CHEN90010 Minerals, Materials and Recycling

Credit Points:	12.5
Level:	9 (Graduate/Postgraduate)
Dates & Locations:	2016, Parkville This subject commences in the following study period/s: Semester 2, Parkville - Taught on campus.
Time Commitment:	Contact Hours: 2 x 2 hour lectures per week Total Time Commitment: Estimated 200 hours
Prerequisites:	Admission into MC-ENG Master of Engineering (Chemical) or MC-ENG Master of Engineering (Chemical with Business) or MC-ENG Master of Engineering (Biochemical) OR All other MC-ENG Master of Engineering students may seek approval from their Course Coordinator and the Subject Coordinator to take this subject
Corequisites:	None
Recommended Background Knowledge:	None
Non Allowed Subjects:	CHEN40011 Minerals, Materials and Recycling

Subject	Study Period Commencement:	Credit Points:
CHEN90035 Advanced Topics in Chemical Engineering	January	12.50

Core Participation Requirements:	For the purposes of considering request for Reasonable Adjustments under the Disability Standards for Education (Cwth 2005), and Students Experiencing Academic Disadvantage Policy, academic requirements for this subject are articulated in the Subject Description, Subject Objectives, Generic Skills and Assessment Requirements of this entry.The University is dedicated to provide support to those with special requirements. Further details on the disability support scheme can be found at the Disability Liaison Unit website: http://www.services.unimelb.edu.au/disability/
Coordinator:	Prof George Franks
Contact:	Prof George Franks Email: **gvfranks@unimelb.edu.au (mailto:gvfranks@unimelb.edu.au)**
Subject Overview:	**AIMS** The importance of the minerals industry to the Australian economy. Liberation, size reduction, size separation and concentration separations in minerals processing. Extractive metallurgy, including hydrometallurgy and pyrometallurgy. Aspects of physico-chemical principles of mineral separation processes to produce metals and ceramic products from ores as well as recycled materials and consumer products. The influence of interatomic bonding and material atomic structure on material behaviour. Phase diagrams and equilibria as well as material mechanical, electrical and magnetic properties will be covered. The process of developing material selection criteria and selecting materials for particular applications will be presented. The systems approach to recycling of products, process sustainability and environmental considerations. **INDICATIVE CONTENT** Understand: why recycling makes sense; mineral processing separation concepts; processing-structure-property relationships; atomic bonding and atomic scale structure in materials;

	thermodynamic basis for phase equilibria; influence of material properties on recyclability; influence of recycling on material purity and properties. Know how to design mineral separation processes; use phase diagrams; derive a number of material properties based upon atomic bonding and atomic scale structure. Be familiar with: similarities and differences in mineral processing and recycling; equipment used in size reduction and separation and concentration separations; extractive metallurgy; typical minerals processing and metals production processes; typical properties of metals, polymers, ceramics and semiconductors; influence of materials on society; influence of microstructure on material properties; mechanical, electrical, magnetic, optical and thermal properties of materials; typical material processing; be able to select materials for particular applications.
Learning Outcomes:	**INTENDED LEARNING OUTCOMES (ILO)** On completion of this subject the student is expected to: 1 Understand the complex interaction of processes within the material cycle i.e. starting with primary material production from minerals, material production and properties, consumer products and ending with recycled material, waste and environmental issues. This will be based on material science principles, thermodynamics, system engineering and optimization 2 The students will understand the relationships between materials composition, processing, microstructure and properties 3 The students will be able to select materials for particular engineering design applications
Assessment:	Continuous assessment comprising regular assignments, requiring approximately 35 - 40 hours of work in total (30%) One written 3-hour end-of-semester examination (70%). Intended Learning Outcomes (ILOs) 1 - 3 are addressed in the examination and the regular assignments.
Prescribed Texts:	None
Breadth Options:	This subject is not available as a breadth subject.
Fees Information:	Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees
Generic Skills:	# Capacity for independent thought # Awareness of advanced technologies in the discipline # Ability to apply knowledge of basic science and engineering fundamentals # Ability to undertake problem identification, formulation and solution # Ability to utilise a systems approach to design and operational performance
Notes:	**LEARNING AND TEACHING METHODS** Lectures, homework assignments, worked examples case studies and guest lectures. **INDICATIVE KEY LEARNING RESOURCES** Comprehensive Lecture Notes are provided on LMS for the Students. Materials for the lecture notes are taken from the following list of sources which is provided to the students. MINERALS # Introduction to Mineral Processing, Kelly, E. G., and Spottiswood, D. J., 1995.Australian Mineral Foundation, (K&S) # Mineral Processing Technology, 6th Edition, Wills, B. A., 1997. Butterworth Heinemann, (Wills) METALS PRODUCTION # Principles of Extractive Metallurgy, F. Habashi, Gordon and Breach, 2nd ed., Vols 1-3, 1980. (Habashi). # Process Principles in Minerals & Materials Production, P. Hayes, Hayes Publishing, Brisbane, 1993. (Hayes). # Extraction Metallurgy, 3rd ed., J. D. Gilchrist, Pergamon Press, 1989. (Gilchrist)

	# Extractive Metallurgy of Copper, W. G. Davenport, M. King, M. Schlesinger, A. K. Biswas, 4th ed., Pergamon, 2002. (DKSB) MATERIALS # Materials Science and Engineering an Introduction, Callister, W. D. Jr. # Sixth Edition, John Wiley and Sons, 2003. (Call) # The Principals of Engineering Materials, Barrett, C. R., Nix, W. D., and Tetelman, A.S., Prentice Hall, 1973. (BNT). # Introduction to Engineering Materials, Second Edition, John, V. B., Macmillan Press, 1983. (John). # Principles of Materials Science and Engineering, 3rd edition, Smith, W. F., McGraw Hill, NY, 1996. (Smith) # Materials Selection in Mechanical Design, Ashby, M. F., Permagon Press 1992 and 1999. (Ashby). # Engineering Materials 1, 3rd edition, and Engineering Materials 2, Ashby, M. F. and Jones , D. R. H., Elsevier, 2005., Butterworth-Heinemann, (A&J) # MIT OpenCourseWare, Materials Science and Engineering Department, http://ocw.mit.edu/OcwWeb/index.htm (MIT) # Elements of Materials Science and Engineering, 3rd Edition, Van Vlack, L. H., 1975., Addison-Wesley, Reading, MA, (Van Vlack) # Introduction to Ceramics, 2nd Edition, Kingery, W. D., Bowen, H. K., Uhlmann, D. R., 1976. John Wiley and Sons, NY, (KBU) # Materials Science for Engineers, 5th edition, Anderson, J. C., Leaver, K. D., Leevers, P., Rawlings, R. D., 2003., Nelson Thornes, Ltd. London, (ALLR) # Coulson and Richardson's Chemical Engineering, Volume 6, Third Edition, R. K. Sinnot, R. K., 1999, Butterworth-Heinemann, (C&R). # Introduction to Dislocations, 2nd edition, D. Hull, Pergamon Press, Oxford, 1975, (Hull) # Materials Science and Engineering, G. F. Carter and D. E. Paul, 1991. ASM International, (C&P) # Physical Chemistry, 7th Edition, P. Atkins and J. de Paula, Oxford Univ. press, 2002. (Atkins) RECYCLING # The Metrics of Material and Metal Ecology, Reuter, M. A., Heiskanen, K., Boin, U., van Schaik, A., Verhoef, E. yang, Y., Georgalli, G., Elsevier, 2005. (Reuter) **CAREERS / INDUSTRY LINKS** The recycling component of the subject, (lectures and a case study) is taught by an engineer from industry. There are also typically 2 or 3 other guest lecturers (1 to 2 hours) from industry as well.
Related Course(s):	Doctor of Philosophy - Engineering Master of Philosophy - Engineering
Related Majors/Minors/ Specialisations:	B-ENG Chemical Engineering stream B-ENG Chemical and Biomolecular Engineering stream Master of Engineering (Biochemical) Master of Engineering (Chemical)