

Course Details

School of Materials Science and Engineering

MATS1002 Microstructural Analysis

UOC3. Prerequisites: Nil. Lectures/Tutes/Labs

Specimen preparation techniques; Principles of optical microscopy; Image analysis; Quantitative microscopy and stereology; Electron microscopy; Microchemical analysis.

MATS1013 Diffusion and Kinetics

UOC3. Prerequisites: Nil. Lectures/Tutes

Unit 1 Diffusion - Fick's first and second laws; Solutions for short and long times by analytical and numerical methods; Boundary conditions for solid-fluid and solid-solid interfaces; Diffusion couples; Atomic level diffusion theory; Diffusion with variable D values, phase boundary migration and Kirkendall effect. Unit 2 Kinetics - Elementary and non-elementary reactions; Reaction order; Activation energy; Irreversible and reversible reactions; Heterogeneous reactions; Kinetics of solid state-gas (fluid) reactions; Elementary steps; Rate-controlling step; Intrinsic kinetics; Chemisorption; Mass transfer in the gas phase and fluid; Multicomponent system; Knudsen diffusion; Shrinking core model.

MATS1021 Computing in Materials Science

UOC3. Prerequisites: Nil. Lectures/Tutes/Labs

The aim of the course is to gain a basic understanding of the computing applications and practices that are relevant to materials engineering degrees and industry practice. Topics covered are: a brief overview of the place of computing in materials engineering; use of common materials software packages; using the internet as a part of the degree; search engines; email; website composition; and computer programming to solve materials based problems.

MATS1092 Materials and Design 1

UOC6. Prerequisites: Nil. Lectures/Tutes/Labs

An appreciation of the relationships between the properties of materials, component design, manufacturing and product performance. Materials selection as an integral part of successful design. Long-term potential for materials improvement and substitution.

MATS1101 Materials Engineering and Chemistry

UOC6. Prerequisites: Nil. Lectures/Tutes/Labs

The course covers: stoichiometry, atomic and molecular structure, states of matter, equilibrium, oxidation and reduction, electrochemistry; an introduction to organic chemistry and polymers; 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 by thermomechanical processing and application to commercial engineering materials. Laboratory work includes experiments on mechanical testing, cast and recrystallised structures, and fracture.

MATS1111 Materials Science 1

UOC3. Prerequisites: Nil. Lectures/Tutes/Labs/Plant Visits

Metals, ceramics, polymers and composites, their structure, chemical, physical and mechanical properties, engineering applications and production with particular reference to Australian industries. Role of materials science and engineering in materials industry. Information retrieval. Communication skills. Plant visits. Introductory materials laboratories

MATS1112 Phase Equilibria

UOC3. *Prerequisites: Nil. Lectures/Tutes*

Phase rule. Two-component systems: free energy-composition and temperature composition diagrams, solubility limits, compound formation, invariant points. Three-component systems: isothermal sections and liquidus projections. Solidification and crystallization; cooling curves, crystallization paths.

MATS1142 Crystallographic and X-Ray Diffraction

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Introduction to crystallography, crystal structure, Bravais lattices, Miller indices, Miller-Bravais indices. Production, absorption, and diffraction of X-rays. Powder and single-crystal X-ray methods. Stereographic projection. Application of diffraction methods to solid solutions, thermal analysis, stress measurement, X-ray fluorescence spectroscopy, chemical analysis.

MATS1152 Materials Engineering 1B

UOC6. *Prerequisites: Nil. Lectures/Tutes/Labs*

Materials process principles and engineering application. Steady and unsteady state material and energy balances. Heat transfer mechanisms such as conduction, convection and radiation. Principles of steady and unsteady heat transfer and application in the production and application of materials. Materials and heat flow involving high temperature solid, liquid and gaseous phases. Computer programming and application. Course examples are drawn from materials engineering practice in the broadest sense.

MATS1163 Chemistry of the Solid State

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Crystal chemistry, nature of bonding in solids, silicate structures, and structure-composition relationships. Glass and glass-ceramics. Reactions with solids, grain boundary and interfacial effects, ceramic reactions, and polymorphic transformations (oxides, non-oxides, aluminosilicates).

MATS1172 Physical Properties of Materials

UOC3. *Prerequisites: Nil. Lectures/Tutes*

The particle and wave nature of matter; The Schrodinger equation; Electrons in a crystal: Zone and band theory; Fermi energy, Fermi surface and density of states; Electrical conduction in materials; Intrinsic and extrinsic semiconductors; Band-gap engineering; Basic semiconductor devices; Superconductivity and superconducting materials; Thermal properties of a solid: Heat capacity and thermal conduction. Magnetic behaviour: Basic concepts, modern theory and types of magnetism; Magnetic materials and applications.

MATS1214 Welding and Other Joining Processes

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Fusion welding. Capabilities, advantages and limitations. Metallurgical aspects of fusion welding. Cause of welding defects and weldability of carbon and alloy steels, stainless steels, aluminium and other common non-ferrous alloys. Design of welded fabrications to reduce distortion and the risk of failure by fatigue, brittle fracture, etc. Soldering, brazing, adhesive bonding.

MATS1223 Corrosion Control

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Topics covered: cost of corrosion; basic principles and classifications of corrosion; thermodynamics of corrosion; electrode kinetics; passivity and pitting; atmospheric corrosion; corrosion in soil and biological corrosion; corrosion under stress; liquid erosion failure and liquid metal embrittlement; high temperature corrosion and oxidation; designing against corrosion.

MATS1232 Materials Engineering 1A

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Fluid flow in materials processing. Application of the principles of fluid flow in the production and application of materials. Examples are drawn from ceramic, materials and metallurgical engineering practices in the broadest sense.

MATS1244 Materials Industry Management A

UOC6. *Prerequisites: Nil. Lectures/Tutes/Guest Lectures/Seminar*

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

MATS1262 Mechanical Properties of Materials

UOC6. *Prerequisites: Nil. Lectures/Tutes/Labs*

Nature and significance of mechanical properties. Stress-strain relationships of metals, ceramics and polymers; oriented materials, textiles. Elasticity, anelasticity, plasticity, superplasticity. Young's modulus, Shear modulus, bulk modulus, Poisson's ratio. Creep, fatigue and viscoelasticity. Mechanical testing : tension, compression, hardness and impact tests. Stress and strain transformation. Mohr's circle. Fundamentals of stress analysis. Failure criteria. Application to materials' working processes

MATS1282 Thermodynamics of Materials

UOC6. *Prerequisites: CHEM2718. Lectures/Tutes*

Thermodynamic functions and systems - PVT system, stretched wire, paramagnetic solid, and electrolytic cell. The first and second thermodynamic laws in application to materials engineering. Phase transitions of first and second order. Ellingham and Pourbaix diagrams. Thermodynamics of solutions. Gibbs-Duhem equation. Thermodynamic activity. Perfect and regular metallic and ionic solutions. Thermodynamic stability. Calculation of phase diagrams. Calculation of chemical equilibria in complex systems.

MATS1343 Materials industry Management B

UOC3. *Prerequisites: Nil. Lectures/Tutes/Seminar/Guest Lectures/Seminar*

Legal Issues in Management & Business: structure of the Australian legal system; the legal process and alternative dispute resolution; business law; contract law; restrictive trade practises; consumer protection; protection and exploitation of intellectual property. Micro- and macro-economics: economic principles; supply and demand analysis; market structures; pricing and production; market failures and regulation; the business cycle and government policy; inflation and unemployment. People management issues: diversity in the workplace: racial, gender, age, educational; leadership styles: leaders and managers, generic vs. trained, motivation, emotional intelligence; group behaviour and intergroup conflict. Operations management: management principles; operational management; risk management and AS 4360; quality management and ISO 9000; continual improvement, environmental management and ISO 14000. Occupational Health and Safety: OHS management and AS 4801. Course includes pertinent case studies and guest lecturers from industry.

MATS1354 Design Project

UOC3. *Prerequisites: Nil. Lectures/Tutes/Design Project/Seminar*

This project will cover the design of a selected piece of processing equipment or an engineering component. It will involve selection and specification of materials and other relevant aspects covered within the undergraduate program.

MATS1414 Surface Treatment and Wear

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Coatings for corrosion prevention, engineering and decorative purposes. Adhesion. Surface modification. Specifications for coating systems. Selection, testing and evaluation of coatings. Classification of wear modes. Mechanisms of adhesive and abrasive wear. Selection, testing and evaluation of materials for wear mitigation. Wear-resistant materials.

MATS1464 Professional Communication and Presentation

UOC3. *Prerequisites: Nil. Lectures/Written and Oral Presentations*

Presentation skills: public speaking, presentation techniques, visual aids, library usage. Honours thesis: guidelines for thesis preparation, two oral presentations. Job search skills: curriculum vitae, cover letter, interviews.

MATS1902 Industrial Training A

UOC24. *Prerequisites: Nil.*

Industrial Training (Co-op IT. 2)

MATS1903 Industrial Training B

UOC24. *Prerequisites: Nil.*

Industrial Training (Co-op IT. 3)

MATS2013 Ceramic Materials

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Geological origin and classification of ceramic raw materials. Composition, crystal structures, chemical and physical properties, and physical aspects of the production of ceramics and related materials. Chemical and physical reactions during processing and firing of traditional and advanced ceramics, cement, glass, refractories, and composites. Fabrication routes of commercial ceramic materials.

MATS2135 Ceramic Processing Laboratory

UOC3. *Prerequisites: Nil. Labs/Plant Visits*

Laboratory program illustrating processing and engineering aspects of ceramic technology. Students are required to take part in a series of factory inspections.

MATS2183 Refractories

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Classification of refractories. Chemical and physical properties of refractories. Introduction to raw materials and manufacturing technology. Description of chemical reactions occurring between refractories and solid, liquid, and gas phases in ferrous and nonferrous metal industries. Review of phase equilibria.

MATS2203 Physico-Chemical Ceramics Laboratory

UOC3. *Prerequisites: Nil. Lectures/Labs*

Laboratory program illustrating the physical and chemical properties associated with the processing and performance of ceramic materials. Students are required to take part in a series of factory inspections.

MATS2263 Sintering of Ceramics

UOC3. *Prerequisites: Nil. Lectures/Tutes*

Introduction to sintering: definitions of sintering, brief history of sintering, driving forces of sintering, mass transport mechanisms, and atomic mobility. Solid-state sintering: mass transport mechanisms, stages of sintering, microstructure and processing considerations. Liquid-phase sintering: thermodynamic and microstructural considerations, liquid-phase sintering models.

Reactive sintering processes: reactive sintering, reaction bonding, and transient-liquid phase sintering and reactive hot compaction. Pressure-assisted sintering: effect of pressure in sintering, deformation mechanisms, densification maps, and pressure-assisted sintering processes. Secondary phenomena: phase transformation, chemical reactions, and firing shrinkage and warpage. Introduction to sintering technology.

MATS2294 Mechanical and Thermal Properties of Ceramics

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Heat capacity, measurement of heat capacity, and factors affecting heat capacity. Thermal expansion, measurement of thermal expansion, and factors affecting thermal expansion. Thermal conductivity, thermal diffusivity, measurement of thermal conductivity and thermal diffusivity, factors affecting thermal transport, phonon and photon conductivity, and factors affecting phonon and photon conductivity. Thermal stresses and thermal shock. Influence of structure and composition of pure materials on thermal conductivity of multiphase materials. Effects of composition, microstructure, and physical properties on the mechanical properties of ceramics, design approaches for ceramics, inspection and non-destructive testing of ceramics, and case studies.

MATS2314 Glass-Based Ceramics

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Raw materials, glass compositions and types of glasses. Glass composition calculations. Glass forming processes. Design and construction of glass tanks. Electric melting. Fusion casting, crystal growth from melts. Relationship between composition and properties of glasses. Glass ceramics: compositions, melt forming, nucleation and crystallisation, and properties. Glazes and enamels: preparation of glazes, glaze calculations, design of glazes for bodies, chemical reactions, glaze body stress and defects, and porcelain enamels.

MATS2363 Ceramic Processing and Design

UOC3. *Prerequisite: MATS5013. Lectures/Tutes/Labs*

Forming of ceramics: forming processes and equipment used in traditional and technical ceramics, advanced forming processes, and forming problems. Drying of ceramics: review of the drying process, statics of drying (psychrometry), kinetics of drying, principles of dryer design, drying problems, and drying case studies. Firing of ceramics: review of chemical and physical processes, statics of firing (mass and energy balances on kilns), dynamics of firing and design of firing cycles, advanced kiln design, fast firing processes, and firing case studies.

MATS3064 Composite Materials

UOC3. *Prerequisites: Nil. Lectures/Tutes*

Philosophy of a composite. Fibre and matrix materials. Role of the interface. Polymer matrix, metal matrix and ceramic matrix composites. Physico-chemical characterization. Strengthening and toughening mechanisms. Effect of reinforcement volume fraction. Size and size distribution. Properties of composites. Fabrication techniques. Design with composites. Applications.

MATS3443 Polymer Science and Engineering

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Polymer structure, monomers, bond strength, addition/condensation polymerisation, amorphous, crystalline, conformation, chain branching, co-polymer, additives in plastics, glass transition. Effect of molecular structure on performance, orientation, structure-property correlation, commodity and specialty plastics; application of polymers in ceramic industry, rheological behaviour.

MATS3524 Materials Engineering Project

12UOC. *Prerequisites: Nil. Labs*

An experimental or technical investigation or design related to some aspects of materials engineering in the specific discipline (ceramic engineering, metallurgical engineering or materials engineering).

MATS3564 Polymer Engineering 1

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Critical effects of temperature on behaviour of thermoplastics under load; Comparisons with thermosets; Factors contributing to strength and toughness; Yield, deformation and fracture; Cracking; Effects of environment.

MATS3574 Polymer Engineering 2

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Strategies to reduce stress and increase toughness. Creep, recovery and stress relaxation. Time-temperature superposition, fatigue, selection of commodity plastics, engineering plastics and elastomers for particular applications. Degradation. Processing of polymers.

MATS3624 Materials Engineering Project

UOC18. *Prerequisites: Nil. Labs*

An experimental or technical investigation or design related to materials engineering in the specific discipline (metallurgical engineering, materials engineering or ceramic engineering). Students with an average mark above 70 will be allowed to do the 24 UOC Project MATS3724, with approval from the Head of School. Note: this course is 18 UOC in total: 9 UOC per semester over two semesters

MATS3724 Materials Science Project

UOC24. *Prerequisites: Nil. Labs*

An experimental or technical investigation or design related to materials engineering in the specific discipline (metallurgical engineering, materials engineering or ceramic engineering). Only students with an average mark above 70 will be allowed to do this 24 UOC Project, with approval from the Head of School. Students with an average mark below 70 do the 18 UOC project MATS3624 AND ADDITIONAL 6 UOC Elective courses in Materials Science and Engineering. Note: this course is 24 UOC in total: 12 UOC per semester over two semesters

MATS4013 Physical Metallurgy

UOC3. *Prerequisites: Nil. Lectures/Tutes*

Unit 1 Dislocations - Deformation of metals. Atomic and molecular description of deformation. Introduction to dislocation theory and its application to mechanical properties. Unit 2 Phase Transformations - Solidification. Solid state transformations; diffusional and diffusionless transformations. Kinetics of phase transformations. Unit 3 Alloys - Steels and nonferrous alloys. Development of microstructure.

MATS4023 Phase Transformations

UOC3. *Prerequisites: Nil. Lectures/Tutes*

Theory of nucleation and growth of a new phase. Interface behaviour during solidification of single component systems. Alloy solidification - Interface stability and constitutional supercooling. Solidification by invariant transformation. Solidification of ingots and castings - Inoculation effects. Single crystal growth. Rapid solidification processing. Nucleation and growth of precipitates - age hardening. Spinodal decomposition and ordering reactions. Diffusional and diffusionless transformations - characteristics; nucleation and growth; crystallographic aspects. Case studies.

MATS4064 Thermomechanical Processing

UOC3. Prerequisites: Nil. Lectures/Tutes

Polycrystalline plasticity and origin of deformation microstructure; stored energy; mechanisms of dynamic and static restoration in materials; flow stress; superplasticity; nucleation and growth of new grains; kinetics; effect of purity, solutes and particles; control of grain size; grain growth and secondary recrystallization; deformation and annealing textures; anisotropy of mechanical and physical properties; case studies.

MATS4083 Physical Metallurgy of Alloys

UOC3. Prerequisites: MATS4013. Lectures/Tutes/Labs

Relationship between composition, thermal processing, phase equilibrium, microstructure and properties in ferrous and non-ferrous alloys. Carbon steels: heat treatment, including annealing, normalising, spheroidising, quenching and tempering, austempering and martempering. Cast irons: grey, white mottled malleable and ductile irons. Wrought and cast aluminium alloys, heat treatable and non-heat treatable aluminium alloys. Copper, low-alloy coppers, and copper alloys. Magnesium alloys. Lead, zinc and tin alloys.

MATS4084 Specialty Alloys

UOC3. Prerequisites: MATS4013. Lectures/Tutes

Unit 1 Heat resisting alloys. Microstructure and properties of high temperature alloys based on iron, nickel-iron, nickel and chromium. Strengthening mechanisms. Creep, oxidation and hot corrosion. Coatings and protection. Process metallurgy and applications of high temperature alloys. Unit 2 Light alloys. Production, processing, properties and development of titanium alloys. Advanced aluminium alloys. Rapid solidification of titanium and aluminium alloys. Powder processing of titanium and aluminium alloys. Advanced magnesium alloys. Unit 3 Alloy Steels. Effects of alloying elements on phase equilibrium, kinetics of transformation and microstructure. Hardenability, tempering and embrittlement of quenched steels. Alloy engineering (constructional) steels, tool and die steels, corrosion and heat resistant steels, high strength low alloy steels.

MATS4133 Deformation and Strengthening Mechanisms

UOC3. Prerequisites: MATS4013. Lectures/Tutes

Grain size dependence of strength, solute strengthening, work-hardening, age-hardening, strain ageing. Point defects and the role of point defects in strengthening. Creep, fatigue and high temperature deformation. Twinning. Interfaces.

MATS4213 Fractographic Analysis

UOC3. Prerequisites: MATS4013. Lectures/Labs

Classification of macroscopic and microscopic fracture mechanisms. Initiation and propagation of ductile, brittle, fatigue, stress corrosion, corrosion fatigue and hydrogen induced fractures. Effect of material defects, design deficiencies and incorrect processing on the origin and cause of fracture. Analysis of various modes of fracture using fractographic techniques involving optical microscopy and scanning and transmission electron microscopy. Non destructive testing techniques. Surface analysis techniques. Analysis of service failures.

MATS4333 Fracture Mechanics

UOC3. Prerequisites: Nil. Lectures/Tutes

Linear elastic fracture mechanics: modes of loading, stress intensity factor concept, effect of finite boundaries, energy release rate concept. Fracture toughness testing and evaluation; ASTM E399 and alternative specimen types. Subcritical fracture mechanics; fatigue, stress corrosion cracking. Elastic-plastic fracture mechanics; crack opening displacement, J-integral. Interface mechanics.

MATS5013 Materials Processing

UOC6. *Prerequisites: Nil. Lectures/Tutes/Labs*

Unit 1: Pyrometallurgical Processes - Roasting processes. Blast furnace and alternative ironmaking. BOF and EAF steelmaking. Steel refining. Aluminium smelting. Non-ferrous pyrometallurgical processes. Unit 2: Metal Forming Processes - Deformation and workability. Hot working, cold working, recrystallization. Casting, forging, rolling, extrusion, wire drawing. Processing defects and their avoidance. Unit 3: Ceramic Processing Technologies - Overview of unit operations in ceramic industries. Processing of ceramic raw materials. Ceramic forming processes. Ceramic drying and firing technologies.

MATS5033 Extractive Metallurgy

UOC3. *Prerequisites: MATS5013. Lectures/Tutes/Labs*

Unit 1 Hydrometallurgical Processes- Application of principles of aqueous thermodynamics, electrochemistry, chemical and electrochemical kinetics to hydrometallurgical processes: leaching of minerals and concentrates, solution purification, precipitation, and other separation processes, ion-exchange and liquid-liquid extraction, electrowinning and electrorefining. Unit 2 Light Metals Production - Bayer process. Thermodynamics and kinetics of electrochemical reactions. Aluminium smelting and refining. Hall-Heroult process and alternative technologies. Technologies for magnesium and titanium production. Economics and environmental issues.

MATS5043 Heat, Fluid and Mass Flow in Materials Processing

UOC3. *Prerequisites: MATS1232, MATS1152. Lectures/Tutes/Labs*

In-depth understanding of fundamental principles dictating transport phenomena in materials processing. Development of governing equations related to the transfer of fluid, energy and mass and their inter-dependence based upon fundamentals to analyse and solve problems encountered in current metallurgical operating environments. Application of the understanding developed to the emerging new technologies for metals processing such as direct reduction and smelting for iron making and near net shape casting

MATS5113 Materials Engineering Laboratory

UOC3. *Prerequisites: Nil. Labs/Plant Visits*

A laboratory program designed to illustrate property-structure-processing relationships in materials science and engineering through experimentation and analysis. Laboratory experiments are linked directly to lecture materials taught in MATS1013 Diffusion and Kinetics, MATS2013 Ceramic Materials, MATS3443 Polymer Science and Engineering, MATS4013 Physical Metallurgy, and MATS5013 Materials Processing. Students will be exposed to experimental methods and instruments used for materials characterization as well as processing techniques. Implicit in this course is the cultivation of safe laboratory practices and good experimental techniques, and training in routine property measurements, methods of literature search, reliable data collection, data representation, elementary statistical analysis of data, and writing of technical reports. Two visits to selected manufacturing plants in the Sydney region are compulsory in the course.

MATS5253 Metallurgical Reaction Engineering

UOC3. *Prerequisites: Nil. Lectures/Tutes*

Metallurgical reactor design: batch and continuous reactors. Gas-solid reactions. Limiting laws for gas-liquid reactions in steelmaking processes. Liquid-liquid reactions, design of extractive and refining operations.

MATS5323 Modelling in Materials Engineering 1

UOC3. *Prerequisites: MATH1131, MATH2049. Lectures/Tutes*

The course introduces a range of numerical and analytical modelling techniques and then applies them to situations faced in materials science and engineering. Initially the pre-requisite knowledge is reviewed. Topics then covered are finite difference modelling and finite element

modelling. These techniques are then applied to stress analysis, and heat transfer. A number of commercial software packages are introduced as well as designing computer programs to suit specific situations.

MATS5394 Pollution Control in Materials Processing

UOC3. *Prerequisites: Nil. Lectures/Tutes/Plant Visits*

Pollutants from the different industrial processes. Technical principles and equipment to control the emission of pollutants. Examples of various processes in the metallurgical, ceramic and chemical industries. Pollution control legislation specific to industry and compliance case studies.

MATS5413 Kinetics of Metallurgical Processes

UOC3. *Prerequisites: MATS1013. Lectures/Tutes*

Application of kinetics of heterogeneous reactions to metallurgical processes. Roasting and solid state reduction processes. Calcination. Coal Gasification. Interfacial reactions, Ideal Langmuir isotherm and surface active elements. Reduction of iron oxides from molten slag. Steel decarburisation in BOF. Desulphurisation process. Nucleation and growth. Kinetics of solidification processes. Experimental techniques.

MATS5423 Pyrometallurgy 1

UOC3. *Prerequisites: MATS5013. Lectures/Tutes/Labs*

The course includes two units: Unit 1: Extractive Metallurgy Laboratory, and Unit 2: Metallurgical Plant Practice.

MATS5424 Modelling in Materials Engineering 2

UOC3. *Prerequisites: Nil. Lectures/Tutes*

Principles of mathematical modelling. Types of mathematical models and their main components. Governing equations and boundary/initial conditions. Numerical techniques and computational fluid flow analysis. Application of commercial software packages. Dimensional analysis and application in physical modelling. Surface response methodology. Course examples are drawn from materials engineering practice in a broadest sense.

MATS5244 Pyrometallurgy 2 – Casting

UOC3. *Prerequisites: MATS5013. Lectures/Tutes/Labs/Plant Visits*

Selected topics in ironmaking, steelmaking and nonferrous metallurgy. Electrometallurgy of steel. Ferroalloy making. Casting and solidification.

MATS9410 Materials for Mining Engineers

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Microstructure and structure-property relationships of the main types of engineering materials (metals, polymers, ceramics 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 by thermomechanical processing and application to commercial engineering materials. Laboratory and tutorial work includes experiments on mechanical testing, cast and recrystallised structures, ferrous and non-ferrous microstructures, wear, fracture and failure analysis.

MATS9520 Engineering Materials

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Microstructure and structure-property relationships of the main types of engineering materials (metals, polymers, ceramics 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 by thermomechanical processing and application to commercial engineering materials. Laboratory and tutorial work includes experiments on mechanical testing, cast and recrystallised structures, ferrous and non-ferrous microstructures, and fracture and failure analysis.

MATS9530 Materials Science for Mechanical Engineering

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Materials used in Mechanical Engineering and related fields (Manufacturing Engineering Management, Aerospace Engineering, Naval Architecture) are discussed with emphasis on the dependence of properties and performance on microstructure. Aspects of materials selection during the design of engineering components that affect the service performance in applications, where failure can occur by brittle fracture, corrosion, creep or fatigue, will also be discussed.

Other Schools

ENGG1000 Engineering Design and Innovation

UOC6. *Prerequisites: Nil. Lectures/Tutes/Project*

In this course, students will experience first hand one of the major things that engineers do: designing and building creative solutions to problems. They will learn to think the way that engineers think, coming up with good solutions to problems despite being limited by budget, time and resources, the requirement to also meet environmental and social objectives and of course the limitations of the laws of physics. This will help them to appreciate the central ideas of engineering design as an on-time, on-budget and fit for purpose solution to a poorly specified, open-ended problem. They will be assigned to a team to work over a ten week period to solve a practical problem. The projects on offer change from year to year. In doing all this they will start to build key skills for engineers that will be called upon repeatedly in their academic and professional lives, including concept development, critical thinking and evaluation skills, clear communication, research and information literacy skills and the skills involved in successfully functioning within a team environment to complete a given task.

ENGG1811 Computing for Engineers

UOC6. *Prerequisites: Nil. Lectures/Tutes/Labs*

The objective of this course is for engineering students to acquire sufficient computing skills that allow them to effectively solve computational problems in engineering, design and development, such as simulation, process control, quality control, etc. Topics covered include: introduction to computational problem solving for engineering tasks, such as simulation, process control, etc, introduction to popular applications (such as spreadsheets and database) to solve computational problems in engineering, introduction to emerging Technologies, with the aim to understand their limitations/advantages and how they could be exploited to innovatively and effectively solve engineering problems. No prior computing background is required.

CHEM1011 Fundamentals of Chemistry 1A

UOC6. *Prerequisites: Nil. Lectures/Tutes/Labs*

Elements, compounds and stoichiometry. Basic atomic structure and periodicity. Properties of gases. Thermodynamics (1st Law). Reactions classes. Equilibrium. Acids and bases. Behaviour of oxides, hydroxides, halides. Reactions of organic compounds. Chemical kinetics. Assumed Knowledge: a basic knowledge of chemistry (equivalent to one year of high school chemistry)

CHEM1021 Fundamentals of Chemistry 1B

UOC6. *Prerequisites: CHEM1011. Lectures/Tutes/Labs*

Atomic and molecular structure. Properties of solutions. Solids and solubilities. Aqueous chemistry. Thermodynamics (Second Law, entropy and free energy). Electrochemistry. Mechanisms in organic chemistry.

CHEM1031 Higher Chemistry 1C*

UOC6. Prerequisites: Nil. Lectures/Tutes/Labs

Atomic structure and periodicity. Structure and shapes of molecules. Chemical reactions, rates and mechanisms. Reactions of organic compounds. Includes advanced laboratory work. Assumed knowledge: Equivalent to a good standard in high school chemistry (HSC 2 unit chemistry [75 - 100] or equivalent)

CHEM1041 Higher Chemistry 1D*

UOC6. Prerequisites: CHEM1031. Lectures/Tutes/Labs

Properties of gases. Atmospheric chemistry. Properties of liquids and solids. Solubility and properties of solutions. Thermodynamics and equilibrium. Aqueous chemistry. Electrochemistry. Includes advanced laboratory work.

CHEM2718 Physical Chemistry for Materials Science & Engineering

UOC3. Prerequisites: Nil. Lectures/Tutes/Labs

Thermodynamics; first, second and third laws. Chemical Equilibria. Electrochemistry, electrochemical cells. Chemical kinetics.

MATH1131 Mathematics 1A

UOC6. Prerequisites: Nil. Lectures/Tutes

Complex numbers, vectors and vector geometry, linear equations, matrices and matrix algebra, determinants. Functions, limits, continuity and differentiability, integration, polar coordinates, logarithms and exponentials, hyperbolic functions, functions of several variables. Introduction to computing and the Maple symbolic algebra package. Assumed knowledge: HSC Mathematics Extension 1. Students will be expected to have achieved a combined mark of at least 100 in Mathematics and Mathematics Extension 1.

MATH1141 Higher Mathematics 1A*

UCO6. Prerequisites: Nil. Lectures/Tutes

As for MATH1131 but in greater depth. Assumed knowledge: HSC Mathematics Extension 1 and Extension 2. Students will be expected to have achieved a combined mark of at least 186 in Mathematics Extension 1 and Extension 2.

MATH1231 Mathematics 1B

UOC6. Prerequisites: MATH1131. Lectures/Tutes

Vector spaces, linear transformations, eigenvalues and eigenvectors. Introduction to probability and statistics. Integration techniques, solution of ordinary differential equations, sequences, series, applications of integration.

MATH1241 Higher Mathematics 1B*

UOC6. Prerequisites: MATH1141. Lectures/Tutes

As for MATH1231 but in greater depth.

MATH2049 Mathematics and Statistics for Materials Science A

UOC3. Prerequisites: MATH1231 or MATH1241. Lectures/Tutes

Statistics: graphical data analysis, random variables and their properties, normal and binomial distributions, functions of random variables and their simulation using computers, one and two sample inference methods, simple and multiple linear regression. Mathematics: functions of two variables, double integrals. Note: Available only to students for whom it is specifically required as part of their program.

MATH2059 Mathematics for Materials Science B

UOC3. *Prerequisites: MATH1231 or MATH1241. Lectures/Tutes*

Ordinary differential equations. Partial differential equations. Fourier series. Note: Available only to students for whom it is specifically required as part of their program.

MECH0130 Engineering Drawing and Solid Modelling

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

Communication of form and layout of real world objects, solid modelling of objects. Engineering drawing layouts, orthogonal projections, dimensioning, tolerancing and standard drawing symbols, principles of detail design drawings and assembly drawings. Use of computer graphics and production of drawings.

MECH0440 Engineering Statics

UOC3. *Prerequisites: Nil. Lectures/Tutes*

Composition and resolution of forces, laws of equilibrium. Friction. Statics of rigid bars, pin-jointed frames and beams. Simple states of stress. Statics of fluids.

NANO3420 Fabrication of Nanostructured Devices

UOC3. *Prerequisites: Nil. Lectures/Tutes*

Material processes used in the fabrication of electronic devices such as single crystal growth, implantation, lithography, etching and thin film growth. Methods of device packaging. Sources of failure and methods of fault diagnosis in devices.

PHYS1121 Physics 1A

UOC6. *Prerequisites: Nil. Lectures/Tutes/Labs*

Motion in a line and a plane. Oscillations. Motion of particles under the influence of mechanical, electrical, magnetic and gravitational forces. Rotational motion. Force, inertial mass, energy, momentum. Charge, potential, electric and magnetic fields. Capacitors, dielectrics. Electric current and circuits. Conservation principles applied to problems involving charge, energy and momentum.

PHYS1131 Higher Physics 1A*

UOC6. *Prerequisites: Nil. Lectures/Tutes/Labs*

Vectors, kinematics, particle dynamics, work and energy, the conservation of energy, conservation of linear momentum, rotational kinematics and dynamics, simple harmonic motion, gravitation. Electrostatics, magnetostatics in vacuum, ferromagnetism, electromagnetic induction.

PHYS1221 Physics 1B

UOC6. *Prerequisites: PHYS1121. Lectures/Tutes/Labs*

Waves in elastic media: application of wave theories to optical and acoustical phenomena such as interference, diffraction and polarisation. Properties of matter: solids, liquids, gases. Fluids and thermal physics. Inductance and electric circuit transients. Alternating current circuit theory.

PHYS1231 Higher Physics 1B*

UOC6. *Prerequisites: PHYS1131. Lectures/Tutes/Labs*

Temperature, heat and the first law of thermodynamics, kinetic theory of gases. Waves in elastic media, sound waves, interference, diffraction, gratings and spectra, polarisation. Relativity, quantum physics, wave nature of matter.

CEIC6205 Fuel and Energy 1

UOC3. *Prerequisites: Nil. Lectures/Tutes/Plant Visits*

Enrolment Requires School Approval - Current energy resources and alternatives for the future. Basic principles of fuel conversion processes: gasification, carbonisation, oil refining etc. Introduction to combustion of solid, liquid and gaseous (fossil) fuels.

INDC3070 Instrumentation and Process Control 1

UOC3. *Prerequisites: MATH2021, CEIC2010. Lectures/Tutes*

Analogue Computation: theory and application of basic analogue computing elements; magnitude and time scaling; solution of linear differential equations. Instrumentation: theory and application of transducers and transmitters for measurement of process variables. Process Dynamics: behaviour of linear, lumped parameter dynamics systems; first, second and higher order and integrating systems. Process Control closed loop, block diagrams, controllers and controller tuning.

MINE3800 Mineral Processing

UOC3. *Prerequisites: Nil. Lectures/Tutes/Labs*

This introductory course provides a description of the principal unit processes and their applicability, and of the mineral properties and characteristics of mined materials on which they are based. Topics include: Rocks, minerals and ores. Grades, recoveries. Materials balances. Liberation. Comminution (crushing and grinding). Screening. Size classification. Dry and water-based separation processes. Dense media separation. Surface properties of liquids and solids. Froth flotation. Leaching processes. Screens and centrifuges. Flocculation and thickening. Filtration. Tailings disposal. A series of laboratory investigations forms part of the course. Assumed Knowledge: PHYS1169, CHEM1817, MINE2500 (or equivalents)

FUEL0040 Fuel Engineering for Ceramic Engineers

UOC3. *Prerequisites: Nil. Lectures/Tutes/Plant Visits*

An introduction to combustion technology, combustion calculations, burner design, furnace, kiln and boiler thermal design.