



THE UNIVERSITY OF
NEW SOUTH WALES

SCHOOL OF MATERIALS SCIENCE AND ENGINEERING

MATS1152

**Materials Engineering 1B –
Heat Transfer**

SESSION 2, 2009

Course staff

| Staff | Responsibility | Contact details | Consultation hours |
|---------------|------------------------------|---|---|
| Dr Runyu Yang | Course Co-ordinator/Lecturer | Room: 218, Ph: 93856787 r.yang@unsw.edu.au | Open door, but make an appointment if important |

Time Table

| Lecture/Tutorial | Day | Time | Location |
|------------------|-----------|---------|-----------|
| Lecture | Monday | 2 – 4pm | ASBus 207 |
| Lecture | Wednesday | 4 – 6pm | Law 201 |

Course information

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| Unit of Credit | 6 |
| Parallel teaching involved in this course | N/A |
| How the course relates to other course offerings and overall program(s) in the discipline | <ul style="list-style-type: none">• This course introduces the basic concepts in heat transfer which are widely used in materials engineering• This course will apply students' knowledge learned from other courses such as thermal dynamics and fluid dynamics |
| Course Aims | <ul style="list-style-type: none">• To develop and apply students' knowledge of heat transfer to specific systems of interest in materials engineering |
| Expected student learning outcomes (including those related to graduate attributes) | Students are expected: <ul style="list-style-type: none">• To understand the principles and concepts in the heat transfer• To follow proper procedures and apply fundamental equations to analyse heat transfer related problems Graduate attributes: <ul style="list-style-type: none">• Analytical and problem solving skills• Information literacy and writing communication |
| Teaching Strategies used in the course and the ways they support student learning outcomes | <ul style="list-style-type: none">• Lectures covering fundamentals and major concepts, with their applications to specific problems• Students are expected to attend classes and prepare for discussion• Assignments and lab experiments to enhance student's understanding• Lab work for students to practise their knowledge learned in class• Report to develop students' literature review and writing skill |

Assessment

| Assignments | Lab Work | Mid-term Exam | Final Exam |
|-------------|----------|---------------|------------|
| 20% | 15% | 20% | 45% |

- **Assignments (20%):** Four take-home assignments will be handed out. Assignments will be graded and returned two weeks later.
- **Lab Work (15%):** Three laboratories will commence in around week 8 and groups will be allocated. A completed report is required for each lab (further details will be given later on).

- **Mid-term Exam (20%):** The two-hour exam will be conducted in the middle of the session. It aims to assess students' knowledge on heat transfer covered up to that time.
- **Final Exam (45%):** The two-hour final exam will be based upon teaching covered in the entire session. It assesses the students' understanding of basic concepts and the ability to apply fundamental equations to specific system, rather than equation memorise.

Note: All assignments and lab reports must contain a completed student declaration sheet and will be submitted on the due date. Late submissions will not be accepted without adequate reason in writing. Requests for special consideration must be submitted using the form available from the Student Desk in the Chancellery and must include medical certificates or other appropriate documents.

Course outline

1) Conduction

- Fundamentals of heat transfer, Fourier's and Newton's laws
- 1D conduction through plate, hollow cylinder and composite wall, heat resistance
- 1D conduction in heat sources, governing equation, conduction for heated plane slab and solid cylinder
- General equation for conduction
- Conduction of heat at steady state in two-dimensions

2) Convection

- Convection types, Nusselt and Prandtl numbers, laminar and turbulent flow
- Heat transfer to a fluid from a horizontal flat plate
- Internal fluid flow in a cylindrical pipe, energy balance
- Natural convection, Rayleigh and Grashof numbers

3) Transient heat transfer

- Newtonian cooling, lumped capacitance method
- Non-Newtonian cooling, semi-infinite system

4) Radiation

- Radiation and irradiation, blackbody, real surface
- Radiation exchange between surfaces, view factor, reciprocity relation, summation law

Resources

- Gaskell DR, *An introduction to transport phenomena in materials engineering*, Macmillan Company.
- Bird, Stewart and Lightfoot, *Transport Phenomena*, John Wiley & Sons Inc.
- Guthrie RIL, *Engineering in process metallurgy*, Oxford Science Publications
- Additional resource materials including recommended web sites will be provided during class lectures

The learning and teaching philosophy underpinning the course (based on UNSW Learning Guidelines)

- **Students are actively engaged in the learning process.**
Students are expected to attend the classes and lab work, and engage in discussion in and after class time. Students are also expected to read the lecture note, textbook as well as other relevant materials, finish the assignments and lab reports independently.
- **Effective learning is supported by a climate of inquiry where students feel appropriately challenged.**
Heat transfer is often complex and challenging, requiring good understanding of fundamentals, analytical and mathematical skills. Students will be given assignments which reflect these important aspects.

- **Learning is more effective when students' prior experience and knowledge are recognised and built on.**

This course is built on prior courses on thermodynamics and transport phenomena of fluid flow. A background in ordinary differential equation is helpful for proper understanding of the material.

- **Students become more engaged in the learning process if they can see the relevance of their studies to professional and disciplinary contexts**

Students will be given assignments to solve problems relevant to material engineering. Three lab works will be conducted to apply students' knowledge to real applications.

Continual course improvement

- We welcome feedback at all times on presentation of course materials and any other course-related matters, and will be happy to discuss any issues raised in the lectures. You will be asked to provide evaluative feedback through the UNSW's Course and Teaching Evaluation and Improvement (CATEI) Process at the end of the course. Feedback from prior assessments will be discussed in lecture 1.
- Students are encouraged to address any problems regarding teaching of this course at the annual staff-student meeting.
- Student's comments on teaching during the session are welcome and will be appreciated.

Administrative Matters

- Students are expected to attend minimum 80% of lectures and tutorial, and to check the course website at WebCT-Vista regularly.
- Students unable to attend to mid-term and final exams on the health ground should submit requests for special consideration by using the form available from the Student Desk in the Chancellery and must include medical certificates or other appropriate documents.
- Information on relevant Occupational Health and Safety policies and expectations: www.riskman.unsw.edu.au/ohs/ohs.shtml
- Equity and diversity: those 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 convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or www.equity.unsw.edu.au/disabil.html). Early notification is essential to enable any necessary adjustments to be made. Information on designing courses and course outlines that take into account the needs of students with disabilities can be found at: www.secretariat.unsw.edu.au/acboardcom/minutes/coe/disabilityguidelines.pdf

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;
- 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.