UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Semester 2 2017

MECH4880

REFRIGERATION AND AIR CONDITIONING

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Chris Menictas
Office Location: Room 402F, Mechanical and Manufacturing Engineering
Tel: (02) 9385 6269
Fax: (02) 9663 1222
Email: c.menictas@unsw.edu.au

Contact details and consultation times for additional lecturers/demonstrators/lab staff

Name: Mitchell Kazmierczak
Email: m.kazmierczak@unsw.edu.au

Name: Nicholas Gilmore
Email: nicholas.gilmore@unsw.edu.au

Name: Melanie Finch
Email: m.finch@unsw.edu.au

Consultation concerning this course is available on Tuesdays 11:00-12:00 unless otherwise advised.

2. Important links

- Moodle
- UNSW Mechanical and Manufacturing Engineering
- Course Outlines
- Student intranet
- UNSW Mechanical and Manufacturing Engineering Facebook
- UNSW Handbook

3. Course details

Credit Points

This is a 6 unit-of-credit (UoC) course, and involves three (3) hours per week (h/w) of face-to-face contact.

The UNSW website states “The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week.”

This means that you should aim to spend about 9 h/w on this course. The additional time should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

Contact hours

	Day	Time	Location
Lectures	Tuesday	3pm – 5pm	K-K15-149 - Old Main Building 149
Coaching	Tuesday	5pm – 6pm	K-K15-149 - Old Main Building 149
CAMEL Workshop (Week 6)	Tuesday	3pm – 6pm 6pm – 9pm*	K-J17-204 - Ainsworth 204
Laboratory Class (Week 9)	Tuesday	3pm – 6pm	K-J17-116 – Willis Annexe 116

* Additional session time

Summary and Aims of the course

This course introduces the student to the terminology, principles and methods used in refrigeration and air conditioning.

The aim of this course is to take your knowledge of thermodynamics further, and in a much more general fashion, than you obtained in your first course in thermodynamics. In particular, to extend your theoretical background of the thermodynamics of refrigeration and air conditioning.

The term air conditioning implies the creation and maintenance of an atmosphere having such conditions of: (i) temperature, (ii) humidity, (iii) air circulation and (iv) air purity, as to produce the desired effects upon the occupants or materials (or both) in a given space. It is the simultaneous control of all these four factors within required limits which defines an air conditioning system.

Refrigeration is the control of the environment, e.g. air conditioning, cold room, refrigerators, display cabinets etc., and involves the use of refrigeration in one form or another.
In this course the topics covered include: psychrometry, cooling and heating loads, applied psychrometrics and air conditioning, system analysis and mathematical modelling, air duct design, refrigerants, vapour compression refrigeration, multi-stage vapour compression systems, components of vapour compression systems and other types of cooling systems.

The objectives of the course are to:

- Familiarise you with the terminology associated with refrigeration & air conditioning
- To cover the basic principles of psychrometry and applied psychrometrics
- Familiarise you with system analysis and mathematical modelling

- Familiarise you with load calculations and elementary duct design
- Familiarise you with refrigerants; vapour compression refrigeration and multi-stage vapour compression systems
- Understand the components of vapour compression systems and other types of cooling systems.

Student learning outcomes

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

Learning Outcome		**EA Stage 1 Competencies**
1.	Be familiar with the terminology associated with refrigeration & air conditioning	PE1.3
2.	Apply the basic principles of psychrometry and applied psychrometrics	PE1.1
3.	Undertake system analysis and mathematical modelling	PE1.1, PE1.2
4.	Perform load calculations and elementary duct design	PE1.1, PE1.2, PE1.3, PE1.5 PE2.1, PE3.2, E3.5
5.	Be familiar with refrigerants; vapour compression refrigeration systems	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2
6.	Understand the components of vapour compression systems and other types of cooling systems.	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.4

4. Teaching strategies

- Presentation of the material in lectures, workshops and laboratory sessions so that students know how to approach complex engineering calculations required in industry.
- To present a wealth of real-world engineering examples to give students a feel for how refrigeration and air conditioning is applied.

5. Course schedule

A schedule of lectures for each week and relevant readings from the textbook and other reference material is shown in Table 1.

Table 1 Lecture Schedule

Week	Topic	Relevant Reading
1	Introduction Psychrometry	Chapter 1 &2 Chapter 3
2	Applied Psychrometrics	Lecture Notes
3	Air Conditioning	Lecture Notes Chapter 3
4	Cooling and Heating Loads	DA9; Chapters 5-8
5	Quiz and Air Duct Design and Refrigerants	Chapters 11 & 12 and lecture Notes
6	Use of Camel Program	Special Workshop in K-J17-204 - Ainsworth 204
7	Components of Vapour Compression Systems and System Modelling	Lecture Notes
8	Vapour Compression Refrigeration	Chapter 15
9	Laboratory Class	Laboratory Class in K-J17-116
10	Multi Stage Vapour Compression Systems	Lecture Notes
11	Assignment Assistance	TBA
12	Other Types of Cooling Systems	Lecture Notes Chapter 14
13	TBA	

Note: The above schedule is subject to change at short notice to suit exigencies.

6. Assessment

General

You are assessed by way of two assignments, one quiz, and examination which involve both calculations and descriptive material. These assessments test your grasp of the principles involved, and are typical of the calculations you will be expected to perform as graduate mechanical engineers.

All assessments must be attempted.

Assessment overview

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Marks returned	Deadline for absolute fail
Assignment 1	TBA	40%	1, 2, 3 and 4	Technical content, design capability and report writing skills	Part A 5:00pm, Friday 15th September Part B 5:00pm, Friday 27th October	Part A: Two weeks after submission Part B: During exam period	Part A 5:00pm, Friday 22nd September Part B 5:00pm, Friday 3rd November
Assignment 2	TBA	10%	1, 3, 5 and 6	Technical content, design capability and report writing skills	9:00 pm, Tuesday 3rd October via Moodle	Two weeks after submission	9:00 pm, Friday 6th October via Moodle
Quiz	2 hours	20%	1, 2 and 3	Understanding of lecture material	During Week 5 lecture	One week after submission	N/A
Final exam	2 hours	30%	1, 2, 4, 5 and 6	All course content from weeks 1-12	Exam period, date TBC	During results period	N/A

Assignments

Presentation

All submissions should have a standard School cover sheet which is available from this course's Moodle page.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work. Presenting them clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Submission

Assignments should be submitted as instructed in the assignment question.

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Special consideration for assessment tasks must be processed through student.unsw.edu.au/special-consideration.

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Where there is no special consideration granted, the 'deadline for absolute fail' in the table above indicates the time after which a submitted assignment will not be marked, and will achieve a score of zero for the purpose of determining overall grade in the course.

Marking

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Examinations

You must be available for all tests and examinations. Final examinations for each course are held during the University examination periods, which are June for Semester 1 and November for Semester 2.

Provisional Examination timetables are generally published on myUNSW in May for Semester 1 and September for Semester 2.

For further information on exams, please see the Exams section on the intranet.

Calculators

You will need to provide your own calculator, of a make and model approved by UNSW, for the examinations. The list of approved calculators is shown at student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an "Approved" sticker for it from the School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special consideration and supplementary assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see the School intranet, and the information on UNSW's Special Consideration page.

7. Attendance

You are required to attend a minimum of 80% of all classes, including lectures, labs and seminars. It is possible to fail the course if your total absences equal to more than 20% of the required attendance. Please see the School intranet and the UNSW attendance page for more information.

8. Expected resources for students

Textbooks

Textbooks which will be used in the course:

- F.C. McQuiston, D. Parker and J.D. Spitler, *Heating, Ventilation, and Air Conditioning: Analysis and Design*, 6th Edition, John Wiley & Sons Inc., 2005 *(available for purchase in the bookshop and available in the UNSW library).*
- *Load Estimation and Psychrometrics: Application Manual DA9*. Australian Institute of Refrigeration, Air-conditioning and Heating. *(available for purchase in the bookshop)*

Required and suggested additional readings

- *ASHRAE Fundamentals*, American Society of Heating, Refrigeration and Air Conditioning Engineers, (2005).
- Jones, W.P., *Air Conditioning Engineering,* 3rd Ed., Edward Arnold, (1985).
- Stoecker, W.F. and Jones, J.W., *Refrigeration and Air Conditioning,* 2nd Ed., McGraw-Hill Book Co., (1982).
- Stoecker, W.F., *Design of Thermal Systems,* 3nd Ed., McGraw-Hill Book Co., (1989).
- Threlkeld, J.L., *Thermal Environment Engineering,* 2nd Ed., Prentice-Hall Inc., (1970).
- *AIRAH Application Manuals,* Australian Institute of Refrigeration, Air Conditioning and Heating.
- *AIRAH Handbook,* Australian Institute of Refrigeration, Air Conditioning and Heating.

- *ASHRAE Thermodynamic Properties of Refrigerants,* American Society of Heating, Refrigeration and Air Conditioning Engineers, (1980).
- *Handbook of Air Conditioning System Design*, Carrier Air Conditioning Company, McGraw-Hill Book Co., (1965).

These are all available in the UNSW Library: https://www.library.unsw.edu.au/

Lecture and additional materials will be uploaded to Moodle: https://moodle.telt.unsw.edu.au/login/index.php

9. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include additional guest lectures to provide an industry perspective and case studies during various lectures. Recent changes include the addition of a mid-session quiz and the structure of assignment 1.

10. Academic honesty and plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism: student.unsw.edu.au/plagiarism The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work

or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here: www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is available on the intranet.

11. Administrative matters and links

All students are expected to read and be familiar with School guidelines and polices, available on the intranet. In particular, students should be familiar with the following:

- Attendance, Participation and Class Etiquette
- UNSW Email Address
- Computing Facilities
- Assessment Matters (including guidelines for assignments, exams and special consideration)
- Academic Honesty and Plagiarism
- Student Equity and Disabilities Unit
- Health and Safety
- Student Support Services

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership