**3B1 THERMODYNAMICS** [5 credits]

**Lecturers:** Assistant Prof. Anthony Robinson (arobins@tcd.ie)

### Module Organisation

The module runs for 12 weeks of the academic year and comprises three lectures per week. A tutorial is given every week. Total contact time is 44 hours.

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<tr>
<th>Semester</th>
<th>Start Week</th>
<th>End Week</th>
<th>Lectures per week</th>
<th>Lectures total</th>
<th>Tutorials per week</th>
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<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>12</td>
<td>3</td>
<td>33</td>
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### Module Description

This module is developed to strengthen the student’s skills in the thermal fluid sciences and is organised into three main subsections: energy, energy conversion devices and power cycles. The energy part deals primarily with work and heat developing the mathematical modelling skills and analysis techniques for practical energy transfer problems based on the fundamental scientific principle of conservation of energy. The energy conversion devices focuses on traditional and novel approaches for energy transfer and conversion with focus on devices found in power generation and refrigeration systems. Finally, power cycles will be considered ranging from internal combustion engines to steam power plants.

### Learning Outcomes

On successful completion of this module, students will (be able to):

1. Recognise, classify and describe the basic operating functions and thermodynamic principles energy conversion devices;
2. Understand the concepts related to perfect (Carnot), ideal (e.g. Rankine, Otto & Refrigeration) and actual cycles;
3. Analyse and solve problems related to perfect (Carnot), ideal (e.g. Rankine, Otto & Refrigeration) and actual cycles;
4. Estimate the Thermal Efficiency (power generation systems) or Coefficient of Performance (refrigeration system);
5. Recognise the environmental and socio-economic implications associated with desired system output (i.e. power/cooling) versus required ‘cost’ input (i.e. electrical/fuel);
6. Recognise and evaluate the limitations of various mechanical components and engineering systems;
7. Describe and explain problems relating to reheating and regeneration with focus on efficient energy use;
8. Analyse and solve problems relating to the rational use of energy;
9. Analyse and generate mathematical models for problems related to power generating thermodynamic cycles;
10. Solve problems related to power generating thermodynamic cycles;
11. Recognise basic workshop and laboratory procedures and safety;
12. Perform laboratory and engine workshop tasks as a group;
13. Acquire, tabulate and analyse useful data in the laboratory;
14. Communicate information and provide physical interpretation of measurements in technical laboratory reports;
15. Utilise internet resources for general module material and lab report preparation.
16. Communicate information to an audience via formal presentation.

Module Content

- Introduction to energy transfer: basic concepts and the 1st & 2nd laws of thermodynamics.
- The thermodynamics of practical energy conversion components and devices.
- Steam and gas power cycles: e.g. Carnot cycle, ideal and actual Rankine, Otto, Diesel and Brayton cycles (including regeneration).

Teaching Strategies

The module encompasses a diverse range of teaching and learning strategies. This is accomplished by coordinating formal lectures with problem solving tutorial sessions supplemented by ‘hands-on’ laboratory experimentation, technical report writing, workshops and a group assignment. The module is delivered in a technologically up-to-date fashion by providing access to computerised module notes, by using modern audio-visual equipment and by exposing the students to digital control and data acquisition whilst encouraging the use of modern software packages.

Assessment Modes

Written examination, group project and laboratory experiments (with logbook and formal written reports)

Recommended Texts

Other Relevant Texts

- Moran and Shapiro, *Fundamentals of Engineering Thermodynamics* (Wiley and Sons)

Laboratories

- Refrigeration study
- Diesel engine

Assessment Mode(s)

Written Exam (80%) Continuous Assessment (20%)