

# ES3B5-15 Engines and Heat Pumps

**21/22**

**Department**

School of Engineering

**Level**

Undergraduate Level 3

**Module leader**

Zacharie Tamainot-Telto

**Credit value**

15

**Module duration**

10 weeks

**Assessment**

30% coursework, 70% exam

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

ES3B5-15 Engines and Heat Pumps

[Module web page](#)

### Module aims

Mechanical Engineers are expected to have a working knowledge of the thermodynamic basis of a number of types of engine and refrigerators / heat pumps, together with the principles (such as the Second Law) that constrain their performance.

This module addresses those requirements.

### 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. Second Law of Thermodynamics
2. Properties of working fluids
3. Entropy of perfect gases
4. Otto cycle engines

5. Diesel cycle engines
6. Rankine cycle engines
7. Fuels and combustion
8. Air Conditioning, Refrigeration and Heat pump cycles

## **Learning outcomes**

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

- Apply the Second Law of Thermodynamics to complex processes occurring in internal combustion engines.
- Carry out complex thermodynamic analyses of various engine cycles.
- Discriminate between different types of engine cycle and their applications.
- Perform complex thermodynamic analyses of refrigeration and heat pump cycles.
- Carry out complex calculations relating to the combustion of fuels.
- Demonstrate practical skills in a professional and scientific manner.
- Apply numerical and mathematical skills to the solution of mechanical and related engineering problems and communicate solutions
- Communicate the place and use of thermodynamic equipment in society.

## **Indicative reading list**

Required Textbook:

- Efstathios, M., Nanofluidics : thermodynamic and transport properties. E-book. Springer, 2014.
- Miloslav, P., The Thermodynamics of linear fluids and fluid mixtures. E-book, Springer, 2014
- G.F.C. Rogers and Y.R. Mayhew, Thermodynamic and transport properties of fluids, 5th ed., Oxford Blackwell, 1995.

Recommended Textbook:

- Y.A. Çengel & M.A. Boles, Thermodynamics: an engineering approach, 7th ed., London: McGraw Hill, 2011.
- Kenneth A. Kroos & Merle C. Potter, Thermodynamics for Engineers, SI Edition, Cengage Learning, 2015
- Jonh R.Reisel, Principles of Engineering Thermodynamics, SI Edition, Cengage Learning, 2016

## **Subject specific skills**

Ability to conceive, make and realise a component, product, system or process. Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for, often complex, concepts to become reality. Ability to seek to achieve sustainable solutions to problems and have strategies for being creative and innovative

## **Transferable skills**

Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions. Apply problem-solving skills, information retrieval, and the effective use of general IT facilities. Communicate (written and oral; to technical and non-technical audiences) and work with others. Plan self-learning and improve performance, as the foundation for lifelong learning/CPD. Exercise initiative and personal responsibility, including time management, which may be as a team member or leader. Overcome difficulties by employing skills, knowledge and understanding in a flexible manner.

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## Study

### Study time

| Type           | Required                    |
|----------------|-----------------------------|
| Lectures       | 30 sessions of 1 hour (20%) |
| Tutorials      | 3 sessions of 1 hour (2%)   |
| Demonstrations | 3 sessions of 1 hour (2%)   |
| Private study  | 114 hours (76%)             |
| Total          | 150 hours                   |

### Private study description

Guided independent learning 114h

### Costs

No further costs have been identified for this module.

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## 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 |
|---|-----------|------------|
| Laboratory Assignment                           | 30%       |            |
| Laboratory-type assignment of (nominal) 9 pages |           |            |
| Online Examination                              | 70%       |            |
| QMP 0 January                                   |           |            |

~Platforms - AEP,QMP

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- Students may use a calculator
- Engineering Data Book 8th Edition
- Graph paper
- Thermodynamics tables

### **Feedback on assessment**

- Coursework will be returned with marks and detailed feedback.
- Model solutions to examination type questions.
- Support through advice and feedback hours.
- Cohort level feedback on examinations

[Past exam papers for ES3B5](#)

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## **Availability**

### **Courses**

This module is Core for:

- Year 3 of UESA-H310 BEng Mechanical Engineering
- Year 3 of UESA-H315 BEng Mechanical Engineering
- Year 4 of UESA-H314 BEng Mechanical Engineering with Intercalated Year
- Year 3 of UESA-H311 MEng Mechanical Engineering
- Year 3 of UESA-H316 MEng Mechanical Engineering
- Year 4 of UESA-H317 MEng Mechanical Engineering with Intercalated Year

This module is Core optional for:

- Year 3 of UESA-H115 MEng Engineering with Intercalated Year
- UESA-H317 MEng Mechanical Engineering with Intercalated Year
  - Year 3 of H317 Mechanical Engineering with Intercalated Year
  - Year 4 of H317 Mechanical Engineering with Intercalated Year

This module is Optional for:

- Year 3 of UESA-H113 BEng Engineering
- Year 3 of UESA-H114 MEng Engineering
- Year 4 of UESA-H115 MEng Engineering with Intercalated Year

This module is Option list A for:

- Year 4 of UESA-H111 BEng Engineering with Intercalated Year
- UESA-H112 BSc Engineering
  - Year 3 of H112 Engineering
  - Year 3 of H112 Engineering