UNSW Course Outline

MATS3003 Engineering in Process Metallurgy - 2024

Published on the 09 Feb 2024

General Course Information

Course Code : MATS3003
Year : 2024
Term : Term 1
Teaching Period : T1
Is a multi-term course? : No
Faculty : Faculty of Science
Academic Unit : School of Materials Science & Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This is an elective course for 3rd or 4th year undergraduate students of Materials Science & Engineering focusing on the fundamentals of process and physical metallurgy principles, some of which have been introduced in 1st year (e.g., in MATS1192 'Design and Application of

Materials in Science and Engineering’). The first part of this course focuses on traditional and modern processes required to refine iron from ores into iron and steel. Students will also learn how to describe and evaluate recent major developments in the steel industry, and how to apply this knowledge to identify areas for improvement in terms of the sustainability of these processes. The second part focuses on the physical metallurgy of simple steels before exploring the process metallurgy of specialty alloys and non-ferrous alloys. Prior knowledge of the basic principles governing processing-microstructure-property relationships of alloys will be expanded to consider various factors affecting the final properties of semi-finished metal products such as thermo-mechanical treatments, segregation, complex heat treatments, additive processing routes, workflows during non-ferrous processing, energy consumption, and other environmental aspects. This is a face-to-face course with live lectures and tutorials.

Course Aims

The course is aimed to equip students with a solid knowledge of basic steps from ores via process metallurgy to semi-finished products during ferrous and non-ferrous metals processing. The course expands prior knowledge of physics and chemistry and builds on the knowledge of the structure of materials and its relationship to mechanical properties. From this knowledge, students can pursue future work in industry or academia (including Honour’s projects in process or physical metallurgy). Students will participate in a variety of assignments and discussions aimed to provide a solid understanding about recent developments in metallurgy.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain and critically analyse traditional processes used to refine iron and steels from its ores.
CLO2 : Evaluate recent major developments in the steel and non-ferrous metallurgy industry and apply this knowledge to identify areas for improvements in terms of the sustainability of these processes.
CLO3 : Describe relationships between the processing route, microstructure and final properties of steels and other common engineering alloys, and devise strategies to advance these relationships to achieve superior properties.
CLO4 : Communicate scientific concepts to a specialist audience in both written and oral formats.

Course Learning Outcomes	Assessment Item
CLO1 : Explain and critically analyse traditional processes used to refine iron and steels from its ores.	• Assignment 1 • Mid-term Test • Presentation
CLO2 : Evaluate recent major developments in the steel and non-ferrous metallurgy industry and apply this knowledge to identify areas for improvements in terms of the sustainability of these processes.	• Final Exam • Assignment 1 • Mid-term Test • Presentation
CLO3 : Describe relationships between the processing route, microstructure and final properties of steels and other common engineering alloys, and devise strategies to advance these relationships to achieve superior properties.	• Final Exam • Assignment 1
CLO4 : Communicate scientific concepts to a specialist audience in both written and oral formats.	• Presentation

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Assignment 1 Assessment Format: Group	15%	
Mid-term Test Assessment Format: Individual	35%	Start Date: Not Applicable Due Date: Week 5: 11 March - 17 March
Presentation Assessment Format: Individual	20%	Due Date: Week 10: 15 April - 21 April
Final Exam Assessment Format: Individual	30%	Start Date: Exam period Due Date: Exam period

Assessment Details

Assignment 1

Assessment Overview

This assessment involves two parts. In the first part, you will answer a series of questions with the task due before the end of Week 3. The second part will involve the preparation of a written report on innovative and solutions for achieving more sustainable solutions in iron and steel making. This will be based on a literature survey, and creative ideas are preferable. This part of assignment will be due in week 5.

You will receive feedback before census date on the first part of this assignment. Feedback for the second part will be given during and after the completion of that part. Overall comments on how the class performed will be given.

Course Learning Outcomes

- CLO1 : Explain and critically analyse traditional processes used to refine iron and steels from its ores.
- CLO2 : Evaluate recent major developments in the steel and non-ferrous metallurgy industry and apply this knowledge to identify areas for improvements in terms of the sustainability of these processes.
- CLO3 : Describe relationships between the processing route, microstructure and final properties of steels and other common engineering alloys, and devise strategies to advance these relationships to achieve superior properties.

Mid-term Test

Assessment Overview

Your mid-term test paper will cover the concepts, processes, and related calculations taught in weeks 1-5. You will complete several questions and problems requiring either short written answers, descriptions/explanations, drawings, and/or workings/calculations. This test will be held in week 5

You will receive a mark and feedback within two weeks of the test.

You need to achieve at least 35% for the mid-term test (and a combined mark for the mid-term test and final exam of at least 45%).

Course Learning Outcomes

- CLO1 : Explain and critically analyse traditional processes used to refine iron and steels from its ores.
- CLO2 : Evaluate recent major developments in the steel and non-ferrous metallurgy industry and apply this knowledge to identify areas for improvements in terms of the sustainability of these processes.

Detailed Assessment Description

A 2 hr exam covering the contents of weeks 1-4

Assessment Length

2 hours

Hurdle rules

Satisfactory completion of the course includes the requirement to achieve ≥ 35% in the mid-term exam and ≥ 35% in the final exam, and ≥ 45% weighted average over the two exams. Students who fail to achieve this will be awarded an Unsatisfactory Fail (UF) grade for the course regardless if they receive over 50% in total for the course.

Presentation

Assessment Overview

You will select or get assigned a recent high impact publication on microstructure and property control in alloys via additive manufacturing routes. This publication will contain some concepts and/or techniques that you may need to research yourself. You will give a short pitch about the concepts and findings in this publication to your peers in week 10 You will also get the opportunity to propose ideas for future research in this area based on a literature review where

you define gaps in the current knowledge.

You will receive written feedback on your uploaded PowerPoint slides and face to face delivery of your presentation within 10 days. You may receive verbal feedback immediately after your presentation.

Course Learning Outcomes

- CLO1 : Explain and critically analyse traditional processes used to refine iron and steels from its ores.
- CLO2 : Evaluate recent major developments in the steel and non-ferrous metallurgy industry and apply this knowledge to identify areas for improvements in terms of the sustainability of these processes.
- CLO4 : Communicate scientific concepts to a specialist audience in both written and oral formats.

Detailed Assessment Description

Short individual presentations on topics covered in lectures in microstructure and property relationships in steels and extraction of non-ferrous alloys. Each student will be assigned a specific topic.

Final Exam

Assessment Overview

The final exam will assess your learning of content in weeks 7-10 and involves completing a written exam and will typically include short-answer style questions and calculations. It will be 2 hours in duration and held in the formal UNSW examination period at the end of term.

Feedback: You will receive your final mark and grade for the course; additional feedback may be available through inquiry with the course convenor.

You are required to achieve a mark of at least 35% in the final exam (and at least 45% weighted average for the final exam and the mid-term test) to pass the course otherwise an Unsatisfactory Fail (UF) grade may be awarded.

Course Learning Outcomes

- CLO2 : Evaluate recent major developments in the steel and non-ferrous metallurgy industry and apply this knowledge to identify areas for improvements in terms of the sustainability of these processes.
- CLO3 : Describe relationships between the processing route, microstructure and final properties of steels and other common engineering alloys, and devise strategies to advance these relationships to achieve superior properties.

Assessment Length

Two hours

Hurdle rules

Satisfactory completion of the course includes the requirement to achieve ≥ 35% in the mid-term exam and ≥ 35% in the final exam, and ≥ 45% weighted average over the two exams. Students who fail to achieve this will be awarded an Unsatisfactory Fail (UF) grade for the course regardless if they receive over 50% in total for the course.

General Assessment Information

Short Extensions:

The School of Materials Science and Engineering has reviewed its range of assignments and projects to determine their suitability for automatic short extensions as set out by the UNSW Short Extension Policy. After consultation with teaching staff and examination of our course offerings we consider our current deadline structures already accommodate the possibility of unexpected circumstances that may lead students to require additional days for submission. Consequently, the School does not offer the Short Extension provision in its MATS courses but students, if needed, can apply for formal Special Consideration via the usual procedure.

Grading Basis

Standard

Requirements to pass course

Satisfactory completion of the course includes the requirement to achieve ≥ 35% in the mid-term exam and ≥ 35% in the final exam, and ≥ 45% weighted average over the two exams. Students who fail to achieve this will be awarded an Unsatisfactory Fail (UF) grade for the course regardless if they receive over 50% in total for the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 12 February - 18 February	Lecture	Introduction to iron making From pig iron to steel
Week 2 : 19 February - 25 February	Lecture	From pig iron to steel Green steel and recent developments
Week 3 : 26 February - 3 March	Lecture	Steel making and environmental challenges Metal Casting and solidification
Week 4 : 4 March - 10 March	Lecture	Metal casting and solidification Heat treatment for as-cast parts Heat treatment
Week 5 : 11 March - 17 March	Lecture	Part 1 - revision
	Assessment	Mid-term exam
Week 6 : 18 March - 24 March	Other	Week six is known as 'flexi week', no classes are held this week to give students an opportunity to focus on assessable tasks and revising course content.
Week 7 : 25 March - 31 March	Lecture	Phase transformations of steels Microstructure-property relationships of steels
Week 8 : 1 April - 7 April	Lecture	Microstructure-property relationships of steels Processing of low-alloyed steels (HSLA steels)
Week 9 : 8 April - 14 April	Lecture	Processing of low-alloyed steels (HSLA steels) Processing of high-alloyed steels (HSS steels)
Week 10 : 15 April - 21 April	Lecture	Introduction to non-ferrous metallurgy (Al, Cu, Ti, Ni) Assignment 2 presentation

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Resources

Recommended 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.
- 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

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Akif Kaynak		E10 Room 238		By appointment	No	Yes
Lecturer	Jianqiang Zhang		E10 Room 348		By appointment	No	No

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the UNSW Student Code of Conduct Website.

Academic Honesty and Plagarism

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. 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, plagiarism and the use of AI in assessments can be located at:

- The Current Students site,
- The ELISE training site, and
- The Use of AI for assessments site.

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

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: https://student.unsw.edu.au/special-consideration

Important note: UNSW has a "fit to sit/submit" rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant

circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- The Current Students Gateway
- Student Support
- Academic Skills and Support
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- UNSW IT Service Centre
- Science EDI Student Initiatives, Offerings and Guidelines