Program Structure

The program consists of one year of full-time study (two sessions) or two years of part-time study (four sessions). This comprises 36 UOC of formal coursework plus 12 UOC of experimental and/or design project work (MATS6695 Materials Project). Initial enrolment in Session 1 is preferred, but entrance in Session 2 is permitted. All formal coursework is taught during work hours, although the project work may be undertaken with considerable flexibility in terms of time and location. Enrolment in formal coursework offered by Schools other than the School of Materials Science and Engineering is permitted, subject to the approval of the Head of School.

Course Selection

Students must enrol in:
MATS6605 Prof. Comm & Presentation (3 UOC)
MATS6695 Materials Project (6 UOC)
Note: UOC are per session. Courses MATS6605 and MATS6695 are full-year subjects and therefore 6UOC and 12UOC, respectively.

Plus a balance of 30 UOC of formal coursework. This may consist of five of the below eight courses or selected offerings from other Schools if desired. Corresponding Undergraduate courses need to be chosen that equate to the below selections, students ‘audit’ these courses.
MATS6665 Mats Applications & Performance (6 UOC)
MATS6605 Prof. Comm & Presentation (3 UOC)
MATS6615 Materials Design (6 UOC)
MATS6625 Materials Processing (6 UOC)
MATS6635 Materials Properties (6 UOC)
MATS6645 Materials Characterisation (6 UOC)
MATS6655 Adv. Materials Characterisation (6 UOC)
MATS6675 Materials Modelling (6 UOC)
MATS6685 Management (6 UOC)
MATS6695 Materials Project (6 UOC)

Process

- Student receives a formal offer from the University.
- A meeting is to be arranged with Professor Chris Sorrell (Postgraduate Coordinator in the School of Materials Science and Engineering). At this meeting the student will discuss a supervisor.
- A meeting is to be arranged with the allocated supervisor to determine which combination of courses will be studied.
- A ‘Course Enrolment’ form is to be filled out with the supervisor and taken to Prof. Sorrell, who will sign off on the course selections.
- Signed and completed form then need to be taken to Courtenay Atwell in the School Office (Room 113 – Materials Science and Engineering Building), where you will be enrolled.

Prof. Chris Sorrell
Postgraduate Coordinator
c.sorrell@unsw.edu.au
Level One, Room 105

Courtenay Atwell
Administrator
c.atwell@unsw.edu.au
School Office, Room 113
Section One - to be completed by the student

Student Number: ______________________
Family Name: ______________________ Given Name: ______________________
Email Address: _____________________________________________________________________
Address: _____________________________________________________________________
Phone Number: ______________________ Program: _________________________________
Semester: ______________________ Year: _________________________________

Section Two - to be completed with Prof. Chris Sorrell (Program Authority)

Supervisor: _____________________________________________________________________

Section Three - to be completed with the allocated Supervisor

Please ensure that there are no timetable clashes between auditing courses. This can be done by viewing the Online Handbook entry, followed by the ‘Class Timetable’ link. (www.handbook.unsw.edu.au)

<table>
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<tr>
<th>Course Code</th>
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Section Four - to be completed by the student

I have read and understood the guidelines and advice on this application form. I certify that all information, including supporting documentation and certificates, is correct. I hereby authorise the University to contact the professional authority concerned for the purpose of verifying any information he or she supplied. I acknowledge that the University will, where appropriate, advise the relevant Commonwealth government authority of the outcome of this application. In signing this form I understand that the details are protected by the Privacy and Personal Information Protection Act 1998 (NSW).

Student Signature: ______________________ Date: ______________________
MATS1192 - Design and Application of Materials in Science and Engineering (6 UOC Semester Two)
The design of materials for applications in industry and society including, for example, metallurgical, electronic, medical, packaging and transport. Microstructure and structure-property relationships of the main types of engineering materials (metals, ceramics, polymers and composites); micromechanisms of elastic and plastic deformation; fracture mechanisms for ductile, brittle, creep and fatigue modes of failure in service; corrosion; metal forming by casting and wrought processes; phase equilibria of alloys; microstructural control and application to commercial engineering materials. Information retrieval. Communication skills. Plant visits. Introductory materials laboratories. Application of fundamental learning to problem solving.

MATS2001 - Physical Properties of Materials (6 UOC, Semester One)
Modern atomic theory: shortfall of classical physics and an introduction to wave mechanics; many-electron atoms and the Pauli exclusion principle; zone and band theories. Electrical properties: classification of metals, semi-conductors and insulators; properties of amorphous, dielectric, piezoelectric, ferroelectric and pyroelectric materials. Thermal properties: heat capacity, thermal expansion, thermal conductivity and thermoelectricity. Magnetic properties: diamagnetism, paramagnetism, antiferromagnetism, ferrimagnetism and ferromagnetism; magnetic anisotropy and magnetostriction; magnetic materials and devices. Superconductivity and superconducting materials. Optical properties.

MATS2003 - Materials characterisation (6 UOC, Semester One)
Introduction to crystallography: crystal symmetry, Bravais lattices and crystal structures; Miller and Miller-Bravais Indices. Specimen preparation; optical and electron microscopy; image analysis and stereology; x-ray, electron, and neutron diffraction; x-ray fluorescence, infrared spectroscopy, Raman spectroscopy, x-ray photoelectron spectroscopy; differential scanning calorimetry, thermal gravimetric analysis, dynamic thermal analysis; non-destructive analysis - ultrasounds, radiography, computed tomography.

MATS2004 - Mechanical behaviour of materials (6 UOC - Semester Two)
Stress strain behaviour; atomic bonding and elastic modulus; basic introduction to plastic deformation and yielding; slip systems, dislocations, twinning; deformation behaviour of non-crystalline materials; principal stresses, transformation of stresses, complex stress and strain analysis; failure criteria, ductile failure, brittle fracture and Weibull modulus; deformation behaviour of polymers; deformation behaviour of composites.

MATS2005 - Introduction to fluid flow and heat transfer (6 UOC - Semester Two)
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 conduction; forced and natural convection heat transfer; radiation, single body radiation, radiation exchange between objects.

MATS2006 - Diffusion and Kinetics (6 UOC - Semester Two)
Introduction to solid state diffusion, atomistics of diffusion, Fick's first and second laws; thin film solution and tracer diffusion measurements, semi-infinite and infinite diffusion couples - diffusion in a concentration gradient; temperature effects; surface, grain boundary and dislocation pipe diffusion; diffusion in ionic solids, interdiffusion and the Kirkendall effect, measurement of variable diffusion coefficients; thermodynamics vs. Kinetics, elementary and non-elementary reactions, reaction order, activation energy, Arrhenius law, irreversible and reversible reactions, degree of reaction; heterogeneous reactions, kinetics of solid state-gas (fluid) reactions, elementary steps, rate-controlling steps, intrinsic kinetics, chemisorptions, mass transfer in the gas phase and fluid, multicomponent system, Knudsen diffusion, shrinking core model.

MATS2007 - Design and application of materials in science and engineering 2 (6 UOC - Semester Two)
This is a capstone course intended to develop problem solving skills and integrate the concepts learned in Years 1 and 2 by applying them to sustainable materials and processing. Topics would include: Problem solving methodology; environmental footprint – production, maintenance and end-of-life disposal; embodied energy; pollution and carbon estimation and accounting; life cycle analysis; energy recovery; carbon sequestration; pollution minimisation; sustainable materials and processing technologies.

MATS2008 - Thermodynamics and phase equilibria (6 UOC, Semester One)
Thermodynamic functions and properties of materials (chemical, mechanical and magnetic systems); thermodynamic laws and their application to materials: chemical equilibrium, gas-solid equilibria, Ellingham diagrams; electrochemistry: Porbax diagrams; thermodynamics of solutions; construction and interpretation of 2 component phase diagrams.
MATS3001 - Micromechanisms of mechanical behaviour of metals (6 UOC, Semester One)
Theoretical strength; slip; twinning; deformation of single and polycrystals; dislocation multiplication; cross slip; climb; dislocation interactions. Strain hardening; solid solution hardening; age-hardening; dispersion hardening; grain size strengthening; other strengthening mechanisms. High temperature deformation; creep; stress relaxation; effect of strain rate and temperature; superplasticity. Common methods of forming metal products. Common classes of aluminium and nickel-based and titanium alloys to be taught illustrating some of the principles involved.

MATS3002 - Fundamentals of ceramic processing (6 UOC, Semester One)
Ternary phase equilibria in ceramic systems. Processing of ceramics and its relationship to structure, properties and performance of ceramic materials. Starting materials, ceramic processing fundamentals, and processing technology taught in context of the main classes of ceramic materials (polycrystalline monolithic ceramics, glasses, and films/coatings) and the determination of structure, properties and performance.

MATS3003 - Engineering in process metallurgy (6 UOC, Semester One)
Basic mechanisms of heat, mass and fluid flow; fluid statics and fluid dynamics in metallurgy; macroscopic balance for isothermal systems; dimensional analysis and reactor design; heat and mass transfer through motionless media; heat and mass transfer in convective flow systems.

MATS3004 - Polymer science & engineering 1 (6 UOC - Semester Two)
Polymer Chemistry: Raw materials and synthesis of polymers: monomers, homopolymers, copolymers, vinyl polymers; basic organic chemistry and applied polymer chemistry; free radical polymerization, reaction and termination rates using physical chemistry models; ionic, condensation and mixed mode polymerization. Physical structure of polymers: primary and secondary bonds; amorphous, semi-crystalline, and rubbery states; molecular statistics of rubbery states; chain branching, networking; iso-free volume theory; properties affected by primary bonds; physical properties affected by secondary bonds. Deformation behaviour of polymers: fundamental rheology; glassy and viscoelastic behaviour; effect of molecular weight, temperature and shear rate; structure-property correlation in glassy, semicrystalline and oriented polymers; free volume and fractal theories; tensile, shear, compression and impact properties; effect of temperature and strain rates. Commodity and specialty plastics: additives in plastics; commercial manufacture and application; single phase and multiphase conducting polymers, Nanopolymers: concept, fabrication, characterization.

MATS3005 - Phase transformations (6 UOC - Semester Two)
Classification of phase transformations. Nucleation in the gaseous, liquid and solid states. Solidification of pure and impure materials; thermal and constitutional supercooling and their influence on interface stability; solute redistribution and coring; eutectic and peritectic solidification; generation of as-cast structures during casting; grain refining; single crystal growth techniques; glass formation and glassy materials. Diffusional and non-diffusional solid-state transformations: nucleation and growth of phases; decomposition of solid solutions; ordering reactions; spinodal decomposition; the role of the eutectoid transformation in the formation of pearlite, bainite and martensite; hardenability; tempering. Theory of transformation kinetics and the origin of transformation diagrams. Aspects of ferrous and non-ferrous metallurgy and common classes of low carbon and alloy steels to be taught illustrating some of the principles involved.

MATS3006 - Design and application of materials in science and engineering 3 (6 UOC - Semester Two)
This is a capstone course intended to provide students with the tools required for computational design and modelling for technological and professional materials engineering applications through application to the concepts learned in Years 1 to 3. The course starts with computer-aided drawing and design including dimensioning, tolerancing and standard drawing symbols, principles of detail design drawings and assembly drawings. Finite element, finite difference computational fluid dynamic modelling are then introduced based upon structural, heat transfer and fluid modelling respectively. The use of computational modelling as a part of materials engineering design is emphasised.

MATS3007 - Materials industry management (6 UOC - Semester Two)
Project Management: the stages of a project; planning; scheduling; personal dynamics; reporting; stakeholders; development of a project plan pertinent to the materials industry. Accounting: financial accounting; development and analysis financial statements; ratio analysis; financial planning; finance; management accounting. Career Development: self-promotion to gain employment; development of job applications and resumes; goal setting; performance appraisal; reward structures. Marketing: market analysis; marketing concepts; product development. Professional ethics.