



THE UNIVERSITY OF  
NEW SOUTH WALES

SCHOOL OF MATERIALS SCIENCE AND ENGINEERING

**MATS5423**

# **Pyrometallurgy 1**

Course Outline

Session 2, 2009

## Course staff

Dr Guangqing Zhang  
Lecturer

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Consultation hours:  
by appointment

## Timetable

Lecture/Tutorial	Day	Time	Location
Lecture	Monday	15:00-17:00	Goldstein College Room G01

## Course Objectives

The major aim is to further understand the principles of typical and major pyrometallurgical processes by practically visiting industrial facilities of extractive metallurgy.

At the completion of this subject the student should know major pyrometallurgical technologies in ferrous and nonferrous metallurgy; their unit operations and principles, major operation parameters, driving forces for their development.

## Course outline

- Iron and steel making: Sintering, blast furnace ironmaking, basic oxygen furnace, casting.
- Steelmaking: steel scrap recycling, electric arc furnace, casting
- Aluminium production: electrode production, electrolysis, casting

## 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 read larger varieties of literature about the metallurgical processes and are encouraged to engage in discussions of mass and heat transport phenomena, thermodynamic and kinetic principles in these processes.
- **Effective learning is supported by a climate of inquiry where students feel appropriately challenged.**  
Students are encouraged to learn through group discussions and reading.
- **Learning is more effective when students' prior experience and knowledge are recognised and built on.**  
Prior experience and knowledge in physics, chemistry, thermodynamics and kinetics will be applied to solve problems encountered in metallurgical processes and further build fundamental understanding of metallurgical processes.
- **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 role and place of metallurgical processes in materials science and world economy. In addition, this course will also provide students with the opportunities to apply the fundamental concepts in high temperature processes for metal production, research methodology and environmental issues in process metallurgy to analyse the commercial metallurgical plants and the issues the production processes face.

### Course information

Units of credit	3
Parallel teaching involved in this course	None
How the course relates to other course offerings and overall program(s) in the discipline	A materials scientist, metallurgical engineer or mineral processing engineer needs to understand how metals are extracted. A metallurgical engineer facing production industry needs to use their understanding to analyse, judge and solve problems.
Course aims	At the completion of this course, the student will gain knowledge and understanding of the major technologies in ferrous and nonferrous metallurgy; driving forces for their development; major unit operations and their operation parameters.
Graduate attributes which will be gained through the course	<ul style="list-style-type: none"> <li>• Research, inquiry and analytical thinking abilities</li> <li>• Capability and motivation for intellectual development</li> <li>• Communication</li> <li>• Information literacy</li> </ul>
Expected learning outcomes	Students should gain knowledge and understanding of principles of metallurgical processes, and to review unit operations of extractive metallurgy.
Teaching strategies	<ul style="list-style-type: none"> <li>• Students will visit major iron and steel making facilities and aluminium smelting plants, to establish basic concepts of commercial operation of the facilities and further understand the basic principles of metallurgical processes.</li> </ul>

### Assessment:

A student will be required to take part in all three plant tours to complete this course. A report will be prepared after each plant tour to demonstrate the student's knowledge and understanding to the plant and related principles.

Three plant visit reports will be marked based on 100 marks and the average will be the final marks of a student. A plant visit report should include the following sections and contents:

Report Title

Introduction (10 marks)  
(Description of) Metallurgical process (30 marks)  
Principles (30 marks)  
Major issues and further development (20 marks)  
Conclusions (10 marks)  
References (if any).

## 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](http://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.

## Recommended Reference Materials

- *Biswas, A.K., Principles of Blast Furnace Ironmaking: Theory and Practice, Cootha Publishing House, 1981.*
- *Hayes, P., Process Principles in Minerals & Materials Production, Hayes Publishing, 1993.*
- *Pehlke, R.D., Unit Processes of Extractive Metallurgy, Elsevier Publishing Co., New York, 1973.*
- *Alcock, C.B., Principles of Pyrometallurgy, Academic Press, New York, 1976.*
- *Moore, J.J., Chemical Metallurgy, 2nd Ed. Butterworth & Co. (Publishers), 1990.*
- *Peacey, J.G. and Davenport, W.G., The Iron Blast Furnace. Theory and Practice, Pergamon Press, 1979.*
- *Fruehan, R.J., Ladle Metallurgy Principles and Practices, Iron and Steel Society, 1985.*
- *Gill, C.B., Nonferrous Extractive Metallurgy, A Wiley-interscience Publication, 1980.*
- *Gilchrist, J.D., Extraction Metallurgy, 3rd Ed., 1989.*
- *Turkdogan E. T., Fundamentals of Steelmaking, Institute of Materials, 1996.*
- *Coudurier L., Fundamentals of Metallurgical Processes, Pergamon Press, 1985.*
- *Thonstad J., Grjotheim K., Krohn M., Aluminium Electrolysis: Fundamentals of the Hall-Héroult Process, Aluminium-Verlag, 2001.*

## 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.

## Administrative Matters

- Students should attend all the plant visits.
- Reports submitted after the deadline will receive a 10% of maximum grade penalty for every day late, or part thereof.
- Students unable to submit reports on time on health grounds should make a request for special consideration by submitting the form available from the Student Desk in

the Chancellery. Medical certificates or other appropriate documents must be included. Students should also advise the lecturer.

- 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](http://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](http://www.secretariat.unsw.edu.au/acboardcom/minutes/coe/disabilityguidelines.pdf)