SCHOOL OF MECHANICAL AND MANUFACTURING ENGINEERING

MECH9720

SOLAR THERMAL ENERGY DESIGN

SESSION 1, 2013
## CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. STAFF CONTACT DETAILS</td>
<td>3</td>
</tr>
<tr>
<td>2. COURSE DETAILS</td>
<td>4</td>
</tr>
<tr>
<td>3. TEACHING AND LEARNING STRATEGIES</td>
<td>5</td>
</tr>
<tr>
<td>4. ASSESSMENT</td>
<td>6</td>
</tr>
<tr>
<td>5. ACADEMIC HONESTY AND PLAGIARISM</td>
<td>6</td>
</tr>
<tr>
<td>6. COURSE SCHEDULE</td>
<td>8</td>
</tr>
<tr>
<td>7. COURSE EVALUATION AND DEVELOPMENT</td>
<td>9</td>
</tr>
<tr>
<td>8. RESOURCES FOR STUDENTS</td>
<td>10</td>
</tr>
<tr>
<td>9. ADMINISTRATIVE MATTERS</td>
<td>11</td>
</tr>
</tbody>
</table>
1. CONTACT DETAILS

Primary contact for course questions

1) Online discussion board (Moodle)
2) Email: unsw.mech.9720@gmail.com

Course convenor

Dr. Robert Taylor
Room ME 318
Tel (02) 9385 5400
Fax (02) 9663 1222
Email Robert.Taylor@unsw.edu.au

Additional lecturers

Prof. Graham Morrison
Room ME 123
Tel (02) 9385 4496
Email g.morrison@unsw.edu.au

Head tutor

Edward Law
Email: edward.law@student.unsw.edu.au
2. COURSE DETAILS

Overview of the course

This course introduces the student to the terminology, principles and methods used in solar thermal engineering. Although it is not essential, a grounding in heat transfer will be very useful (Mech3601). This course will be helpful to those students who intend to take more classes or pursue a career in renewable energy or (more generally) the thermal sciences.

The course deliberately stays away from photovoltaics and focuses on the direct conversion of solar energy into heat. This heat can then be used for a wide variety of applications ranging from domestic solar water heating at 70°C to melting sodium at temperatures above 1500°C.

In this course the topics covered include: solar radiation characteristics and measurements, collector systems and material selection, thermal analysis of solar collectors and systems and system testing.

Units of credit

This is a 6 unit-of-credit (UoC) course, which included weekly face-to-face contact and several laboratory periods. Some students spend much more, but you should aim to spend not less than 10 h/w on coursework for this 6 UoC course. 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 16 weeks (fourteen weeks of session, plus stuvac, plus one effective exam week). 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.

Lecture periods

This course generally involves a 2 hour lecture and a 1 hour tutorial. Laboratory time will be scheduled in the first few weeks of the course.

Lectures: Tuesday 14:00 to 17:00
Location: Civil Engineering G1 (K-H20-G1)

Expectations of the students

This course 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 assignment and tutorial problems, and revising and learning for the examinations. In addition, there will be 5-10 hours during the semester of a solar laboratory component. This will be scheduled outside of the designated class time and held throughout the semester (your specific laboratory times will be determined by week 5 of the semester).

The objectives of the course
The objectives of the course are to:

- Be able to use engineering terminology associated with solar thermal energy systems
- Give you a basic understanding of how to obtain salient radiation properties and data that will allow you to solve solar thermal energy design
- Understand how to measure and test solar thermal systems to ANZ
- Apply the above to solar thermal systems from an engineering perspective

3. Teaching and Learning Strategies

The teaching strategies that will be used include:

- 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 fluid mechanics is applied in engineering practice
- A research essay into a topic of the students choice
- The use of in-house and commercial software to solve problems

Suggested approaches to learning in the course

Suggested approaches to learning in this course include:

- Careful reading, discussion and understanding of the material presented in lectures.
- Additional reading on and about the material presented in lectures to broaden the knowledge base.
- Paying attention throughout the tutorials, and asking questions when anything is not understood.
- Conscientiously working through ALL the tutorial problems.
- Learning the lecture material in preparation for examinations.
- Perusal of the past examination papers for the last five years in this course to ensure that you know how to answer typical questions.

Expected learning outcomes; their association with the teaching strategies and with the suggested approaches to learning

On completion of the course, it is expected that you will:

- Be familiar with the terminology associated with solar thermal energy
- Be able to use solar radiation properties correctly to solve problems (information literacy)
- Be able to analyse and test solar thermal systems (independent enquiry)
- Know how to use some of the most common solar thermal energy systems software tools (digital literacy)

If these are realized, students will be:

- capable of independent, self-directed practice
- capable of lifelong learning
- capable of operating within an agreed Code of Practice
4. ASSESSMENT IN THE COURSE

Overall rationale for assessment components and their association with course objectives

You are assessed by way of a mid-session test, laboratory work, tutorial questions, a seminar paper and presentation and an examination which involve both calculations and descriptive material. These assessments test your grasp of the principles involved, your progress in the learning objectives mentioned above, and are typical of the calculations you will be expected to perform as graduate mechanical engineers.

i) Weekly Tutorials 10% Due Weekly
ii) Online Quizzes 5% Due Weekly
iii) Test 10% Week 6
iv) Seminar Paper 15% Due Week 10
v) Lab Report 10% Due Week 13
vi) Seminar Presentation (PG) 15% (5%) Weeks 11-13
vii) Final Exam UG / (PG) 50% / (45%) TBD

FINAL EXAM NOTES

Calculators
You will need to provide your own calculator, of a make and model approved by UNSW, for the examination. The list of approved calculators is shown at


It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an “UNSW Approved” label for it from the School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an “UNSW 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 for All Courses, available from the School office as part of The Guide, or on the School website.

5. Academic Honesty and Plagiarism

What is Plagiarism?
Plagiarism is the presentation of the thoughts or work of another as one’s own.* Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person’s assignment without appropriate acknowledgement;

* Examples include:
• paraphrasing another person’s work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
• piecing together sections of the work of others into a new whole;
• presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and
• claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does not amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

• correct referencing practices;
• paraphrasing, summarising, essay writing, and time management;
• appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students 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 items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle
† Adapted with kind permission from the University of Melbourne.

Further information on School policy and procedures in the event of plagiarism is presented in a School handout, Administrative Matters for All Courses, available from the School website.
6. **COURSE SCHEDULE**

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture/laboratory program</th>
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<tbody>
<tr>
<td>1</td>
<td>Characteristics of solar thermal systems. Solar collector efficiency, solar thermal power systems.</td>
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<tr>
<td>5/March</td>
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<tr>
<td>12/March</td>
<td></td>
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<tr>
<td>3</td>
<td>Solar radiation measurement, data sources.</td>
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<tr>
<td>19/March</td>
<td></td>
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<td>4</td>
<td>Diffuse radiation models. Calculation of hourly and daily irradiation on inclined surfaces. Clear sky radiation. Tutorial. Visit to Solar Energy Laboratory (1/2 class)</td>
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<tr>
<td>26/March</td>
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<tr>
<td>2/April</td>
<td>*Mid-Semester Break</td>
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<td>5</td>
<td>Heat transfer in flat plate solar collectors. Solar collector test methods and standards. Selective surfaces, integrated radiation properties. Visit to Solar Energy Laboratory (1/2 class)</td>
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<tr>
<td>9/April</td>
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<td>6</td>
<td><strong>Test</strong> (no tutorial)</td>
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<tr>
<td>16/April</td>
<td></td>
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<tr>
<td>7</td>
<td>Solar and long wave transmission of collector covers, Thermal analysis of flat plate solar collectors. Tutorial, laboratory</td>
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<tr>
<td>23/April</td>
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<td>8</td>
<td>Thermal analysis of collectors, solar collector efficiency factor.</td>
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<tr>
<td>30/April</td>
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<tr>
<td>9</td>
<td>Thermal analysis of collectors, CSP analysis</td>
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<tr>
<td>7/May</td>
<td>Tutorial, laboratory</td>
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<td>14/May</td>
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<tr>
<td>21/May</td>
<td></td>
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<tr>
<td>12</td>
<td>High temperature solar thermal systems and electricity generation</td>
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<tr>
<td>28/May</td>
<td></td>
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<tr>
<td>13</td>
<td>Review and revision (if required)</td>
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*The schedule shown may be subject to change at short notice.*
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 tutorial 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, revised tutorial and lecture notes will be included for students. In addition, a tutor will be available to support and construct liaise between course convenor and student for continual and further improvement.
8. **RESOURCES FOR STUDENTS**

**Class notes (required in lieu of a textbook)**

Available for purchase from School copy office, ground floor Mech Eng.

**Suggested Readings:**


**Additional materials provided in UNSW Moodle Site**

This course has a website on UNSW Moodle which includes:

- copies of assignments (as they are issued, in case you missed the hand-out in class);
- lecture notes
- solutions to selected problems as they after evaluation and/or presentation in the course
- a discussion forum.

The discussion forum is intended for you to use with other students enrolled in this course. The course convenor and tutors will occasionally look at the forum, monitor the language used and take note of any frequently-asked questions, but may not respond to every question on the forum. If you want help from the convenor then direct contact through email or office visit is preferred.

**Recommended Internet sites**

There are many websites giving lectures, papers and data on solar technology. Try searching for “solar thermal”, "solar hot water", "CSP", etc. YouTube has many entertaining (and sometimes very informative) videos related to solar thermal energy. Some examples will be given during lecture.

**Other Resources**

If you wish to explore any of the lecture topics in more depth, then other resources are available and assistance may be obtained from the UNSW Library.
9. **ADMINISTRATIVE MATTERS**

Information about each of the following matters is presented in a School handout, *Administrative Matters for All Courses*, available from the School website:


It is essential that you obtain a copy, read it carefully and become familiar with the information, as it applies to this course and to each of the other courses in which you are enrolled.

**Expectations of students (including attendance at lectures and tutorials/laboratory classes/seminars; and computer use, for example, in the use of email and online discussion forums)**

- **Lecture periods**
  This generally involves a 2 hour lecture and a 1 hour tutorial.
  Lectures: Tuesday 14:00 to 17:00
  Location: Civil Engineering G1 (K-H20-G1)

*** Important Note: Additional laboratory time will be scheduled listed above (subject to weather).

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

**Information on relevant Occupational Health and Safety policies and expectations:**

www.ohs.unsw.edu.au

**Laboratory Safety**

All staff and students must observe all safety requirements in the laboratory. You must come to the laboratory dressed for work, NO LOOSE OR BAGGY CLOTHING, NO SANDALS OR BARE FEET. Before beginning any experiment you will be required to do the ‘Solar Lab’ safety induction which requires you to inspect all equipment and the surroundings on the solar lab for potential hazards. While using laboratory equipment keep alert for any developing hazard, other students working, any unusual noise, vibration, unusual data trends, etc.

**Examination procedures and advice concerning illness or misadventure**

If you miss a test or exam due to illness a doctor’s certificate is required and you must lodge for special consideration at Student Central.

**Equity and disability**

Students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course
convenor prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Student Equity and Disability Unit (SEADU) by phone on 9385 4734, email seadu@unsw.edu.au or via the website http://www.studentequity.unsw.edu.au/

The office is located on the Ground Floor of the Goodsell building (F20).

Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

Dr. Robert A. Taylor
January 2013