MECH3002

Heat and Mass Transfer

Session 2, Special circumstances, North Ryde 2021

School of Engineering

Contents

Session 2 Learning and Teaching Update

The decision has been made to conduct study online for the remainder of Session 2 for all units WITHOUT mandatory on-campus learning activities. Exams for Session 2 will also be online where possible to do so.

This is due to the extension of the lockdown orders and to provide certainty around arrangements for the remainder of Session 2. We hope to return to campus beyond Session 2 as soon as it is safe and appropriate to do so.

Some classes/teaching activities cannot be moved online and must be taught on campus. You should already know if you are in one of these classes/teaching activities and your unit convenor will provide you with more information via iLearn. If you want to confirm, see the list of units with mandatory on-campus classes/teaching activities.

Visit the MQ COVID-19 information page for more detail.

General Information

Unit convenor and teaching staff
Lecturer
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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 heat and mass transfer. The unit covers knowledge in theories related to the analysis of different heat transfer modes such as conduction, convection, and radiation. At the end of the unit, students are expected to demonstrate the ability to apply the principles of heat and mass transfer to analyse local and overall heat and mass transfer coefficients and to design experiments to improve existing heat and mass transfer engineering 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: Characterise heat transfer systems undergoing conduction, convection and/or radiation processes with and without mass transfer.

ULO2: Apply analytical equations, dimensional analysis, and empirical correlations to formulate solutions for heat and mass transfer systems.

ULO3: Design heat and mass transfer systems and critically evaluate their performance and limitations in the context of real-world applications.

ULO4: Design and manufacture a realistic and effective heat transfer system through problem-solving and critical thinking.

General Assessment Information

In order to pass this unit a student must obtain a mark of 50 or more for the unit (i.e. obtain a passing grade P/ CR/ D/ HD). There are no hurdle assessments.

The following conditions apply for all assessments:

For assignments handed in late the following penalties apply: 0-24hrs -25%, 24-48hrs -50%, greater than 48hrs -100%.

All assessments will be graded according to standards set in the marking rubrics. Students will receive a numerical grade for each assessment which will be representative of a fail (0-49%), pass (50-64%), credit (65-74%), distinction (75-84%) or high distinction (85-100%) as defined by the university standards based assessment guidelines. The definitions of these standards will be posted on the iLearn page. All marking rubrics specific to each assessment will be released on the iLearn page clearly indicating requirements to achieve a particular standard. These will be released well in advance of the assessment due date or are specified below.

Weekly Quiz (10/100)

Each tutorial will typically consist of 4 questions. In addition, students will also receive 1 tutorial question as a weekly quiz . Students must individually attempt the weekly quiz and submit the answer on iLearn by that week. The tutor will allocate either a fail grade for incorrect methodology and incorrect answer, a pass grade for sound methodology but incorrect answer, or up to a high distinction grade for sound methodology and correct answer. A maximum of 1 mark (out of 100 available for the unit) is available for each of the tutorial sessions from weeks 3-7 and 9-13.

Assignments (15/100)

Assignment 1: (5/100)

This individually marked assignment will test the student's ability to apply and critically interpret the course material related to introductory concepts in heat transfer by conduction. The assignment will involve a combination of analytical calculations, design and report writing.
A rubric will be provided with the assessment handout.

Assignment 2: (10/100)

This individually marked assignment will test the student's ability to conceptually design an experimental system for heat convection. The student will design a system based on analytical calculations, whilst making considerations for suitable equipment, develop a series of theoretical results and suggest methods of experimental improvement. A rubric will be provided with the assessment handout.

Practical Laboratory Sessions (15/100)

Two individual lab reports written for two unique experiments. Attendance will be taken at the practical sessions. Students must be present in order to submit lab report. The location of the practical sessions will be in F9C 110. Precise details on time will be advised via the iLearn page. Both laboratory reports will be assessed according to a rubric to be made available on the iLearn page.

Laboratory Report 1: (7/100)

The first experiment will demonstrate the operation of heat exchangers. Students will test a particular heat exchanger design, acquire data, and compare to theoretical calculations of heat exchanger performance. A laboratory report is then handed in.

Laboratory Report 2: (8/100)

The second experiment will demonstrate experimental techniques used to take measurements of conduction and convection. The data collected will be presented and interpreted along with some theoretical calculations. A laboratory report is then handed in.

Mid-Session & Final Examinations (60/100)

Mid-Session Test: (15/100)

An in-class 1-h test assessing material delivered between weeks 1 and 6.

Final Examination: (45/100)

A final examination (2h) assessing all material (weeks 1-13) delivered throughout the unit.

If you receive special consideration for the final exam, a supplementary exam will be scheduled in the supplementary examination 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
Assignment 1	5%	No	Week 4
Final Examination	50%	No	Exam Period
Weekly Tutorial Questions	10%	No	Week 3-7 and 9-13
Assignment 2	5%	No	Week 12
Practical Lab Report 2	8%	No	Week 11
Mid-Session Test	15%	No	Week 7
Practical Lab Report 1	7%	No	Week 8

Assignment 1

Assessment Type [1]: Design Task
Indicative Time on Task [2]: 8 hours
Due: **Week 4**
Weighting: **5%**

Understand and apply heat transfer conduction principles in new situations.

On successful completion you will be able to:

- Characterise heat transfer systems undergoing conduction, convection and/or radiation processes with and without mass transfer.
- Apply analytical equations, dimensional analysis, and empirical correlations to formulate solutions for heat and mass transfer systems.
- Design and manufacture a realistic and effective heat transfer system through problem-solving and critical thinking.

Final Examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 3 hours
Due: **Exam Period**
Weighting: **50%**

3-h final examination assessing all materials delivered throughout the unit.

On successful completion you will be able to:

- Characterise heat transfer systems undergoing conduction, convection and/or radiation processes with and without mass transfer.
- Apply analytical equations, dimensional analysis, and empirical correlations to formulate solutions for heat and mass transfer systems.

Weekly Tutorial Questions

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 8 hours
Due: **Week 3-7 and 9-13**
Weighting: **10%**

One tutorial quiz to be completed prior to the timetabled tutorial session, and one tutorial quiz to be completed during the tutorial session

On successful completion you will be able to:

- Characterise heat transfer systems undergoing conduction, convection and/or radiation processes with and without mass transfer.
- Apply analytical equations, dimensional analysis, and empirical correlations to formulate solutions for heat and mass transfer systems.

Assignment 2

Assessment Type [1]: Design Task
Indicative Time on Task [2]: 8 hours
Due: **Week 12**
Weighting: **5%**

Understand and apply theory learned in the lectures to create a thermal product

On successful completion you will be able to:

- Characterise heat transfer systems undergoing conduction, convection and/or radiation processes with and without mass transfer.

- Apply analytical equations, dimensional analysis, and empirical correlations to formulate solutions for heat and mass transfer systems.
- Design heat and mass transfer systems and critically evaluate their performance and limitations in the context of real-world applications.
- Design and manufacture a realistic and effective heat transfer system through problem-solving and critical thinking.

Practical Lab Report 2

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 4 hours
Due: **Week 11**
Weighting: **8%**

Free and forced convection

On successful completion you will be able to:

- Characterise heat transfer systems undergoing conduction, convection and/or radiation processes with and without mass transfer.
- Apply analytical equations, dimensional analysis, and empirical correlations to formulate solutions for heat and mass transfer systems.
- Design heat and mass transfer systems and critically evaluate their performance and limitations in the context of real-world applications.

Mid-Session Test

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 1 hours
Due: **Week 7**
Weighting: **15%**

1-hour test assessing materials delivered between weeks 1-5

On successful completion you will be able to:

- Characterise heat transfer systems undergoing conduction, convection and/or radiation processes with and without mass transfer.
- Apply analytical equations, dimensional analysis, and empirical correlations to formulate

solutions for heat and mass transfer systems.

Practical Lab Report 1

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 4 hours
Due: **Week 8**
Weighting: **7%**

Shell and tube heat exchanger

On successful completion you will be able to:

- Characterise heat transfer systems undergoing conduction, convection and/or radiation processes with and without mass transfer.
- Apply analytical equations, dimensional analysis, and empirical correlations to formulate solutions for heat and mass transfer systems.
- Design heat and mass transfer systems and critically evaluate their performance and limitations in the context of real-world applications.

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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

Required and Recommended Texts and/or Materials

There is no single core text for this course. However the following texts are recommended:

“Heat Transfer” by J.P. Holman

“A heat transfer textbook” by Leinhard and Leinhard.

Technology Used and Required

Heat transfer processes/equipment will be used in the practical session.

Unit Schedule

Unit Schedule

Week 1 Introduction to heat transfer, basic modes of heat transfer, steady-state conduction

Week 2 Conduction equations, thermal resistance network

Week 3 Overall heat transfer coefficient, thermal contact resistance

Week 4 Types of heat exchangers, effects of heat exchanger geometry, log-mean temperature difference method

Week 5 Overall heat transfer equations, fouling, heat transfer effectiveness/NTU approach

Week 6 Practical design of heat exchangers, introduction to heat convection, Buckingham-pi Therorem

Week 7 Thermal boundary layers, **Mid-Session Test**

Week 8 Convection analysis, external forced convection

Week 9 Internal forced convection

Week 10 Natural convection

Week 11 Mass transfer, boiling, condensation, evaporation

Week 12 Radiative heat transfer, black bodies, solar energy

Week 13 Revision

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.

Changes from Previous Offering

In order to better reflect students engagement time on task, the weighting of assignment 2 is increased from 5% to 10%, while the weighting of final exam is decreased from 50% to 45% and its duration is therefore reduced from 3 hours to 2 hours due to COVID-19.