



# MECH301

## Thermodynamics

S1 Day 2015

*Dept of Engineering*

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## General Information

Unit convenor and teaching staff

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Contact via 02 9850 9598

E6B 1.08

Tuesday 11.00 - 12.00, Friday 11.00 - 12.00

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 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:

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

4. 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.
5. The students will develop specific skills on team work, project management, oral and written communication skills and sustainable engineering design.

## Assessment Tasks

Name	Weighting	Due
<u>Assignments</u>	15%	Week 4, Week 8, Week 10
<u>Group Project</u>	15%	Week 12
<u>Mid term test</u>	20%	Week 6
<u>Final Exam</u>	50%	End of Semester (Date TBA)

### Assignments

Due: **Week 4, Week 8, Week 10**

Weighting: **15%**

Assignment based on problem solving

3 x 5% each

On successful completion you will be able to:

- 1. The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium, and idea of temperature and pressure.
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- 4. 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.
- 5. The students will develop specific skills on team work, project management, oral and written communication skills and sustainable engineering design.

## Group Project

Due: **Week 12**

Weighting: **15%**

Group Project on Sustainability

Project Report 10%

Presentation 5%

On successful completion you will be able to:

- 5. The students will develop specific skills on team work, project management, oral and written communication skills and sustainable engineering design.

## Mid term test

Due: **Week 6**

Weighting: **20%**

Mid term test

On successful completion you will be able to:

- 1. The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium, and idea of temperature and pressure.
- 2. The students will be able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
- 3. The students will be able to analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
- 4. 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.

## Final Exam

Due: **End of Semester (Date TBA)**

Weighting: **50%**

Final Examination

On successful completion you will be able to:

- 1. The students will develop comprehensive understanding of the Laws of

Thermodynamics and Energy systems including properties of substances, state and equilibrium, and idea of temperature and pressure.

- 2. The students will be able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
- 3. The students will be able to analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
- 4. 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.

## 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
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	Renewable Energy	Renewable Energy, Solar, Wind, Hydro, Geothermal and Biomass Energy.
4	Properties of Pure Substances	Properties of pure substances, Phase change processes, Property diagram and property tables, Equation of state
5	Energy Analysis of Closed Systems	Closed system, Moving boundary work, Energy balance for Closed systems, Internal energy, enthalpy and specific heats.
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
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

8	Entropy and Exergy	Entropy, Entropy diagrams, Entropy change, Entropy balance, 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	Chemical Reactions and Equilibrium	Fuels and Combustion, Combustion Processes, Enthalpy Formation and Combustion, Chemical Equilibrium.

## 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](http://mq.edu.au/policy/docs/academic_honesty/policy.html)

Assessment Policy <http://mq.edu.au/policy/docs/assessment/policy.html>

Grading Policy <http://mq.edu.au/policy/docs/grading/policy.html>

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

Grievance Management Policy [http://mq.edu.au/policy/docs/grievance\\_management/policy.html](http://mq.edu.au/policy/docs/grievance_management/policy.html)

Disruption to Studies Policy [http://www.mq.edu.au/policy/docs/disruption\\_studies/policy.html](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/](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](http://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](http://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](http://ask.mq.edu.au)

## IT Help

For help with University computer systems and technology, visit <http://informatics.mq.edu.au/help/>.

When using the University's IT, you must adhere to the [Acceptable Use 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

- 1. The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium, and idea of temperature and pressure.
- 2. The students will be able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
- 3. The students will be able to analyse mass and energy transfer in both closed and open systems in steady and unsteady states.
- 4. 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.

- 5. The students will develop specific skills on team work, project management, oral and written communication skills and sustainable engineering design.

## **Assessment tasks**

- Group Project
- Mid term test

## **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**

- 5. The students will develop specific skills on team work, project management, oral and written communication skills and sustainable engineering design.

### **Assessment task**

- Group Project

## **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**

- 1. The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium, and idea of temperature and pressure.
- 2. The students will be able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
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- 5. The students will develop specific skills on team work, project management, oral and written communication skills and sustainable engineering design.

## **Assessment tasks**

- Assignments
- Mid term test
- Final Exam

## **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:

## **Learning outcomes**

- 1. The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium, and idea of temperature and pressure.
- 2. The students will be able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
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## **Assessment tasks**

- Assignments

- Mid term test
- Final Exam

## 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

- 1. The students will develop comprehensive understanding of the Laws of Thermodynamics and Energy systems including properties of substances, state and equilibrium, and idea of temperature and pressure.
- 2. The students will be able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
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### Assessment tasks

- Assignments
- Mid term test
- Final Exam

## 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

- 1. The students will develop comprehensive understanding of the Laws of

Thermodynamics and Energy systems including properties of substances, state and equilibrium, and idea of temperature and pressure.

- 2. The students will be able to demonstrate the concept of energy, enthalpy, entropy, entropy balance, energy balance and energy transfer.
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## Assessment tasks

- Assignments
- Group Project
- Mid term test
- Final Exam

## 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

- 5. The students will develop specific skills on team work, project management, oral and written communication skills and sustainable engineering design.

## Assessment tasks

- Assignments
- Group Project

## 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**

- 5. The students will develop specific skills on team work, project management, oral and written communication skills and sustainable engineering design.

### **Assessment task**

- Group Project

## **Socially and Environmentally Active and Responsible**

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

### **Learning outcome**

- 5. The students will develop specific skills on team work, project management, oral and written communication skills and sustainable engineering design.

### **Assessment task**

- Group Project