MECH301

Thermodynamics

S1 Day 2016

Dept of Engineering

Contents

General Information

Unit convenor and teaching staff
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Room: E6B 143
Consultation hours: Thursday 2.00 to 3.00 pm/ Friday 2.00 to 3.00 pm

Credit points
3

Prerequisites
6cp at 200 level including MECH202

Corequisites

Co-badged status

Unit description
The unit is designed to give a comprehensive treatment of thermodynamics to the engineering students. The unit will provide the students with detailed understanding of energy systems and application of energy systems in practical engineering. In particular, the students will learn the concepts of energy, enthalpy, entropy, energy transfer, mass and energy balance, laws of thermodynamics, design principles of thermo-fluid systems, use of the property tables and how to the improve the design of the existing thermo-fluid 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:

The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium.
The students will able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
The students will be able to analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
The students will be able to analyse gas power cycle, vapour and combined power cycle,

refrigeration cycle and air-conditioning cycle and apply their knowledge of thermodynamics to improve the design and optimize the operating parameters of existing cycle.

The students will develop specific skills on team work and written communication skills through technical report writing and laboratory work.

General Assessment Information

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

1. at least 50% marks overall

2. must submit at least 2 assignments and 2 lab reports

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

Assessment Tasks

Name	Weighting	Due
Active engagement	6%	Week 2 - 13
Assignments	15%	Week 5, Week 8, Week 11
Laboratory reports	9%	Week 7, Week 9, Week 12
Class test 1	5%	Week 4
Mid term test	15%	Week 6
Final Examination	50%	Exam period

Active engagement

Due: **Week 2 - 13**
Weighting: **6%**

Attendance And Active Engagement in Tutorials and Practicals

On successful completion you will be able to:

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- The students will be able to analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
- The students will be able to analyse gas power cycle, vapour and combined power cycle, refrigeration cycle and air-conditioning cycle and apply their knowledge of thermodynamics to improve the design and optimize the operating parameters of existing cycle.
- The students will develop specific skills on team work and written communication skills through technical report writing and laboratory work.

Assignments

Due: **Week 5, Week 8, Week 11**
Weighting: **15%**

Assignments based on problem solving 3 x 5% each

On successful completion you will be able to:

- The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium.
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Laboratory reports

Due: **Week 7, Week 9, Week 12**
Weighting: **9%**

3 Laboratory reports on 3 practicals

3 x 3% each

On successful completion you will be able to:

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Class test 1

Due: **Week 4**
Weighting: **5%**

In Class test

On successful completion you will be able to:

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- The students will be able to analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
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Mid term test

Due: **Week 6**
Weighting: **15%**

Mid term examination

On successful completion you will be able to:

- The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium.
- The students will able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
- The students will be able to analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
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Final Examination

Due: **Exam period**
Weighting: **50%**

Final Examination

On successful completion you will be able to:

- The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium.
- The students will able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
- The students will be able to analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
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Delivery and Resources

Primary Text:

Thermodynamics: An Engineering Approach (8th 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	Learning activity/ Assessment task
1	Introduction and Basic Concepts	Thermodynamics and Energy, Dimension and Units, Different Applications and definitions related to Thermodynamics, Processes and Cycle	Lecture only
2	Energy, Energy Transfer and General Energy Analysis	Forms of energy, Energy transfer by work and heat, First law of Thermodynamics, Energy efficiency	Lecture + Tutorial
3	Renewable Energy	Renewable Energy, Solar, Wind, Hydro, Geothermal and Biomass Energy.	Lecture + Tutorial
4	Properties of pure substances	Properties of pure substances, Phase change processes, Property diagram and property tables, Equation of state	Lecture + Tutorial / **Class Test 1**
5	Energy Analysis of Closed Systems	Closed system, Moving boundary work, Energy balance for Closed systems, Internal energy, enthalpy and specific heats.	Lecture + Tutorial/ Assignment 1 due
6	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	Lecture + Tutorial + Practical 1/ **Midterm Test**
7	The Second Law of Thermodynamics	The Second Law, Thermal energy reservoir, Heat engines, Refrigerators and Heat pumps, Reversible and Irreversible Processes, The Carnot Cycle	Lecture + Tutorial / Lab report 1 due
8	Entropy	Entropy, Entropy diagrams, Entropy change, Entropy balance,	Lecture + Tutorial + Practical 2 / Assignment 2 due
9	Exergy	Exergy, Exergy change of a system, Exergy transfer by heat, work and mass, Exergy balance.	Lecture + Tutorial / Lab report 2 due
10	Gas Power Cycles	Analysis of Power Cycles, The Carnot Cycle, Otto Cycle, Diesel Cycle, Stirling and Ericsson Cycles, Brayton Cycle	Lecture + Tutorial
11	Vapor and Combined Power Cycles	Rankine Cycle, Efficiency of Rankine Cycle, Regeneration, Cogeneration, Combined Gas-Vapor Power Cycles	Lecture + Tutorial + Practical 3 / Assignment 3 due
12	Refrigeration Cycles	Refrigeration and Heat Pumps, Reversed Carnot Cycle, Refrigeration Cycles	Lecture + Tutorial / Lab report 3 due
13	Gas Vapor Mixture and Air Conditioning	Gas Mixtures, Properties of Gas Vapor Mixtures, Properties of Air, Air-Conditioning Processes	Lecture + Tutorial

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

New Assessment Policy in effect from Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Results

Results shown in *iLearn*, 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.

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 improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students

- Ask a Learning Adviser

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

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.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium.
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Assessment tasks

- Assignments

- Laboratory reports

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcome

- The students will develop specific skills on team work and written communication skills through technical report writing and laboratory work.

Assessment task

- Assignments

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium.
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Assessment tasks

- Active engagement
- Assignments
- Class test 1
- Mid term test
- Final Examination

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

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- Active engagement
- Assignments
- Laboratory reports
- Class test 1
- Mid term test
- Final Examination

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

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Assessment tasks

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- Laboratory reports
- Class test 1
- Mid term test
- Final Examination

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium.
- The students will able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
- The students will be able to analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
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Assessment tasks

- Active engagement
- Assignments
- Laboratory reports
- Class test 1
- Mid term test
- Final Examination

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcome

- The students will develop specific skills on team work and written communication skills through technical report writing and laboratory work.

Assessment tasks

- Active engagement
- Laboratory reports
- Final Examination

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning outcome

- The students will develop specific skills on team work and written communication skills through technical report writing and laboratory work.

Assessment tasks

- Assignments
- Laboratory reports
- Class test 1
- Mid term test
- Final Examination