Course Outline

MATS2005

Introduction to Fluid Flow and Heat Transfer

Materials Science and Engineering

Science

T2, 2020

1. Staff

Position	Name	Email	Consultation times and locations
Course Convenor	A/Prof. Runyu Yang	r.yang@unsw.edu.au	Online at the class time or make an appointment

2. Course information

Units of credit: 6

Pre-requisite(s): None

Timetabling website: http://timetable.unsw.edu.au/2020/MATS2005.html

Teaching times and locations:

	Lecture	Lecture	Tutorial/In-class Practice
Day	Monday	Tuesday	Wednesday
Time	11:00-1:00	4:00-6:00	3:00-5:00
Location	Online	Online	Online

2.1 Course summary

Fluid properties, Newtonian and non- Newtonian fluids; principles of fluid motion, mass and momentum balances; turbulent flow, dimensional analysis; mechanical energy balance, Bernoulli's equation; conduction and Fourier's law, steady-state and non-steady state conduction; forced and natural convection heat transfer; radiation, single body radiation, radiation exchange between objects.

2.2 Course aims

This course introduces the basic concepts in fluid flow and heat transfer and their applications in materials and mineral processing. The aims are to develop an understanding of basic principles governing fluid flow and heat transfer and to solve related problems in materials engineering

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Understand the principles and concepts in fluid flow and heat transfer
2. Follow proper procedures and apply fundamental equations to analyse fluid flow and heat transfer related problems
3. Develop analytical and problem-solving skills

4. Communicate effectively and be able to critically analyse information

2.4 Relationship between course and program learning outcomes and assessments

Course Learning Outcome (CLO)	LO Statement	Program Learning Outcome (PLO)	Related Tasks & Assessment
CLO 1	Understand…	1.3, 1.4, 3.2, 3.3 & 3.4	1, 2, 3 & 4
CLO 2	Follow…	1.3, 1.4, 3.2, 3.3 & 3.4	1, 2, 3 & 4
CLO 3	Develop…	2.1, 2.3 & 3.6	1, 2, 3 & 4
CLO 4	Communicate…	1.3 & 3.4	3 & 4

3. Strategies and approaches to learning

3.1 Learning and teaching activities

(Based on UNSW Learning Guidelines)

- *Students are actively engaged in the learning process.*

  It is expected that, in addition to attending classes, students will read, write, discuss, and engage in analysing the course content.

- *Effective learning is supported by a climate of inquiry where students feel appropriately challenged.*

  Students are expected to be challenged by the course content and to challenge their own preconceptions, knowledge, and understanding by questioning information, concepts, and approaches during class and study.

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

  Coursework, tutorials, assignments, laboratories, examinations, and other forms of learning and assessment are intended to provide students with the opportunity to cross-reference these activities in a meaningful way with their own experience and knowledge.

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

  The course content is designed to incorporate both theoretical and practical concepts, where the latter is intended to be applicable to real-world situations and contexts.

Lectures: The core concepts will be taught in lectures, students will have access to the lectures notes before class for annotation during the lecture. Students will be engaged in the learning process through class discussions and problem-solving questions independently and working together with partners and groups.

Tutorials: Tutorials will consolidate the students learning of the core concepts through short-answer and problem-solving questions. Students will have the chance to work collaboratively in class and independently outside of class. Real world examples of the concepts will engage the students in the learning processing by connecting theory to practice.

3.2 Expectations of students

- Students must attend at least 80% of all classes with the expectation that students only miss classes due to illness or unforeseen circumstances
- Students must read through lecture notes and lab sheets prior to class
- During class, students are expected to engage actively in class discussions
- Students should work through lecture, tutorial and textbook questions
- Students should read through the relevant chapters of the prescribed textbook.
- Students should complete all assessment tasks and submit them on time.
- Students are expected to participate in online discussions through the Moodle page

4. Course schedule and structure

This course consists of 60 hours of class contact hours. You are expected to take an additional 90 hours of non-class contact hours to complete assessments, readings and exam preparation spread over the term.

Week	Topics	Activity
1	Introduction of the course, applications of fluid flow and heat transfer in materials and mineral processing. Introduction to fluids, static fluids, pressure and measurement, Buoyancy force, Archimedes principle	Practice 1 Assignment 1 out
2	Laminar flows, viscosity, Newtonian fluid, Reynolds number, transport of momentum, velocity and shear stress distributions in fluids	Practice 2
3	Continuity and Navier-Stokes equations, turbulent flow, turbulence intensity, friction factor, dimensional analysis, flow inside a pipe	Practice 3
4	Flow over a sphere/plate/through a packed bed, Ergun equation Mechanical energy balance, friction loss, Bernoulli's equation	Practice 4
5	Applications of Bernoulli's equation, revision and preparation for mid-term exam	Assignment 1 due Mid-term exam (Wednesday 1 July)
	No lecture in Week 6	
7	Introduction of heat transfer, governing equations for conduction and convection, Fourier and Newton's laws, thermal conductivity, heat transfer coefficient, steady state conduction,	Practice 5 Assignment 2 out
8	Steady state conduction with heat source, general governing equation for conduction Heat transfer by convection, thermal boundary layer, local heat transfer coefficient, forced convection, Nusselt and Prandtl numbers;	Practice 6
9	Natural and mixed convection, Grashof and Rayleigh number Thermal radiation, radiation, irradiation and radiosity, Blackbody emission, Stefan-Boltzmann law, emissivity	Practice 7
10	Radiation between surfaces, view factor Revision and preparation for final exam	Practice 8 Assignment 2 due

5. Assessment

5.1 Assessment tasks

Assessment task	Description	Weight	Due date
In-class practice	Self-tests will be conducted in the Wednesday class	20%	End of class
Assignments	Two assignments (fluid dynamics and heat transfer) will be handed out in Weeks 2 and 7. The assignments help you understand the contents learnt in the class. You are encouraged to discuss with others, but plagiarism is strictly prohibited. Assignments will be graded and returned in two weeks	20% (10% each)	(1) Week 5 (2) Week 10
Mid-term exam:	100 min open book exam will assess your knowledge on the fluid flow part.	30%	Wednesday Week 5
Final exam:	100 min open book will assess the students' understanding of heat transfer. It will focus on the understanding of basic concepts and the ability to apply fundamental equations to a specific system.	30%	Final exam period

Further information

UNSW grading system: https://student.unsw.edu.au/grades

UNSW assessment policy: https://student.unsw.edu.au/assessment

5.2 Assessment criteria and standards

Assessment criteria and standards for each assessment tasks are available on the course Moodle page.

NOTE: Students who fail to achieve a score of at least 40% for the overall exam component (i.e., mid-session exam and final exam marks combined), but achieve a final mark >50% for the course, will be awarded a UF (Unsatisfactory Fail) for the course.

5.3 Submission of assessment tasks

- The in-class practices should be uploaded to Moodle at the end of the class. Failing to do so will lost marks each time.
- All assignments must contain a completed student declaration sheet and will be uploaded to Moodle by the due date. Students will lose 10% of the original mark per working day late for late submission of assignments.
- 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.
- UNSW operates under a Fit to Sit/ Submit rule for all assessments. If a student wishes to submit an application for special consideration for an exam or assessment, the application must be submitted prior to the start of the exam or before an assessment is submitted. If a student sits the exam/ submits an assignment, they are declaring themselves well enough to do so. Information

on this process can be found here: https://student.unsw.edu.au/special-consideration. Medical certificates or other appropriate documents must be included. Students should also advise the lecturer of the situation.

5.4. Feedback on assessment

In-class practices: solutions will be provided in class. Answer sheets will be uploaded to Moodle.

Assignments: The assignments will be marked within two weeks after submission.

Mid-term exam: Students will receive their marks within two weeks of the exam.

Final exam: Students will receive their final grade when UNSW Sydney realises the marks via MyUNSW.

6. Academic integrity, referencing and plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits**:** honesty, trust, fairness, respect, responsibility and courage.[1] At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity and **plagiarism** can be located at:

- The *Current Students* site https://student.unsw.edu.au/plagiarism**,** and
- The *ELISE* training site http://subjectguides.library.unsw.edu.au/elise/presenting

The *Conduct and Integrity Unit* provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct.

7. Readings and resources

- Gaskell, An Introduction to Transport Phenomena in Materials Engineering, Macmillan Company.
- Welty, Wicks, Wilson and Rorrer, Fundamentals of Momentum, Heat, and Mass Transfer (5th ed), Wiley.
- Bird, Stewart and Lightfoot, Transport Phenomena, John Wiley & Sons Inc.
- Additional resource materials including recommended web sites will be provided during class lectures

[1] International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.

8. Administrative matters

School Office: Room 137, Building E10 School of Materials Science and Engineering
School Website: http://www.materials.unsw.edu.au/
Faculty Office: Robert Webster Building, Room 128
Faculty Website: http://www.science.unsw.edu.au/

9. Additional support for students

- The Current Students Gateway: https://student.unsw.edu.au/
- Academic Skills and Support: https://student.unsw.edu.au/academic-skills
- Student Wellbeing, Health and Safety: https://student.unsw.edu.au/wellbeing
- Disability Support Services: https://student.unsw.edu.au/disability-services
- UNSW IT Service Centre: https://www.it.unsw.edu.au/students/index.html
- Assessment Implementation Procedure: https://www.gs.unsw.edu.au/policy/documents/assessmentimplementationprocedure.pdf
- Special Consideration: https://student.unsw.edu.au/special-consideration