

Module Code	MEU33B01
Module Name	Thermodynamics
ECTS Weighting	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Professor Anthony Robinson
<u>Module Learning Outcomes</u> with reference to the <u>Graduate Attributes</u> and how they are developed in discipline	<p>On successful completion of this module, students should be able to:</p> <p>LO1. Recognise, classify and describe the basic operating functions and thermodynamic principles of energy conversion devices.</p> <p>LO2. Understand the concepts and solve problems related to perfect (Carnot), ideal (e.g. Rankine, Otto & Refrigeration) and actual cycles.</p> <p>LO3. Estimate the Thermal Efficiency (power generation systems) or Coefficient of Performance (refrigeration systems).</p> <p>LO4. Recognise the environmental and socio-economic implications associated with desired system output (power/ cooling) versus required 'cost' input (fuel/energy source).</p> <p>LO5. Analyse and solve problems relating to the rational use of energy.</p> <p>LO6. Perform laboratory tasks as a group and acquire, tabulate and analyse useful data in the laboratory.</p> <p>LO7. Communicate information and provide physical interpretation of measurements in a technical laboratory report.</p> <p>LO8. Utilise digital resources for team-based investigation and to communicate information to an audience via formal group presentation.</p> <p>Graduate Attributes: levels of attainment To act responsibly - Introduced To think independently - Enhanced To develop continuously - Enhanced To communicate effectively - Enhanced</p>
Module Content	<p>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 reinforces their understanding of the first and second laws of thermodynamics and the behaviour of ideal gases and pure substances; the property entropy is also introduced. The focus is on developing the mathematical modelling skills and analysis techniques for practical energy transfer problems. 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. The module content is as follows:</p>

- Introduction to energy transfer: revision of basic concepts, 1st & 2nd laws of thermodynamics, entropy.
- 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).
- The Reverse Heat Engine: The Carnot reverse heat engine, ideal and actual refrigeration cycles, practical refrigerators and heat pumps.

Teaching and Learning Methods

This module uses Blackboard, podium lectures, a group assignment, a laboratory session and tutorials to help students achieve the required learning outcomes. There are 3 lectures and one tutorial per week.

Assessment Details

Please include the following:

- **Assessment Component**
- **Assessment description**
- **Learning Outcome(s) addressed**
- **% of total**
- **Assessment due date**

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Laboratory	Heat Pump lab report	6-7	10	2 weeks following lab session
Written examination	End of semester examination	1-5	80	Exam period
Group assignment	Energy themed group presentation	8	10	Weeks 11 and 12

Reassessment Requirements

100% written examination

Contact Hours and Indicative Student Workload

Contact hours: 40
Independent Study (preparation for course and review of materials): 40
Independent Study (preparation for assessment, incl. completion of assessment): 25

Recommended Reading List

Thermodynamics: an Engineering Approach, YA Çengel and MA Boles, McGraw Hill
Moran and Shapiro, Fundamentals of Engineering Thermodynamics (Wiley and Sons)
Rogers and Mayhew, Engineering Thermodynamics Work and Heat Transfer, 4th. edition, S.I. units (Longman)
Sonntag, Borgnakke and Van Wylen, Fundamentals of Thermodynamics, S.I. units, 6th. edition (Wiley)

Module Pre-requisite

2E5 Thermo-fluids

Module Co-requisite

NA

Module Website

<https://www.tcd.ie/Engineering/undergraduate/baiyear4/modules/3B1.pdf>

Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.

No

Module Approval Date

August 2026

Approved by

Anthony Robinson

Academic Start Year

2026

Academic Year of Date

2026/27