Course Outline

MATS3003

Engineering in Process Metallurgy

Materials Science and Engineering

Science

T1, 2020

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor	A/Prof Sophie Primig	s.primig@unsw.edu.au	Room 346, School of Materials Science and Engineering (Building E10) by appointment	Phone: 9385 5284
Lecturer	Prof Jianqiang Zhang	j.q.zhang@unsw.edu.au	Room 348, School of Materials Science and Engineering (Building E10) by appointment	Phone: 9385 5025

2. Course information

Units of credit: 6

Pre-requisite(s): None

Timetabling website: http://timetable.unsw.edu.au/2020/MATS3003.html

Teaching times and locations:

	Lecture	Lecture	Lecture	Presentation	Presentation
Day	Tuesday	Thursday	Friday	Friday	Tuesday
Location	Chemical Sc M10	Science & Engineering G02	Michael Hintze Theatre	Michael Hintze Theatre	Michael Hintze Theatre
Time	9:00-11:00	9:00-11:00	11:00-13:00	11:00-13:00	11:00-13:00
Weeks	1-10	1-9	1-7	10	11

Voluntary excursion to steelworks will be offered (pending confirmation industrial sponsor) in the second half of the course. Bus from and back to UNSW will be provided.

2.1 Course summary

Basic mechanisms of process metallurgy for ironmaking and steelmaking; steel casting and heat treatment; microstructure-property relationship; phase transformation; low alloy and high alloy steels; non-ferrous metal process metallurgy:

- Iron making: Basic principle of produce metallic iron from iron ore and general overview of existing processes. Recent advancement in this area.
- Steel making: what is steel making and basic understanding of this process
- Major development in steelmaking: what are the recent developments which change the face of steelmaking industry? In which areas there is the potential for improvement.

- Steel casting and heat treatment of as-cast parts: after producing the steel what will happen to that. Advanced techniques in steel casting and what is the most common heat treatment after producing as-cast steel.
- Microstructure-property relationships of steels, equilibrium and non-equilibrium phase transformations in steels and resulting mechanical properties
- Processing of low-alloyed steels (e.g. HSLA steels), thermo-mechanical processing, microstructural design towards structural applications
- Processing of high-alloyed steels (e.g. tool steels), re-melting techniques, introduction to powder-metallurgy, processing of powder-metallurgical steels
- Process metallurgy of selected non-ferrous metals (aluminium, nickel, titanium, copper)

2.2 Course aims

This course is designed to introduce the basic steps from ores via process metallurgy to final products during ferrous and non-ferrous metals processing. Furthermore, it is aimed to provide a good understanding about recent developments in each step.

2.3 Course learning outcomes (CLO)

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

1. Apply the principles and concepts of mass, heat and fluid flow to materials systems and metallurgical processes
2. Understand the underlying fundamentals and develop some numerical skills

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	Apply…	1.3, 1.4, 1.5 & 2.3	1, 2, 3 & 4
CLO 2	Understand…	1.4, 1.5, 2.1, 3.3 & 3.4	1, 2, 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 read the references listed above and additional materials provided on Moodle, engage in discussions in the classroom, and independently solve non-assessed examples provided.
- *Effective learning is supported by a climate of inquiry where students feel appropriately challenged.*

Understanding the principles of process metallurgy is challenging; students will be given assignments that will motivate deep analysis of various physical phenomena.

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

  This course is built on prior courses in mathematics, physics and chemistry.

- *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 asked to analyse certain examples on state-of-the-art processing of metals and alloys requiring understanding of various physical phenomena such as solidification, phase diagrams, and phase transformations. This will also require linking this knowledge to large scale industrial processing.

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 52 hours of class contact hours. You are expected to take an additional 98 hours of non-class contact hours to complete assessments, readings and exam preparation spread over the term.

Week	Topics	Activity
1	Introduction to iron making From pig iron to steel	
2	From pig iron to steel Green steel and recent developments	
3	Steel making and environmental challenges Some nonferrous metal production (Al and Cu)	
4	Metal Casting and solidification	Assignment 1
5	Heat treatment for as-cast parts	Mid-term exam
6	Phase transformations of steels	
7	Microstructure-property relationships of steels Processing of low-alloyed steels (HSLA steels)	
8	Processing of low-alloyed steels (HSLA steels) Processing of high-alloyed steels (HSS steels)	
9	Powder metallurgy Introduction to non-ferrous metallurgy (Al, Cu, Ni, Ti)	
10, 11	Student presentations	Assignment 2 presentations

5. Assessment

5.1 Assessment tasks

Assessment task	Description	Weight	Due date
Assignment 1:	Identify problems and find solutions in ironmaking, steelmaking, and metal casting and solidification processes by using knowledge learnt in the class.	15%	Week 6
Mid-term exam:	A 2 hr exam covering the contents of weeks 1-5	35%	Week 5
Group assignment 2:	Group presentation on the processing or recycling of selected metal products covering technical as well as environmental and economic aspects. Each group member will be required to submit a statement their individual contribution. Students will be marked individually.	20%	Week 10-11
Final Exam:	The exam will be 2 hr in duration and held in the final exam period. It will cover the contents covered in weeks 6-10.	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

Assignment standards will be available on the course Moodle page.

Students who fail to achieve a score of at least 40% of the maximum marks for either the Mid-term Examination and/or Final Examination but achieve a final mark >50% for the course, may still be awarded a UF (Unsatisfactory Fail) for the course.

5.3 Submission of assessment tasks

- Students unable to submit assignments on time or attend the mid-session quizzes or final exams on health grounds should make a request for special consideration. 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.
- Unless otherwise specified in the task criteria, all assignments must be uploaded via Moodle prior to the due date for submission.
- Assignments/lab reports submitted after the due date for submission will receive a 10% of maximum grade penalty for every day late, or part thereof.
- 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 coordinator prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity

and Diversity Unit: https://student.unsw.edu.au/disability. Early notification is essential to enable any necessary adjustments to be made.

- Rules governing conduct during exams are given at: https://student.unsw.edu.au/exam-rules

5.4. Feedback on assessment

Assignments: Feedback will be given two weeks after submission of the assignment and take the form of the mark for the assignment, overall comments on how the class performed, any common areas that were not answered correctly. Additionally, personal feedback and how each student performed may be given.

Midsession exams: Students will receive their marked exams indicating what questions were answered correctly and incorrectly. Overall comments and worked solutions may be provided to the class.

Final exam: Students will receive their final mark.

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

- Ahindra Ghosh and Amit Chatterjee, Iron making and Steel making, PHI learning private, 2008.
- John Campbell, Complete casting handbook, Elsevier
- Metal casting Handbook ASM international.
- B Niebel, A. B. Draper and R.A. Wysk Modern manufacturing process Engineering McGraw-Hill Book Company.

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

- Steel and its heat treatment, editors T Holm et al, Swerea IVF, Gothenburg, 2012.
- Ashby and Jones: Engineering Materials 1+2, Butterworth-Heinemann; 4th edition, 2011 and 2012
- Bhadeshia and Honeycombe: Steels: Microstructures and Properties, Butterworth-Heinemann; 2nd edition, 2001
- David A. Porter, K. E. Easterling: Phase Transformations in Metals and Alloys, CRC Press; 3rd edition, 2009
- VCH.: Ullmann's Encyclopedia of Industrial Chemistry, Fifth completely revised Edition, VCH Verlagsgesellschaft mbH, Weinheim, 1996

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