UNSW AUSTRALIA

Course Outline

Semester 2 2015

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

MECH 4880

REFRIGERATION AND AIR CONDITIONING

Contents

1. Staff Contact Details

Course Convenor

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

Consultation concerning this course is available on Tuesdays 11:00-12:00 unless otherwise advised; direct consultation or phone is preferred; email should only be used as a last resort as it uses your time and mine less efficiently

2. Course details

Credit Points:

This course is a 6 unit-of-credit (UoC) course, and involves three hours per week of face-to-face contact, and it is expected that you will put in, on average, an additional three hours per week of your own time (including stuvac and exams). This time should be spent in revising the lecture material and further reading, completing the set assignments, and revising and learning for the examinations.

The time budget above indicates the time expected to be spent on various course activities for an average student aiming for a credit grade. Various factors, such as ability, target grade, etc., will influence the time needed in your case. The time available is based on a total of 40 hours per week spent on 24 units of credit (including both in-class and out-of-class time) for an effective 15 weeks (thirteen weeks of session, plus stuvac, plus one effective exam week). Some students spend much more, but you should aim to spend not less than 40 h/w on coursework for 24 UoC.

Contact Hours

Activity	Day	Time	Location
Lectures	Tuesday	6pm – 9pm	K-J17-102 - Ainsworth 102
CAMEL Workshop (Week 5)	Tuesday	6pm – 9pm	K-J17-203 - Ainsworth 203

Summary of the Course

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

Aims of the Course

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.

But precisely what do we mean by Air Conditioning and Refrigeration?

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 below learning outcomes 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

3. Teaching strategies

- Presentation of the material in lectures and discussions so that the 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.

4. 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	Use of Camel Program	Special Workshop in K-J17-203 - Ainswth 203
6	Quiz and Air Duct Design and Refrigerants	Chapters 11 & 12 and lecture Notes

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.

5. 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 task	**Length**	**Weight**	**Learning outcomes assessed**	**Assessment criteria**	**Due date, time, and submission requirements**
Assignment 1	TBA	35%	1, 2, 3 and 4	Technical content, design capability and report writing skills	5:00pm, Friday 30th October
Assignment 2	TBA	15%	1, 3, 5 and 6	Technical content, design capability and report writing skills	Midnight, Friday 16th October via Moodle
Quiz	1 hour	10%	1, 2, and 3	Understanding of lecture material	During Week 6 lecture
Final exam	3 hours	40%	1, 2, 4, 5, and 6	All course content from weeks 1-12	Exam period, date TBC

Assignments

Presentation

All submissions should have a standard School cover sheet which is available from this subject'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. Where an assessment task is worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor ***before the due date***. Special consideration for assessment tasks of 20% or greater must be processed through https://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.

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 Administrative Matters.

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 https://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 Administrative Matters, available on the School website and on Moodle, and the information on UNSW's Special Consideration page.

6. Expected Resources for students

Textbook details, including title, publisher, edition, year of publication and availability (in bookshop, UNSW library, Open Reserve)

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. *(orders will be taken during class)*

List of required and suggested additional readings and availability (in bookshop, UNSW library, Open Reserve)

- *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.

The UNSW Library website: *http://info.library.unsw.edu.au/web/services/services.html*

Additional materials provided in Moodle

Lecture materials will be uploaded to Moodle.

7. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the Course and Teaching Evaluation and Improvement (CATEI) 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 contribution of assignment 1, in the overall grade.

8. 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: https://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:
http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is presented in a School handout, Administrative Matters, available on the School website.

9. Administrative Matters

You are expected to have read and be familiar with *Administrative Matters*, available on the School website: https://www.engineering.unsw.edu.au/mechanical-engineering/sites/mech/files/u41/S2-2015-Administrative-Matters_20150721.pdf

This document contains important information on student responsibilities and support, including special consideration, assessment, health and safety, and student equity and diversity.

C. Menictas
21 July 2015

Appendix A: Engineers Australia (EA) Professional Engineer Competency Standards

	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