MECH3001

Thermodynamics

Session 1, Special circumstances, North Ryde 2021

School of Engineering

Contents

Notice

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and other small group activities on campus, and most will keep an online version available to those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face activities for your unit, please go to timetable viewer. To check detailed information on unit assessments visit your unit's iLearn space or consult your unit convenor.

General Information

Unit convenor and teaching staff
Dr Nazmul Huda
nazmul.huda@mq.edu.au
Contact via +61-2-9850-2249
44 Waterloo Road, Room 118
1.00 - 3.00 pm Mondays

Credit points
10

Prerequisites
(MECH2002 or MECH202 and (20cp at 2000 level or above)) or Admission to MEngMechEng

Corequisites

Co-badged status

Unit description
This unit examines the principles of thermodynamics. The unit covers knowledge in energy, enthalpy, entropy, energy transfer, mass and energy balance, laws of thermodynamics, and the design principles of thermo-fluid systems. At the end of the unit, students are expected to demonstrate the ability to improve the design of real-world thermo-fluid systems and demonstrate a detailed understanding and the application of energy systems.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: Articulate and interpret the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium

ULO2: Apply the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer in analysing thermodynamic systems

ULO3: Analyse mass and energy transfer in both closed and open systems in steady and unsteady states.

ULO4: Examine gas power cycle, vapour and combined power cycle, refrigeration cycle

and air-conditioning cycle and apply knowledge of thermodynamics to improve and optimise the design of the existing cycle.

ULO5: Exhibit specific skills in teamwork and written communication skills through technical report writing and laboratory work.

General Assessment Information

Student Responsibilities

Be familiar with University policy and College procedures and act in accordance with those policies and procedures. It is the responsibility of the student to retain a copy of any work submitted. Students must produce these documents upon request. Copies should be retained until the end of the grade appeal period each term. The student is to perform the required due diligent for their assessment grade and rectify as soon as possible upon finding any errors.

Notifications

Formal notification of assessment tasks, grading rubrics, and due dates will be posted on iLearn. Although all reasonable measures to ensure the information is accurate, The University reserves the right to make changes without notice. Each student is responsible for checking iLearn for changes and updates.

Report and Assignment Tasks

Assignment Problems will be posted on iLearn at least one week before their submission date. Assignment solutions will be posted within 7 working days after the submission date. Submissions will not be accepted once the solution is posted.

Assignment submissions and plagiarism policies

All assignments and reports must be submitted electronically through iLearn (in pdf format) in the appropriate space provided for submissions in ilearn. Submissions will undergo plagiarism checkers using the Turnitin software and any work deemed to have 30% or higher similarity score may incur an academic penalty. For more details on the policies of academic penalties relating to academic honesty, please refer to the policies and procedures section below. Submissions are expected to be either handwritten or typed in a logical layout and sequence. Markers WILL NOT grade poorly organized or illegible scans or drafts. The expected workload includes preparation of final copies and clear diagrams.

Late submissions

Late submissions or absences from tutorials and laboratories will not be accepted without prior arrangement being made before the submission date. Extenuating circumstances will be considered upon lodgement of a formal notice of disruption of studies.

Grading and passing requirement for unit

In order to pass the unit satisfactorily, the students need to fulfil the following criteria:

1. At least 50% marks overall

For further details about grading, please refer below in the policies and procedures section.

The unit will be graded according to the Macquarie University Grading policy. The following grades will be used according to the listed numerical range:

HD	High Distinction	85-100
D	Distinction	75-84
Cr	Credit	65-74
P	Pass	50-64
F	Fail	0-49

Final Examinations Final examinations will typically take place at the end of the semester. For further information, please refer to the Examination Timetable website on www.mq.edu.au

Assessment Tasks

Name	Weighting	Hurdle	Due
Final Examination	50%	No	TBA
Weekly practice based task	22%	No	Week 3 to Week 13
Final Assignment	10%	No	Week 12
Lab report	18%	No	Week 5, 8 and 13

Final Examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 15 hours
Due: **TBA**
Weighting: **50%**

Final Examination

On successful completion you will be able to:

- Articulate and interpret the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium
- Apply the concept of energy, enthalpy, entropy, entropy balance, energy balance and

energy transfer in analysing thermodynamic systems
- Analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
- Examine gas power cycle, vapour and combined power cycle, refrigeration cycle and air-conditioning cycle and apply knowledge of thermodynamics to improve and optimise the design of the existing cycle.

Weekly practice based task

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 25 hours
Due: **Week 3 to Week 13**
Weighting: **22%**

Weekly practice based task

On successful completion you will be able to:
- Articulate and interpret the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium
- Apply the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer in analysing thermodynamic systems
- Analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
- Examine gas power cycle, vapour and combined power cycle, refrigeration cycle and air-conditioning cycle and apply knowledge of thermodynamics to improve and optimise the design of the existing cycle.

Final Assignment

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 10 hours
Due: **Week 12**
Weighting: **10%**

Final Assignment

On successful completion you will be able to:

- Articulate and interpret the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium
- Apply the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer in analysing thermodynamic systems
- Analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
- Examine gas power cycle, vapour and combined power cycle, refrigeration cycle and air-conditioning cycle and apply knowledge of thermodynamics to improve and optimise the design of the existing cycle.

Lab report

Assessment Type [1]: Lab report
Indicative Time on Task [2]: 15 hours
Due: **Week 5, 8 and 13**
Weighting: **18%**

3 Lab reports based on 3 practical sessions

On successful completion you will be able to:

- Exhibit specific skills in teamwork and written communication skills through technical report writing and laboratory work.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

Primary Text: Thermodynamics: An Engineering Approach (9th Edition in SI Units) by Yunus A. Cengel and Michael A. Boles

Supporting Texts: 1. Engineering Thermodynamics (4th Edition) by Rogers and Mayhew 2. Principles of Engineering Thermodynamics (7th Edition) by Moran, Shapiro, Boettner and Bailey

Unit Schedule

Week	Lecture Topics	Key Topics to be Covered
1	Introduction and Basic Concepts	Thermodynamics and Energy, Dimension and Units, Different Applications and definitions related to Thermodynamics, Processes and Cycle
2	Energy, Energy Transfer and General Energy Analysis	Forms of energy, Energy transfer by work and heat, First law of Thermodynamics, Energy efficiency
3	Properties of pure substances	Properties of pure substances, Phase change processes, Property diagram and property tables, Equation of state
4	Energy Analysis of Closed Systems	Closed system, Moving boundary work, Energy balance for Closed systems, Internal energy, enthalpy and specific heats.
5	Mass and Energy Analysis of Control Volumes	Conservation of mass, Flow work and Energy of a Flowing Fluid, Energy Analysis of Steady flow systems, Energy Analysis of Unsteady flow process
6	The Second Law of Thermodynamics	The Second Law, Thermal energy reservoir, Heat engines, Refrigerators and Heat pumps, Reversible and Irreversible Processes, The Carnot Cycle
7	Entropy	Entropy, Entropy diagrams, Entropy change, Entropy balance,
8	Exergy	Exergy, Exergy change of a system, Exergy transfer by heat, work and mass, Exergy balance.
9	Gas Power Cycles	Analysis of Power Cycles, The Carnot Cycle, Otto Cycle, Diesel Cycle, Stirling and Ericsson Cycles, Brayton Cycle

10	Vapor and Combined Power Cycles	Rankine Cycle, Efficiency of Rankine Cycle, Regeneration, Cogeneration, Combined Gas-Vapor Power Cycles
11	Refrigeration Cycles	Refrigeration and Heat Pumps, Reversed Carnot Cycle, Refrigeration Cycles
12	Gas Vapor Mixture and Air Conditioning	Gas Mixtures, Properties of Gas Vapor Mixtures, Properties of Air, Air-Conditioning Processes
13	Renewable Energy	Renewable Energy, Solar, Wind, Hydro, Geothermal and Biomass Energy.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be

made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.