MECH3001

Thermodynamics

Session 1, In person-scheduled-weekday, North Ryde 2022

School of Engineering

Contents

General Information

Unit convenor and teaching staff
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44 Waterloo Road, Room 118
Thursday 3.00 - 5.00 PM

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

Late submissions

Online quizzes, in-class activities, or scheduled tests and exams must be undertaken at the time indicated in the unit guide. Should these activities be missed due to illness or misadventure, students may apply for Special Consideration.

Should these assessments be missed due to illness or misadventure, students should apply for Special Consideration.

Assessments not submitted by the due date will receive a mark of zero.

Resubmission of work is not permitted under any circumstances.

Grading and passing requirement for unit

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

1. At least 50% marks overall

For further details about grading, please refer below to 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

If you receive special consideration for the final exam, a supplementary exam will be scheduled by the faculty during a supplementary exam period, typically about 3 to 4 weeks after the normal exam period. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure

you are familiar with the policy prior to submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
Midterm examination	20%	No	Week 7
Final Examination	50%	No	During Final Exam Period
Assignment	12%	No	Week 7 and Week 12
Laboratory report	12%	No	Week 6, Week 9, Week 13
Active Engagement	6%	No	From Week 1 to Week 13

Midterm examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 10 hours
Due: **Week 7**
Weighting: **20%**

Midterm in class 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.

Final Examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 30 hours

Due: **During Final Exam Period**
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.

Assignment

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 5 hours
Due: **Week 7 and Week 12**
Weighting: **12%**

Assignment based on problem solving activities

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.

Laboratory report

Assessment Type [1]: Lab report
Indicative Time on Task [2]: 10 hours
Due: **Week 6, Week 9, Week 13**
Weighting: **12%**

Laboratory report based on the practical classes

On successful completion you will be able to:

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

Active Engagement

Assessment Type [1]: Participatory task
Indicative Time on Task [2]: 10 hours
Due: **From Week 1 to Week 13**
Weighting: **6%**

Active Engagement and participation in the tutorial classes

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

[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

Please note:

- All Lectures, SGTAs, and Practicals will be conducted on campus.
- Lectures will start from week 1 (Week 1 to Week 13)
- SGTAs will start from week 2 (Week 2 to Week 13)
- Practical sessions will run only three weeks (on Week 5, Week 8 and Week 11)

*Any student unable to get back to campus in time should contact the convenor As Soon As Possible.

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	Final Review Lecture	Review discussion on the overall contents and final examination

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
- Assessment Procedure
- Complaints Resolution 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

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

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

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the 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

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues

Student Enquiries

Got a question? Ask us via AskMQ, or contact Service Connect.

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.

Engineers Australia Competency Mapping

EA Competency Standard		Unit Learning Outcomes
Knowledge and Skill Base	1.1 Comprehensive, theory-based understanding of the underpinning fundamentals applicable to the engineering discipline.	UL01, UL02, UL03
	1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing.	
	1.3 In-depth understanding of specialist bodies of knowledge	UL04

	1.4 Discernment of knowledge development and research directions	
	1.5 Knowledge of engineering design practice	UL04
	1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice.	
Engineering Application Ability	2.1 Application of established engineering methods to complex problem solving	UL03, UL04
	2.2 Fluent application of engineering techniques, tools and resources.	
	2.3 Application of systematic engineering synthesis and design processes.	UL04
	2.4 Application of systematic approaches to the conduct and management of engineering projects.	
Professional and Personal Attributes	3.1 Ethical conduct and professional accountability.	
	3.2 Effective oral and written communication in professional and lay domains.	UL05
	3.3 Creative, innovative and pro-active demeanour.	
	3.4 Professional use and management of information.	
	3.5 Orderly management of self, and professional conduct.	
	3.6 Effective team membership and team leadership	UL05

Unit information based on version 2022.04 of the Handbook