UNSW Course Outline

ZEIT3701 Heat Transfer and Refrigeration - 2024

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General Course Information

Course Code : ZEIT3701
Year : 2024
Term : Semester 2
Teaching Period : Z2
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : School of Engineering and Technology
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course develops an understanding of the heat transfer mechanisms of conduction, convection and electromagnetic radiation, as well as the thermodynamics of gas mixtures, humidification and air stream mixing. These concepts are applied to ideal and real refrigeration

and air conditioning cycles. A range of engineering applications involving steady and non-steady heat conduction, forced and free convection, and emission and heat transfer between black and grey bodies are examined with the aid of analytical and numerical techniques.

Course Aims

The aim of the course is to provide an understanding of the heat transfer mechanisms of conduction, convection and electromagnetic radiation, heat transfer equipment and the analysis of refrigeration cycles.

Relationship to Other Courses

Prerequisite: ZEIT2503

This course builds on ZEIT2500 Thermofluids and ZEIT2503 Fluid Mechanics; taken as assumed knowledge. The present course assumes knowledge of basic thermodynamic principles and relationships, thermodynamic cycles, and fluid dynamics, particularly boundary layer theory. This course provides a link between the thermodynamics of processes and the possibility of engineering a design for solving practical problems encountered by practising engineers.

Course Learning Outcomes

Course Learning Outcomes	Engineers Australia - Professional Engineer (Stage 1)
CLO1 : On successful completion of this course, the student will be able to identify the heat transfer mechanisms occurring and apply the appropriate analysis to quantify the heat transferred	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving
CLO2 : On successful completion of this course, the student will be able to formulate appropriate strategies to solve practical heat transfer problems	• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving
CLO3 : On successful completion of this course, the student will be able to design and analyse heat transfer equipment either individually or as a member of a design team	• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE3.2 : Effective oral and written communication in professional and lay domains • PEE3.3 : Creative, innovative and pro-active demeanour • PEE3.6 : Effective team membership and team leadership
CLO4 : On successful completion of this course, the student will be able to quantify the performance of air-conditioning and refrigeration cycles and design water cooling equipment.	• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline

Course Learning Outcomes	Assessment Item
CLO1 : On successful completion of this course, the student will be able to identify the heat transfer mechanisms occurring and apply the appropriate analysis to quantify the heat transferred	• Refrigeration assignment • Quizzes • Heat transfer and refrigeration laboratory • Final exam
CLO2 : On successful completion of this course, the student will be able to formulate appropriate strategies to solve practical heat transfer problems	• Refrigeration assignment • Quizzes • Heat transfer and refrigeration laboratory • Final exam
CLO3 : On successful completion of this course, the student will be able to design and analyse heat transfer equipment either individually or as a member of a design team	• Final exam
CLO4 : On successful completion of this course, the student will be able to quantify the performance of air-conditioning and refrigeration cycles and design water cooling equipment.	• Refrigeration assignment • Heat transfer and refrigeration laboratory • Final exam

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

Teaching Approach

In-class or face to face teaching will be the primary teaching mode. The course has been designed to be technically rigorous and demanding. The course content and teaching methods have been informed by course evaluations and discussions with key stakeholders in academia, industry and Defence, to provide essential knowledge and skills for practicing civil engineers. During tutorials, the class may be divided into groups for the discussion sessions.

Learning Approach

It is expected that students will purchase the reference text and keep abreast of each topic as it is taught in class. This will include reading the relevant section(s) of the text prior to each class (note some topics will require wider reading), and completion of all tutorials and assessment work. Students are expected be fully prepared to participate during the classes.

Developing Graduate Capabilities

Successful completion of this course contributes to the acquisition of UNSW graduate capabilities. UNSW aspires to develop globally focused graduates who are **rigorous scholars**, capable of **leadership** and **professional practice** in an **international** community.

Alignment with Program Learning Outcomes

Students will be encouraged to develop the following Program-level learning outcomes by undertaking the course activities and mastering the knowledge content. These outcomes are based on the Engineers Australia Stage 1 Competencies for Professional Engineers and will be assessed within the assessment tasks:

1.3 (Knowledge and Skill Base) In-depth understanding of specialist bodies of knowledge within the engineering discipline.

2.1 (Engineering Application Ability) Application of established engineering methods to complex engineering problem solving.

2.3 (Engineering Application Ability) Application of systematic engineering synthesis and design processes.

3.2 (Professional and Personal Attributes) Effective oral and written communication in professional and lay domains.

The Learning Management System

Moodle is the Learning Management System used at UNSW Canberra. All courses have a Moodle site which will become available to students at least one week before the start of semester. Please find all help and documentation (including Blackboard Collaborate) at the Moodle Support page.

UNSW Moodle supports the following web browsers:

» Google Chrome 50+
» Safari 10+
** Internet Explorer is not recommended

** Addons and Toolbars can affect any browser's performance.

Operating systems recommended are:

Windows 7, 10, Mac OSX Sierra, iPad IOS10

For further details about system requirements click here.

Log in to Moodle here.

If you need further assistance with Moodle:

For enrolment and login issues please contact:
IT Service Centre
Email: itservicecentre@unsw.edu.au
Phone: (02) 9385-1333
International: +61 2 9385 1333

For all other Moodle issues please contact:
External TELT Support
Email: externalteltsupport@unsw.edu.au
Phone: (02) 9385-3331
International: +61 2 938 53331

Opening hours:
Monday – Friday 7:30am – 9:30 pm
Saturday & Sunday 8:30 am – 4:30pm

Other Professional Outcomes

Nil

Additional Course Information

Academic Integrity and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. All students are expected to adhere to UNSW's Student Code of Conduct https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Plagiarism undermines academic integrity and is not tolerated at UNSW. *It is defined as using the words or ideas of others and passing them off as your own, and* can take many forms, from deliberate cheating to accidental copying from a source without acknowledgement.

For more information, please refer to the following:

https://student.unsw.edu.au/plagiarism

Referencing

In this course, students are required to reference following the APA 7 / Chicago NB referencing style. Information about referencing styles is available at: https://guides.lib.unsw.adfa.edu.au/c.php?g=472948&p=3246720

Study at UNSW Canberra

https://www.unsw.adfa.edu.au/study

Study at UNSW Canberra has lots of useful information regarding:

- Where to get help
- Administrative matters
- Getting your passwords set up
- How to log on to Moodle
- Accessing the Library and other areas.

Additional Information as required

CRICOS Provider no. 00098G

The University of New South Wales Canberra.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates	Engineers Australia - Professional Engineer (Stage 1)
Refrigeration assignment Assessment Format: Individual Short Extension: Yes (2 days)	10%	Start Date: Not Applicable Due Date: 1 week from completion of Refrigeration lectures	• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline
Quizzes Assessment Format: Individual	40%	Start Date: Not Applicable Due Date: The first quiz will occur prior to the census date.	• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline
Heat transfer and refrigeration laboratory Assessment Format: Group Short Extension: Yes (2 days)	10%	Start Date: As timetabled for each group on moodle Due Date: 1 week from completion of the experiment	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline
Final exam Assessment Format: Individual	40%	Start Date: SAS decides Due Date: SAS decides	• PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline

Assessment Details

Refrigeration assignment

Assessment Overview

These include tutorials and self-directed assignments. The students are expected to gain problem-solving skills. The assignment marking will focus mainly on the procedures undertaken in answering the question rather than the final answer itself so a clear explanation and set-out of the answer is required. Solutions to the assignments will be given after the submitted work has been marked.

Course Learning Outcomes

- CLO1 : On successful completion of this course, the student will be able to identify the heat transfer mechanisms occurring and apply the appropriate analysis to quantify the heat transferred
- CLO2 : On successful completion of this course, the student will be able to formulate appropriate strategies to solve practical heat transfer problems
- CLO4 : On successful completion of this course, the student will be able to quantify the performance of air-conditioning and refrigeration cycles and design water cooling equipment.

Detailed Assessment Description

The assignment will focus on understanding the thermodynamics underlying refrigeration and the analysis of refrigeration cylcles and refrigerants.

Assessment Length

NA

Submission notes

The submission date will be posted on the course moodle site.

Assessment information

Nil

Assignment submission Turnitin type

Not Applicable

Quizzes

Assessment Overview

Two quizzes will be held during the semester following the completion of the following modules – conduction and convection. They relate to the heat transfer section. Each quiz is worth 20% of the total marks, giving a total of 40% to the quizzes. The first quiz will occur prior to the census date.

Course Learning Outcomes

- CLO1 : On successful completion of this course, the student will be able to identify the heat transfer mechanisms occurring and apply the appropriate analysis to quantify the heat transferred
- CLO2 : On successful completion of this course, the student will be able to formulate appropriate strategies to solve practical heat transfer problems

Detailed Assessment Description

Each quiz is worth 20%.

Assessment Length

Information will be posted on the course moodle site.

Submission notes

NA

Assessment information

Nil

Assignment submission Turnitin type

Not Applicable

Heat transfer and refrigeration laboratory

Assessment Overview

Heat transfer and refrigeration laboratory.

Course Learning Outcomes

- CLO1 : On successful completion of this course, the student will be able to identify the heat transfer mechanisms occurring and apply the appropriate analysis to quantify the heat transferred
- CLO2 : On successful completion of this course, the student will be able to formulate appropriate strategies to solve practical heat transfer problems
- CLO4 : On successful completion of this course, the student will be able to quantify the performance of air-conditioning and refrigeration cycles and design water cooling equipment.

Detailed Assessment Description

A single mark will be assigned to the group unless a request is received at submission for consideration of no participation.

Assessment Length

NA

Submission notes

NA

Assessment information

A selection of refrigeration, heat pump and heat transfer apparatus will be made available where possible. The students, working in groups of 3 to 4 students, are to complete two experiments following a timetable that will be posted on the course moodle site. Each group write up a professional report on the outcome for one experiment (7%) and a brief summary on the second

experiment (3%) as determined by the course convenor. ***All students are required to wear appropriate footwear while in laboratories. This means covered shoes in all laboratories. Students who do not have appropriate footwear will be asked to leave the laboratory space and a mark of zero awarded.***

Assignment submission Turnitin type

Not Applicable

Final exam

Assessment Overview

Exam during exam week.

Course Learning Outcomes

- CLO1 : On successful completion of this course, the student will be able to identify the heat transfer mechanisms occurring and apply the appropriate analysis to quantify the heat transferred
- CLO2 : On successful completion of this course, the student will be able to formulate appropriate strategies to solve practical heat transfer problems
- CLO3 : On successful completion of this course, the student will be able to design and analyse heat transfer equipment either individually or as a member of a design team
- CLO4 : On successful completion of this course, the student will be able to quantify the performance of air-conditioning and refrigeration cycles and design water cooling equipment.

Detailed Assessment Description

Final exam

Assessment Length

3 hours

Submission notes

NA

Assessment information

Please refer to the SAS notification of final exam for allowable material, time and place of the final exam.

Assignment submission Turnitin type

Not Applicable

General Assessment Information

For repeating students, please note that there is no project assessment offered for 2024.

The first quiz will occur prior to the census date. Written feedback and grades of the first quiz will be given to students by the census date (11 August) through the returned scripts of the marked quiz which will be a 1paper based quiz.

Late Submission of Assessment

Unless prior arrangement is made with the lecturer or a formal application for special consideration is submitted, a penalty of 5% of the total available mark for the assessment will apply for each day that an assessment item is late up to a maximum of 5 days (120 hours) after which an assessment can no longer be submitted and a grade of 0 will be applied.bNo verbal request for extensions will be accepted. You may not request an extension on behalf of another student.

If you miss a quiz, you must provide a good reason for your absence in order to be granted a retrial (a “good” reason is one that would qualify for being accepted in an application for Special Consideration). All medical reasons will require a medical certificate. Prior notice of an absence will be much appreciated; please forward the required defence request to the lecturer for information.

Supplementary Assessment

Supplementary assessment in the event of failure of the course is generally not available and should not be expected. Exceptions may be made for students in the final year of their program where there is a single failure preventing graduation.

Use of Generative AI in Assessments

It is prohibited to use any software or service to search for or generate information or answers. If its use is detected, it will be regardes as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion.

If the use of generative AI such as ChatGPT is detected, it will be regarded as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion.

Grading Basis

Standard

Requirements to pass course

To obtain a passing grade in this course, you must attain a minimum mark of 40% in the final examination and a minimum mark of 50% for the combined three in-session components (quizzes, assignments, lab reports) of the assessment and an overall mark of at least 50%. The overall passing mark is set at 50% by the University and this must not be varied.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Other	See above for the schedule.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

The following schedule is only tentative as the pace of lecturing is adjusted continually in response to the pace of learning. Lectures are by Drs. Liow (L) and Ghodrat (G). MD – military day. TT - timetable

Refrigeration and humidification (L)

1. Revision of thermodynamics and cycles **[Wk 1]**
2. Heat pumps and refrigeration cycles. **[Wk 2-3]**

Heat Transfer

1. Basics of heat transfer [Wk 4] (G)

Brief introduction to conduction, convection, and radiation modes of heat transfer. Heat capacities and their estimation.

2. Conductive heat transfer [Wk 5-6] (G) [13 Aug - Friday TT, MD in week 5]

Fourier's law of heat conduction. Electrical analogue of thermal resistance. Heat conduction in

multiple layers in planar, cylindrical and spherical coordinates. Transient heat conduction. Extended surfaces.

3. Convective heat transfer [Wk 7-8] (L) [Conduction quiz - week 7]

Thermal boundary layer, flow over parallel flat plates, cylinders and spheres. General thermal analysis. Laminar and turbulent flow in pipes. Mechanism of natural convection, Grashof and Rayleigh numbers. Natural convection from surface and inside enclosures.

4. Radiative heat transfer [Wk 9-10] (G) [Convection quiz - week 9]

Thermal radiation, black body radiation, radiative properties and view factors, radiation from black, diffuse and gray surfaces.

5. Heat exchangers [Wk 11-12] (G)

Type of heat exchangers, overall heat transfer coefficients, log mean temperature different, number of transfer units, shell and tube heat exchangers, compact heat exchangers.

Week 13 is for revision.

Course Resources

Prescribed Resources

A course website will be created on Moodle. Copies of the lecture notes, assessable materials, tutorials and other resources will be distributed on Moodle. Please access Moodle regularly to check on updates.

Compulsory text:

Yunus Cengel, John Cimbala and Robert Turner 2017 Fundamentals of Thermal-Fluid Sciences (5e) (SI Edition), McGraw Hill (ALL STUDENTS for Heat Transfer and refrigeration). You may use the 4th edition if so required but you will have had the 5th edition from the previous year.

Recommended Resources

Recommended Readings:

Bejan, A. 1988 *Advanced engineering thermodynamics*, Wiley.

Bejan, A, 1993 *Heat transfer*, John Wiley.

Carslaw, H. S. and Jaeger, J. C. 1959 *Conduction of heat in solids*, Oxford University Press.

Gebhart, B., Jaluria, Y., Mahajan, R. L. and Sammalkia, B. 1988 *Buoyancy-induced flows and transport*, Hemisphere Publishing Corp.

Hottel, H. C. and Sarofim, A. F. 1967 *Radiative transfer*, McGraw-Hill.

Incropera, F. P., Dewitt, D. P., Bergman, T. L. and Lavine, A. S. 2007 *Fundamentals of heat and mass transfer,* 6th edition, John Wiley.

Jakob, M. 1949 *Heat transfer*, Vols. I & II, John Wiley.

Kakac, S., Bergles, A. E. and Mayinger, F. 1981 *Heat exchangers: thermal-hydraulic fundamentals and design*, McGraw Hill.

Kakac, S., Shah, R. K. and Aung W. 1987 *Handbook of single-phase convective heat transfer*, John Wiley.

Kakac, S. and Yener, Y. 1979 *Heat conduction*, 2nd edition, Hemisphere Publishing Corporation.

Kay, W. M. and London, A. L. 1964 *Compact heat exchangers,* 2nd edition, McGraw-Hill.

Kern, D. Q. 1950 *Process heat transfer*, McGraw-Hill.

Kreith, F. 1973 *Principles of heat transfer*, 3rd edition, Intext Educational Publishers.

Lienhard, J. H. IV and V 2017 *A heat transfer textbook*. Phlogiston Press, Cambridge, USA.

Long, C. 1999 *Essential heat transfer*, Pearson Education.

Moran, M.J. and Shapiro, H. N. 2008 *Fundamentals of engineering thermodynamics*, 6th edition, Wiley.

Rohsenhow, W. M., Hartnett, J. P. And Ganic, E. N. 1973, *Handbook of heat transfer fundamentals*, 2nd edition, McGraw-Hill.

Shah, R. K. and Sekulic, D. P. 2003 *Fundamentals of heat exchanger design*, John Wiley.

Siegel, R. and Howell, J. R. 1972 *Thermal radiation heat transfer*, McGraw-Hill.

Additional Costs

Nil

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of this course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the "On-going Student Feedback" link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups. Student opinions really do make a difference. Refer to the Moodle site for this course to see how the feedback from previous students has contributed to the course development.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct Policy

https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Jong-Leng Liow		Building 20 Rm 104	0251145174	Open door policy	No	Yes
Lecturer	Maryam Ghodrat		Building 17 Rm130	0251145153	By appointment	No	No