[Past exam papers for ES4E4](#)

---

## Availability

### Pre-requisites

The students should have taken one of the first two and the third one.

Essentially, this module requires students to have some prior knowledge of fluid mechanics and thermodynamics

To take this module, you must have passed:

- Any of
  - [ES2C5-15 Dynamics and Fluid Mechanics](#)
  - [ES3D6-15 Fluid Mechanics for Mechanical Engineers](#)
  - [ES190-15 Dynamics and Thermodynamics](#)

## Courses

This module is Core for:

- Year 4 of UESA-H311 MEng Mechanical Engineering

This module is Core optional for:

- Year 4 of UESA-H311 MEng Mechanical Engineering
- Year 2 of TESA-H1A0 Postgraduate Taught Sustainable Energy Technologies

This module is Optional for:

- Year 4 of UESA-H116 MEng Engineering with Exchange Year
- Year 1 of TESA-H1A0 Postgraduate Taught Sustainable Energy Technologies

This module is Option list A for:

- Year 4 of UESA-H311 MEng Mechanical Engineering
- Year 4 of UESA-H318 MEng Mechanical Engineering with Exchange Year

This module is Option list B for:

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