
FACULTY OF ENGINEERING AND DESIGN

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Faculty of Engineering and Design

Academic Integrity

ACADINT A01

0 Points

Academic Integrity Course

An online course designed to increase student knowledge of academic integrity, university rules relating to academic conduct, and the identification and consequences of academic misconduct. Students work through a series of modules, outlining scenarios that they may encounter while studying at university. Each scenario provides information on relevant rules, resources and expected behaviour.

Aerospace Engineering

Postgraduate 700 Level Courses

AEROSPCE 720

15 Points

Space Dynamics and Missions

Classical orbital mechanics and dynamics of spacecraft. Application of this knowledge in mission design for achieving pre-specified objectives and adequate spacecraft pointing. Examples of past missions.

AEROSPCE 730

15 Points

Aerospace Systems Design

Systems engineering for aerospace systems design. Current practice and standard methods to reach a preliminary design review stage are taught, encompassing requirements translation, functional analysis, budgeting, and stakeholder engagement (including Mātauranga Māori perspectives). Overview of major aircraft and satellite subsystems (such as structure, propulsion, aerodynamics), initial vehicle sizing, and the impact of the operational environment on these vehicles.

AEROSPCE 740

15 Points

Aerospace Structures and Mechanisms

Overview of the main issues to be addressed during the structural design process of aircraft and spacecraft, including space mechanisms. Includes requirements definition, analysis processes, materials selection, manufacturing, and typical aircraft and spacecraft configurations.

AEROSPCE 791

45 Points

AEROSPCE 791A

15 Points

AEROSPCE 791B

30 Points

Research Project (Aerospace Engineering) - Level 9

Prerequisite: Departmental approval

To complete this course students must enrol in AEROSPCE 791 A and B, or AEROSPCE 791

AEROSPCE 792A

45 Points

AEROSPCE 792B

45 Points

Thesis (Aerospace Engineering) - Level 9

Prerequisite: Departmental approval

To complete this course students must enrol in AEROSPCE 792 A and B

AEROSPCE 793A

30 Points

AEROSPCE 793B

60 Points

Thesis (Aerospace Engineering) - Level 9

Prerequisite: Departmental approval

To complete this course students must enrol in AEROSPCE 793 A and B

Architectural Design

Stage I

ARCHDES 103

15 Points

Design 2

The Formal: An introduction, in studio format, to the discipline of architectural organisation and form-making. Re-examines the traditional notions of typology, precedent, geometry, parti and diagrams. Emphasises strategies that build on and transform understanding for organising form given contemporary programmes and modes of representation.

Restriction: ARCHDES 101

Stage II

ARCHDES 200

30 Points

Design 3

The Domestic: Exploring through design those things both familiar and unfamiliar in our understanding of home, family, privacy, identity, and community. Examines both the most intimate and the most exposed aspects of dwelling. Emphasises the role of precedent in design and addresses scales ranging from the room to the block.

Prerequisite: ARCHDES 100 or 102 or BLTENV 101

ARCHDES 201

30 Points

Design 4

The Constructed: An introduction to architectural practice as a complex and collaborative enterprise. Offers the opportunity to explore materials, construction, fabrication processes, and detailing, through making. Requires students to understand the full range of drawings required to move from design concept to actual construction.

Prerequisite: ARCHDES 101 or 103

Stage III

ARCHDES 300

30 Points

Design 5

The Experimental: Students will be exposed to experimental approaches to architectural design that seek to expand the field of architecture. Highlights the role and agency of media in explorative architectural pursuits.

Prerequisite: ARCHDES 200

ARCHDES 301

30 Points

Design 6

The Integrated: The culmination of all aspects – conceptual, formal, material, tectonic, environmental, structural – of architectural design within the context of a larger network of infrastructural services. Also requires an understanding of the full range of drawings describing the workings of the building as both an active ‘machine’ and place for human comfort.

Prerequisite: ARCHDES 200, and 201 or 300

ARCHDES 302

30 Points

Directed Study

A topic approved by the Head of School of Architecture and Planning.

Prerequisite: ARCHDES 300 and 301 or Departmental approval

Postgraduate 700 Level Courses

ARCHDES 700

30 Points

Advanced Design 1

A studio based inquiry into an architectural topic approved by the Head of School of Architecture and Planning

intended to facilitate in-depth study that is both tailored to a student's own interest and aligned with the School's research clusters, sharing workshops, discussions, pin-ups and tutorials.

ARCHDES 701 **30 Points**
Advanced Design 2

A studio based inquiry into an architectural topic approved by the Head of School of Architecture and Planning intended to facilitate in-depth study that is both tailored to a student's own interest and aligned with the School's research clusters, sharing workshops, discussions, presentations and tutorials.

ARCHDES 702 **30 Points**
Adaptive Reuse

A studio-based inquiry into an architectural topic in the field of adaptive reuse, approved by the Head of School of Architecture and Planning.

Prerequisite: Head of School approval

ARCHDES 796A **60 Points**

ARCHDES 796B **60 Points**

Thesis - Level 9

A thesis involving a design-based discourse on a topic approved by the Head of School of Architecture and Planning for the degree of Master of Architecture (Professional) under the guidance of an appointed supervisor.

Prerequisite: Students must have completed the taught component of their programme

To complete this course students must enrol in ARCHDES 796 A and B

ARCHDES 797A **30 Points**

ARCHDES 797B **60 Points**

Thesis - Level 9

A thesis involving a design-based discourse on a topic approved by the Head of School of Architecture and Planning for the Degree of Master of Architecture (Professional) and Urban Planning (Professional).

Prerequisite: ARCHDES 700, 701, ARCHGEN 703 or ARCHPRM 700, ARCHPRM 701, URBPLAN 701-708

To complete this course students must enrol in ARCHDES 797 A and B

Architectural History, Theory and Criticism

Stage I

ARCHHTC 102 **15 Points**

Modern Architecture and Urbanism

Examines through case studies the cultural contexts that shaped the development of architecture, urban design, landscape and the environment during the twentieth century. Emphasis is placed on the historical developments that influenced changes in style and the theoretical contexts that shaped attitudes towards inhabitation, social organisation, national identity, and cultural self-expression, amongst other things.

Restriction: ARCHHTC 100

Stage II

ARCHHTC 237 **15 Points**

Postmodern and Contemporary Architecture and Urbanism

Examines architectural and urban history and theory from the postmodern to the recent and contemporary.

Prerequisite: ARCHHTC 102

Restriction: ARCHHTC 235, 236

Stage III

ARCHHTC 341 **15 Points**

Premodern Architecture and Urbanism

Examines topics in pre-modern architectural and urban history and theory across the continents of Eurasia, Africa, the Americas, Australia and Oceania.

Prerequisite: ARCHHTC 237

Restriction: ARCHHTC 339, 340

ARCHHTC 376 **15 Points**

Directed Study

Postgraduate 700 Level Courses

ARCHHTC 700 **15 Points**

Pacific Architecture

Examines architectural history and practice in the Pacific region from ancient sites to the present day. Explores design from all periods, with a view to informing future design through consideration of climate, culture, society, materials and economics.

ARCHHTC 701 **15 Points**

Architecture and Political Philosophy

Examines the political role of architecture and urban space with emphasis on works of Michel Foucault. Analysis of the ways in which architecture constructs habits and habitats in relation to philosophical concepts.

ARCHHTC 702 **15 Points**

History of Housing in Aotearoa New Zealand - Level 9

A research-based examination of New Zealand's more than 100-year history of building housing at medium and high densities. Includes analysis of exemplars.

ARCHHTC 704 **15 Points**

Special Topic

Architectural Media and Fabrication

Stage I

ARCHDRC 104 **15 Points**

Architectural Media 2

Examines specific types of representation – both freehand and digital – used in architectural media to develop concepts, evaluate architectural thinking and describe and refine design projects.

Restriction: ARCHDRC 202

Stage II

ARCHDRC 203 **15 Points**

Architectural Media 3

Explores the relationship between methods of architectural drawing and the three-dimensional communication of fabrication and assemblage. Central to this investigation

is an understanding of how drawing is evolving in relation to new technologies.

Prerequisite: ARCHDRC 103, 104 or BLTENV 103

Restriction: ARCHDRC 301, 303, 304, 370, 371, 372, 373

Postgraduate 700 Level Courses

ARCHDRC 700 15 Points

Advanced Digital Fabrication

Covers fabrication technologies and materials, practical experimentation with a range of fabrication tools and an introduction to current research and development.

ARCHDRC 701 15 Points

Timber Fabrication

Covers fabrication technologies with timber materials. Includes the design and realisation of a small timber building through the preparation of concept plans, developed design plans and a scale models.

ARCHDRC 702 15 Points

Special Topic: Architectural Drawing

Builds a research literature review that supports architectural drawing and design processes, including historical overview of conceptual approaches and applications of drawing, scale and linearity, time and duration, exhibition and documentation, leading to production of series of drawings.

ARCHDRC 703 15 Points

Special Topic

ARCHDRC 704 15 Points

Digital Reconstruction of Buildings

Examines the digital documentation, recording and reconstruction of buildings from 3-D scanning to 3-D modelling.

Prerequisite: ARCHDRC 203

Architectural Professional Studies

Stage III

ARCHPRM 305 15 Points

Project Management

Professional practice and the practical demands of managing construction. Explores the roles of architect, client, builder and consultants; land, building, planning and environmental legislation; the consenting processes that precede construction; documentation; cost and quality management; procurement; contract law; construction contracts; site observation; contract administration and progress payments; completion; final accounts; and post-project procedures.

Prerequisite: ARCHTECH 210

Restriction: ARCHPRM 304, 700

Postgraduate 700 Level Courses

ARCHPRM 700 15 Points

Project Management

The management of the building project from inception to tendering. An examination of client needs and agreements, feasibility studies, project constraints, cost planning and control, consultants, administration and quality control. An analysis of all aspects of the contracts and documentation during construction and final project accounts.

Restriction: ARCHPRM 304, 305

ARCHPRM 701 15 Points

Practice Management

The New Zealand legal system and the law of contract and torts; negotiations, negligence, disputes and remedies relevant to architects in practice. An examination of the requirements for establishing and maintaining an architectural practice as a business venture as well as strategic market management, financial planning, insurance and taxation.

ARCHPRM 702 15 Points

Architectural Project Management

Examines the theory and practice of managing a building construction project. Explores advanced models of project organisation, procurement, construction contracts, time and cost management and efficient delivery methods.

ARCHPRM 703 15 Points

Transnational Professional Practice

Examines the theory and practice of how the built environment is designed and constructed when the architect is operating in a foreign field. Utilising problem-based learning and case studies, the student will assume the role of the alien designer who curates context and thus encounters: the vernacular, regionalism, internationalism and indigeneity.

ARCHPRM 704 15 Points

Special Topic

ARCHPRM 705 15 Points

Special Topic

Architectural Technology and Sustainability

Stage II

ARCHTECH 207 15 Points

Design Technology 1

Development of structural and construction principles and systems for small-scale and residential buildings. Characteristics and behaviour of common building materials. Building components and detailing. Outline of building codes, health and safety regulations and site operations. Active building services and technologies for residential housing, including heating, cooling, ventilation, water, waste, electrical services and vertical transportation. Application to design studio projects.

ARCHTECH 210 15 Points

Environmental Design 1

Climate, context and energy consideration in buildings. Heat transfer and energy balances. Thermal comfort through passive solar systems, materials and building services in small-scale and residential buildings. Integrating renewable energy sources in building design. Indoor air quality and natural ventilation. Air-tightness and moisture control. Daylight performance of buildings and visual comfort. Behaviour of sound and noise and their control for human comfort.

Prerequisite: ARCHTECH 108 or BLTENV 102

Restriction: ARCHTECH 208

Stage III

ARCHTECH 314 15 Points

Environmental Design 2

Indoor environmental quality for complex, large scale and multi-storey buildings. Requirements of the New Zealand Building Code for energy efficiency and human

comfort. Design strategies and innovative materials for high-performance buildings. Qualitative and quantitative approach to sustainable practices. Simulation tools, measurements and techniques. Natural resources, materials optimisation and building reuse. Sustainability and resilience at the urban scale.

Prerequisite: ARCHTECH 210

Restriction: ARCHTECH 307

ARCHTECH 315 15 Points

Design Technology 2

Development of construction and structural principles for complex, large-scale and multi-storey buildings. Investigation of façade technology, material selection and detailing, as applied in practice. Development of factors affecting buildability, fire protection and building code requirements. Application to design studio projects through drawing and prototyping.

Prerequisite: ARCHTECH 207

Restriction: ARCHTECH 312

Postgraduate 700 Level Courses

ARCHTECH 706 15 Points

Building Materials and Technologies

Explores the selection and integration of appropriate materials, components and systems in relation to the different contexts, scales and stages of the design, documentation, procurement and construction of projects, in alignment with the National Standard of Competency for Architects.

Restriction: ARCHTECH 307, 312, 314, 315

ARCHTECH 707 15 Points

Designing with Resilience Thinking

Examines resilience in the built environment, from reviewing the literature on resilience to analysing case studies and developing strategies to enhance resilience in architecture.

ARCHTECH 708 15 Points

Advanced Building Technologies

Examines how responsive skins can be used to improve building performances. Explores the development of building technologies in the Asian and Oceania regions of the Pacific Rim.

Prerequisite: ARCHTECH 314 and 315

ARCHTECH 709 15 Points

Sustainable and Healthy Housing

Examines the current issues of performances and indoor environmental quality in Aotearoa's housing. Explores strategies, technologies and materials for designing and retrofitting sustainable, resilient and healthy housing.

Prerequisite: ARCHTECH 314 and 315

ARCHTECH 710 15 Points

Special Topic

Architecture General

Postgraduate 700 Level Courses

ARCHGEN 702 15 Points

Research Process

An introduction to the research process including: research paradigms and strategies, the identification of research topics and research questions, the review and critique of literature, research methodologies, the structuring of research theses and reports, referencing and the preparation of a bibliography. The focus of the course is

on preparing students to undertake their own research projects.

Restriction: ARCHGEN 400, 700

ARCHGEN 703 15 Points

Design as Research

Examines the literature on, and approaches to, research by design. Considers research processes and architectural design processes, and the ways in which these processes might be creatively combined in the context of a Masters level design thesis, in order that the thesis process and outcomes might meet the expectations of a research-based thesis.

Restriction: ARCHGEN 300

ARCHGEN 704 15 Points

Directed Study

Prerequisite: Departmental approval

ARCHGEN 711 15 Points

Special Topic

Restriction: ARCHGEN 710, 712-716

ARCHGEN 712 15 Points

Special Topic

Restriction: ARCHGEN 710, 711, 713-716

ARCHGEN 713 15 Points

Special Topic

Restriction: ARCHGEN 710-712, 714-716

ARCHGEN 714 15 Points

Special Topic

Restriction: ARCHGEN 710-713, 715, 716

ARCHGEN 715 15 Points

Special Topic

Restriction: ARCHGEN 710-714, 716

ARCHGEN 733 15 Points

Public Urban Space in the Contemporary City

Examines the role of public urban space in the city and how history, geography, culture, physical connections and architectural form contribute to its formation. Explores how contemporary cities are transforming their urban environments through design.

Restriction: ARCHGEN 730-732, 734-735, URBDES 702

ARCHGEN 744 15 Points

Special Topic

Restriction: ARCHGEN 740-743, 745

ARCHGEN 750 15 Points

Heritage Processes

Examines heritage conservation legislation, policy, guidelines and processes. Includes international context as well as New Zealand laws and processes.

ARCHGEN 751 15 Points

Heritage Assessment and Conservation Planning - Level 9

Examines the assessment of cultural heritage value and the use and preparation of conservation plans to guide heritage conservation work. Coursework comprises the researching and writing of a conservation plan.

ARCHGEN 752 15 Points

Conservation of Materials

Examines the theory and practice of conserving materials commonly found in heritage buildings and artefacts, including stone, brick, timber, concrete and steel.

ARCHGEN 753 15 Points**Diagnosis and Adaptation**

Examines the investigation of existing building fabric, diagnosis of issues impacting upon the state of repair or the level of comfort, and the adaptation of heritage buildings, including strengthening, energy upgrading, reuse and the design of additions and alterations.

ARCHGEN 754 30 Points**Research Project - Level 9**

A research project in the field of heritage conservation which may include an internship. Placements and topics to be approved by the Head of School of Architecture and Planning.

Prerequisite: ARCHGEN 750, 751

ARCHGEN 790 30 Points**ARCHGEN 790A 15 Points****ARCHGEN 790B 15 Points****Research Project - Level 9**

Restriction: ARCHGEN 793, 795

To complete this course students must enrol in ARCHGEN 790 A and B, or ARCHGEN 790

ARCHGEN 793A 60 Points**ARCHGEN 793B 60 Points****Thesis - Level 9**

A study of research processes, together with a thesis involving a discourse on a topic approved by the Head of School of Architecture and Planning for the degree of Master of Architecture under the guidance of an appointed supervisor.

Restriction: ARCHGEN 795, 796, 797

To complete this course students must enrol in ARCHGEN 793 A and B

ARCHGEN 795A 45 Points**ARCHGEN 795B 45 Points****Thesis - Level 9**

A study of research processes, together with a thesis involving a discourse on a topic approved by the Head of School of Architecture and Planning for the degree of Master of Architecture under the guidance of an appointed supervisor.

Restriction: ARCHGEN 793, 796, 797

To complete this course students must enrol in ARCHGEN 795 A and B

ARCHGEN 799 60 Points**ARCHGEN 799A 30 Points****ARCHGEN 799B 30 Points****Research Report - Level 9**

A report involving research and application in an architectural subject for the Postgraduate Diploma in Architecture under the guidance of appointed supervisor on a topic approved by the Head of School of Architecture and Planning.

Prerequisite: ARCHGEN 700 or 702

Restriction: ARCHGEN 798

To complete this course students must enrol in ARCHGEN 799 A and B, or ARCHGEN 799

Bioengineering**Postgraduate 700 Level Courses****BIOENG 721 15 Points****Physics of Physiology**

Develops skills in creating and using physics-based

mathematical models of physiological processes. Focuses on using integrative and hierarchical modelling approaches to scale models from the protein function level to cell and tissue function and then to models of organ physiology and systems physiology at the whole-body level.

BIOENG 741 15 Points**The Bioengineering Toolbox**

Principles and practice of techniques used to develop, construct and use devices and systems for conducting precise measurements in bioengineering research. Application of modern tools for extracting useful biological or physiological information directly from the measured data.

BIOENG 789 30 Points**Bioengineering Research Project - Level 9**

Supervised research on a topic of interest in bioengineering assigned by the Director of the Auckland Bioengineering Institute. Requires independent thought and action to investigate the topic in depth and produce an analysis of the problem and its solution using appropriate analytical, computational and/or experimental techniques culminating in a single sole-authored written report.

BIOENG 796A 60 Points**BIOENG 796B 60 Points****ME Thesis (Bioengineering) - Level 9**

Students are required to submit a thesis on a topic assigned by the Director of Bioengineering.

To complete this course students must enrol in BIOENG 796 A and B

Biomedical Engineering**Stage II****BIOMENG 221 15 Points****Mechanics of Engineered and Biological Materials**

Introduction to the laws of conservation of mass, linear momentum, angular momentum and energy and their application to engineering problems. Topics include control volume analysis, fluid statics, Bernoulli's equation, heat conduction, diffusion, linear elasticity, stresses and strains specific to direct and torsional loading, material constitutive relationships (including anisotropy, nonlinearity, and viscoelasticity), axial and transverse loading, and pressure loading of engineering structures and biomaterials.

Prerequisite: ENGGEN 150, or ENGSCI 111, or a B+ or higher in MATHS 108 or 110, or a B+ or higher in MATHS 120 and 130

BIOMENG 241 15 Points**Instrumentation and Design**

An introduction to engineering instrumentation related to the measurement of biological signals, including a group project on the design methodology of instrumentation systems. Topics include: fundamentals of measurement systems (electric circuits, basic electronics, frequency domain signal analysis and transient analysis, measurement systems), engineering design (teamwork, communication, safety in design and professional responsibility, software tools, material and manufacturing process selection).

Prerequisite: ELECTENG 101

BIOMENG 261 15 Points**Tissue and Biomolecular Engineering**

Overview of molecular and tissue engineering principles emphasising biochemical kinetics, gene regulation, cell behaviour and biomedical ethics. Laboratory practice

and design project in cell culture and molecular biology techniques. Topics include enzymes and regulation of metabolic pathways, thermodynamic principles of biochemical reactions, systems biology and regulatory motifs in biochemical networks, cell culture techniques, research and medical ethics.

Prerequisite: BIOSCI 107, ENGSCI 211

Restriction: BIOMENG 361

BIOMENG 299 0 Points

Workshop Practice

Restriction: ENGGEN 299

Stage III

BIOMENG 321 15 Points

Continuum Modelling in Bioengineering

An introduction to continuum modelling approaches to bioengineering problems across a range of spatial scales. Topics include: tensor analysis, molecular and cellular mechanics of striated muscle; finite deformation elasticity and constitutive relations for soft biological materials; conservation equations for momentum, mass and heat transfer in fluids; viscous flow; boundary layers; pure conduction and diffusion; advective transport of mass and heat.

Prerequisite: BIOMENG 221, ENGSCI 211

Restriction: ENGSCI 343

BIOMENG 341 15 Points

Bioinstrumentation and Design

Sensors and actuators (temperature, position, force, pressure, flow, bioelectric, optical sensors and instruments). Signals, systems and controls (s-domain signal notation, transfer functions, frequency response functions, block diagrams, the Laplace transform, first and second order systems, characterisation methods, fundamentals of control). Bioinstrumentation design methodology and group design project integrating professional engineering considerations.

Prerequisite: BIOMENG 241

Postgraduate 700 Level Courses

BIOMENG 771 15 Points

Musculoskeletal and Orthopaedic Biomechanics

Topics that biomechanical and orthopaedic engineers use in research and industry. Includes guest lectures from practitioners. Orthopaedic engineering topics cover implant design, material choice, implant stress shielding and bone loss, implant wear and bone remodelling. Musculoskeletal biomechanics topics cover motion capture, inverse kinematics and dynamics, muscle force evaluation, electromyography (EMG), inertial sensors and applications in sports medicine and rehabilitation.

Prerequisite: 15 points from ENGSCI 311, 313, 314

BIOMENG 791 15 Points

Advanced Biomedical Engineering Design

An engineering project requiring the application and integration of material taught in technical and professional engineering courses to the design of medical devices and software to meet client needs. The project also requires consideration of ethical issues, social impact, safety in design, and international regulations.

Prerequisite: BIOMENG 341, and a further 45 points from non-elective courses listed in Part III of the BE(Hons) Schedule for Biomedical Engineering

BIOMENG 792 15 Points

Special Topic

BIOMENG 793 15 Points

Special Topic

BIOMENG 794 15 Points

Special Topic

Built Environment

Stage I

BLTENV 101 15 Points

People, Place and Design Studio

Introduces the conceptual and material domains in which architecture and urban planning operate, making connections to the cultural, physical, formal, social and political dimensions of design in the built environment, emphasising the development of skills and abilities in conceptual thinking, design realisation and representation.

BLTENV 102 15 Points

Environmental and Social Justice

Focuses on developing an ethical understanding of the built environment through the lens of social and environmental justice in order to plan and design fairer habitats, and a critical assessment of social and environmental crises through urban and architectural case studies to develop the knowledge and skills necessary to transition to more sustainable and equitable built environments.

BLTENV 103 15 Points

Media for Spatial Practices

Introduces media processes and methods for spatial practices and designed environments to support design studio practice, and an overview of the analytical and critical values of these techniques for design.

Chemical and Materials Engineering

Stage I

CHEMMAT 121 15 Points

Materials Science

Introduction to materials science starting with the fundamentals of atomic structure and bonding and how this builds up a microstructure to create a solid. Metals, polymers, ceramics, electronic materials, composite and biomaterials will be covered and the properties, advantages and disadvantages of each discussed. Considerations such as corrosion, degradation and failure will be studied with a focus on improving design and creating new materials for our future world.

Stage II

CHEMMAT 201 15 Points

Process Engineering 1: Introduction

Materials and energy balances with and without chemical reaction, materials and energy balances in multiphase systems such as crystallisation, evaporation, drying, humidification, dehumidification, absorption, distillation, extraction and filtration. An introduction to the most important unit operations in the chemical industry, design concept and safety as applied to processing.

Prerequisite: CHEM 110 or 120 or ENGGEN 140

Restriction: CHEMMAT 211

CHEMMAT 202 15 Points**Process Engineering 2: Energy and Processing**

Introduction to thermodynamics for process engineering. The first and second laws of thermodynamics. Application of thermodynamic concepts in closed systems, flow processes and cycles, refrigeration and liquefaction. Classical chemical thermodynamics including concepts of chemical potential, fugacity and activities; their applications to vapour-liquid equilibria and reacting systems. Multi-component physical equilibria. Multiple reaction equilibria and system-free energy minimisation. Practical examples and applications.

Restriction: CHEMMAT 212

CHEMMAT 203 15 Points**Process Engineering 3: Transfer Processes**

Fluid properties and statics (specific gravity, viscosity, surface tension, flow types, manometry). Modelling fluid motion (Bernoulli equation. Dimensional analysis and similitude: Reynolds Number, Friction factor, Prandtl number). Flow measurement (pumps/pumping and valves). Heat transfer including: steady state conduction, convection and radiation; and effects of geometry, force and natural convection. Heat transfer processes (correlation with flow processes, heat transfer coefficients). Applications.

Restriction: CHEMMAT 213

CHEMMAT 204 15 Points**Materials**

Solid state transformation – diffusion, vacancies, solidification, nucleation and growth. Dislocations and plastic deformation, strengthening mechanisms. Mechanical performance of materials. Iron-carbon alloy systems and transformations (including pearlitic, austenitic, bainitic and martensitic), effects of alloying elements. Analytical methods: X-ray diffraction and electron microscopy.

Prerequisite: CHEMMAT 121

Restriction: CHEMMAT 221

CHEMMAT 205 15 Points**Process Design 1**

Mechanics of solids and analysis of stress and strain. Introduction to materials selection. Design of thin walled pressure vessels. Application to the design of vessels, tanks, reactors, piping and heat transfer equipment. Introduction to the chemical industry, unit operations, line diagrams and process equipment. Report writing and oral communication skills.

Prerequisite: ENGGEN 121 or equivalent

Restriction: CHEMMAT 231, 232

CHEMMAT 206 15 Points**Applied Chemistry**

Fundamental chemistry required for chemical engineering and materials engineering. Topics may include phase equilibrium, reaction kinetics, thermodynamics, surface chemistry, electrochemistry and polymer chemistry. This course will have an emphasis on problem definition and solution.

Prerequisite: 15 points from ENGGEN 140, CHEM 110, 120

Restriction: CHEMMAT 242

CHEMMAT 299 0 Points**Workshop Practice**

Restriction: ENGGEN 299

Stage III**CHEMMAT 301** 15 Points**Transfer Processes 2**

Principles of continuous and staged processes. Mass transfer in various media, systems and phases. Interrelating equipment design to mass transfer processes. Studies of selected separation processes such as absorption, solvent extraction, distillation, and membrane processes.

Prerequisite: CHEMMAT 203 or 213, and CHEMMAT 242 or 206

Restriction: CHEMMAT 312

CHEMMAT 302 15 Points**Advanced Process Engineering**

An in-depth analysis of selected topics that influence the design, operation, and performance of process plants. Topics include: particulate technology, particle mechanics and particle motions, non-Newtonian fluid flow, two-phase solid-liquid and gas-liquid flow, computational fluid dynamics, flow through porous media and packed beds, filtration, centrifugation, fluidisation, variable-analysis of variations in materials and product processing, membrane separation methods and optimisation techniques.

Prerequisite: CHEMMAT 203 or 213

Restriction: CHEMMAT 313, 316, 411

CHEMMAT 303 15 Points**Chemical Reactor Engineering**

Kinetics of multiple reactions, analysis of basic reactors – batch, plug flow, and continuous stirred tank. Performance under isothermal, adiabatic, and varying temperature. Effect of semi-continuous, counterflow and recycle on performance. Heterogeneous reactions and catalysis, diffusion and reaction in porous catalysts, effects of external mass transfer resistance, fixed and fluidised bed reactors, gas-liquid reactors. Reactor engineering for biological and electrochemical systems.

Prerequisite: CHEMMAT 202 and 206, or CHEMMAT 212 and 242

Restriction: CHEMMAT 315

CHEMMAT 304 15 Points**The Future of Energy**

Discussion of topical and significant developments in the field of energy transformation, usage and storage in the context of climate change, both globally and in New Zealand. Topics include: energy efficiency, energy storage and applications, sustainability, non-renewable and renewable power generation.

Prerequisite: CHEMMAT 201 or 211

Restriction: CHEMMAT 317

CHEMMAT 305 15 Points**Materials Processing and Performance**

Materials processing and performance are critical components of a materials science and engineering degree. This course examines the processing and performance of metals, polymers and ceramics. Topics include metal-making, casting, forming, and forms of degradation, such as corrosion. Emphasis is placed on materials applications for process engineering.

Prerequisite: CHEMMAT 204 or 221

Restriction: CHEMMAT 321, 322, 421

CHEMMAT 306 15 Points**Process Design 2**

The nature and function of design – process conception, alternatives, constraints and their simulation. Raw materials, safety and environmental considerations. Flow sheet representation of information. Separation systems,

heat exchanger networks, and specification of equipment.
Process economics and project documentation.
Prerequisite: CHEMMAT 201 or 211, and CHEMMAT 205 or 232
Restriction: CHEMMAT 331, 756

Postgraduate 700 Level Courses

CHEMMAT 712 15 Points
Directed Study in Chemical Engineering

CHEMMAT 713 15 Points
Advanced Chemical Engineering - Level 9
An independent study in advanced topics, current issues, new trends and developing technologies relevant to the field of chemical engineering, for example energy and environment, alternative fuels, process modeling and control. Topics are informed and supervised by leading researchers in the field and students develop critical assessment, report writing and oral communication skills through independent projects and seminars.

CHEMMAT 717 15 Points
Electrochemical Engineering
The thermodynamics of aluminium electrolysis; heat and mass balance; components of the cell voltage; anode effect and its mitigation, resistance and voltage tracking; cell magnetism and magnetic modelling.
Corequisite: CHEMMAT 718, 726, 727

CHEMMAT 718 15 Points
Aluminium Reduction Process Operations
Monitoring overall aluminium cell performance – what are the appropriate parameters to measure, how are they measured and how are they used for process control? Optimising cell performance, scheduling of operations, dealing with process excursions, metal treatment and quality. Novel cell designs.
Corequisite: CHEMMAT 717, 726, 727

CHEMMAT 720 15 Points
Materials Design and Processing
Materials processing of metals, ceramics and polymers. Phase transformation. Microstructural development during materials processing. Case studies of materials selection in product design.

CHEMMAT 721 15 Points
Advanced Materials - Level 9
An advanced course with emphasis on new developments in materials science and engineering and their impact on technology and society, for example surface engineering, nanomaterials and composites, alloy development, high performance ceramics, powder processing, biomaterials. Students develop critical assessment, report writing and oral communication skills through independent projects and seminars.

CHEMMAT 722 15 Points
Directed Study in Materials
Directed study in materials science and engineering.

CHEMMAT 723 15 Points
Industrial Materials Engineering
Exploration of materials in an industrial context, including industrial metals and alloys, high temperature corrosion, surface engineering, welding, powder metallurgy and additive manufacturing.
Restriction: CHEMMAT 754

CHEMMAT 724 15 Points
Advanced Materials Characterisation - Level 9
The underlying theory essential to understanding modern methods of advanced materials analysis including: electron microscopy, surface analysis, atomic force microscopy and nanoindentation. Teaching is highly research informed with examples drawn from the Research Centre for Surface and Materials Science (RCSMS) and involves principles, practical experience and independent project work related to the application of these techniques.
Prerequisite: CHEMMAT 305 or 322

CHEMMAT 725 15 Points
Advanced Functional Materials
Electronic properties of materials. Functional properties. Materials applications for energy storage, environmental protection and resource recovery. Nanomaterials and nanotechnology.
Restriction: CHEMMAT 755

CHEMMAT 726 15 Points
The Light Metals Industry
An overview of the light metals, Ti, Al and Mg, their chemistry, metallurgy and processing. It also deals with trends in the global light metals production and uses and recent advances in extending applications for these materials; economics of feedstock and materials selection and availability; power supply and management; efficient use of equipment and resources; and environmental issues.
Corequisite: CHEMMAT 717, 718, 727

CHEMMAT 727 15 Points
Materials Performance and Selection for Light Metals Processing
Performance requirements of anodes, cathodes, cell refractories and other aluminium cell construction materials are assessed. Techniques for monitoring materials performance in operation and post operation (autopsies) are discussed. This course also covers materials specifications, how well they predict performance in the aluminium cell as well as the relationship between the fabrication of the cell components and their performance. New materials.
Corequisite: CHEMMAT 717, 718, 726

CHEMMAT 732 30 Points
CHEMMAT 732A 15 Points
CHEMMAT 732B 15 Points
Advanced Design Project - Level 9
An advanced design project utilising the application of the specialised knowledge required for the design and manufacture of a sophisticated product based on multiple plastics materials. Detailed considerations will include material and process selection, mould design, costing and economics, and environmental impact.
To complete this course students must enrol in CHEMMAT 732 A and B, or CHEMMAT 732

CHEMMAT 750A 15 Points
CHEMMAT 750B 15 Points
Capstone Design Project
Specification, planning and executing a specific process design project. The detailed considerations in the project to include environmental impact, safety and occupational health issues, material selection, process energy demand

and efficiency, costing and economics, process start-up and operation.

Prerequisite: CHEMMAT 306 or 331

Restriction: CHEMMAT 431, 432

To complete this course students must enrol in CHEMMAT 750 A and B

CHEMMAT 751A 15 Points

CHEMMAT 751B 15 Points

Research Project - Level 9

Students are required to submit a report on independent investigation carried out on a topic assigned by the Head of Department of Chemical and Materials Engineering. The work shall be supervised by a member of staff.

Restriction: CHEMMAT 441, 442

To complete this course students must enrol in CHEMMAT 751 A and B

CHEMMAT 752 15 Points

Process Dynamics and Control - Level 9

Application of simulation for understanding industry 4.0 focusing on digital twin and process control. Includes rigorous treatment of modelling and control fundamentals, advanced classical control and multiple loop control. Individual research is undertaken to apply advanced concepts and methods in modern chemical processes.

Prerequisite: ENGSCI 211

Restriction: CHEMMAT 311, 411, 412

CHEMMAT 753 15 Points

Biological Materials and Biomaterials - Level 9

Fundamentals of biological materials from small-scale building blocks (genes, proteins) to large-scale biological entities (organs, joints). Biomaterial design, material selection and functionalisation and the interaction between biomaterials and the biological tissue. Critique and review recent research on selected topics. Individual and team research projects apply advanced concepts and methods to design and implement a scaffold or implant prototype.

Prerequisite: BIOMENG 221, or CHEMMAT 204 and 205, or CHEMMAT 221 and 232

Restriction: CHEMMAT 422

CHEMMAT 754 15 Points

Materials Performance Enhancement - Level 9

Materials under extreme service conditions – surface engineering, high-temperature corrosion/oxidation. Nanomaterials and nanotechnology – special properties, synthesis and processing techniques, applications in sensing, catalysis and biomedical areas. Advanced manufacturing technology – additive manufacturing, powder metallurgy, and sustainable/green manufacturing. Selected advanced concepts in materials performance enhancement are taught through research based individual projects.

Prerequisite: CHEMMAT 121, and 305 or 322 or equivalent

Restriction: CHEMMAT 423

CHEMMAT 755 15 Points

Materials for Energy and Environmental Applications - Level 9

Electronic properties of materials. Applications in energy storage. Smart materials and devices – magnetic and dielectric materials, sensors and actuators, recording devices. Materials for environmental applications – photocatalysis and environmental cleaning, membrane materials, and eco-materials. Core concepts related to energy and

environmental applications are extended by individual research projects on selected topics.

Prerequisite: CHEMMAT 121, and 305 or 322 or equivalent

Restriction: CHEMMAT 424

CHEMMAT 756 15 Points

Food Process Engineering

Application of engineering principles to food processing. Topics include: heating and thermal processing, cooling, freezing and thawing, evaporation, dehydration, the use of membranes and packaging. Innovative food processes: high pressure, pulsed electric, UV, ultrasounds and ohmic heating/cooking, and fundamental areas of engineering relevant for food processing such as heat and mass transfer. Process impact on food safety, quality and preservation.

Prerequisite: CHEMMAT 201 or 211, and 15 points from ENGGEN 150, ENGSCI 111, MATHS 108, 110

Restriction: CHEMMAT 463, 772

CHEMMAT 757 15 Points

Engineering Biotechnology

Principles of biochemical engineering. Exploitation of bioreaction and bioprocess systems. Enzyme and microbial reaction kinetics, bioreactor design and downstream processing. Examples of biochemical process and food industry applications.

Prerequisite: ENGSCI 111 or MATHS 108 or equivalent

Restriction: CHEMMAT 361, 464, FOODSCI 704

CHEMMAT 758 15 Points

Resource Recovery Technologies - Level 9

Selection and application of resource recovery processes. Examination of a variety of resource recovery technologies. Critical evaluations of the latest research and development in innovative resource recovery techniques. Social and economic aspects as catalysts or obstacles to resource recovery. Includes an independent research project.

CHEMMAT 759 15 Points

Industry 4.0 for Chemical Engineering

In-depth coverage of digitalisation and Industry 4.0 in the context of modern biological, chemical, food and materials processing industries. Topics include model building, digital models and digital twins using process simulators, scripting, open source software and data-driven analysis using machine learning concepts, and the application of these to modelling a virtual plant.

Prerequisite: ENGSCI 311

CHEMMAT 760 15 Points

Advanced Microbial Technology in Bioprocess Engineering

Microbiological, biochemical, and molecular approaches crucial for analysing, developing, and optimising engineering bioprocesses. Fundamentals of microbial growth and the effect of environmental factors, molecular tools for quantifying bacterial cells and activities, bioinformatics, and in vitro enzymatic reactions. Applications of microbiology in engineering processes for chemical production, food engineering, bioenergy, and waste treatment.

CHEMMAT 761 15 Points

Special Topic

CHEMMAT 762 15 Points

Special Topic

CHEMMAT 763 15 Points

Waste Reduction and Recycling Technologies

Principles, concepts, and technologies in waste minimisation and recycling. Topics include implementation

of waste management and recycling technologies, economic analysis of waste recycling and minimisation and the three pillars of sustainability.

CHEMMAT 772 15 Points

Advanced Food Process Engineering - Level 9

Critical evaluation of the latest research and development in innovative thermal and non-thermal food processing technology. Open-ended application of these latest developments to different specific end-point food processing requirements. Teaching is highly research informed with principles, application examples and related individual research project work.

Restriction: CHEMMAT 756

CHEMMAT 773 15 Points

Food Process Systems Engineering - Level 9

Advanced understanding of the theory and application of process systems engineering for the food industry. Includes advanced process analytical technology, real-time quality control, multivariate data analysis, advanced statistical process control, advanced control methods and strategies, and real-time optimisation. Teaching is highly research informed with examples from the Industrial Information and Control Centre (I2C2) and includes an independent laboratory based project.

CHEMMAT 774A 15 Points

CHEMMAT 774B 45 Points

Dissertation in Food Process Engineering - Level 9

A structured supervised research project addressing a topic relevant to the development and commercialisation of food process engineering technologies.

Restriction: CHEMMAT 775, 776, 777

To complete this course students must enrol in CHEMMAT 774 A and B

CHEMMAT 775A 30 Points

CHEMMAT 775B 30 Points

Dissertation in Food Process Engineering - Level 9

A structured supervised research project addressing a topic relevant to the development and commercialisation of food process engineering technologies.

Restriction: CHEMMAT 774, 776, 777

To complete this course students must enrol in CHEMMAT 775 A and B

CHEMMAT 776A 30 Points

CHEMMAT 776B 60 Points

Research Portfolio - Level 9

A structured supervised research portfolio addressing a topic relevant to the development and commercialisation of process engineering technologies.

Restriction: CHEMMAT 774, 775, 776

To complete this course students must enrol in CHEMMAT 776 A and B

CHEMMAT 777A 45 Points

CHEMMAT 777B 45 Points

Research Portfolio - Level 9

A structured supervised research portfolio addressing a topic relevant to the development and commercialisation of process engineering technologies.

Restriction: CHEMMAT 774, 775, 776

To complete this course students must enrol in CHEMMAT 777 A and B

CHEMMAT 778 15 Points

Dairy Process Engineering - Level 9

Industry-focused advanced topics in post-farm-gate

processing of milk including liquid milk, powdered dairy and fermented products. Waste and high value product recovery from milk processing. Trends in global dairy industry including new development in food physics and chemistry, new products and processes, design and production of novel foods. Includes individual project-based work, laboratory work and completion of a group-based project. Includes independent research to create unique innovative solutions to an open-ended problem.

CHEMMAT 779A 15 Points

CHEMMAT 779B 15 Points

Food Engineering Research Project - Level 9

A structured supervised research project addressing a topic relevant to the development and commercialisation of food process engineering technologies.

Restriction: CHEMMAT 774, 775, 776, 777

To complete this course students must enrol in CHEMMAT 779 A and B

CHEMMAT 780 30 Points

CHEMMAT 780A 15 Points

CHEMMAT 780B 15 Points

Research Project - Level 9

To complete this course students must enrol in CHEMMAT 780 A and B, or CHEMMAT 780

CHEMMAT 787 15 Points

Project X - Level 9

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

CHEMMAT 788 30 Points

CHEMMAT 788A 15 Points

CHEMMAT 788B 15 Points

Research Project - Level 9

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in CHEMMAT 788 A and B, or CHEMMAT 788

CHEMMAT 789 30 Points

Project Z - Level 9

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

CHEMMAT 795 45 Points

CHEMMAT 795A 15 Points

CHEMMAT 795B 30 Points

Research Project - Level 9

Students are required to submit a report on a topic relevant to the specialisation, as assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in CHEMMAT 795 A and B, or CHEMMAT 795

CHEMMAT 796A 60 Points

CHEMMAT 796B 60 Points

ME Thesis (Chemical and Materials) - Level 9

Students are required to submit a thesis on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in CHEMMAT 796 A and B

Civil Engineering

Stage II**CIVIL 200** 15 Points**Introduction to Geotechnical Engineering**

The basic concepts and principles governing the mechanical behaviour of soil. Engineering geology, site investigation and soil classification. The principle of effective stress, permeability and seepage, and soil shear strength.

Restriction: CIVIL 220, 221

CIVIL 201 10 Points**Land Information Systems**

Aspects of elementary engineering surveying as used for gathering site information for the design and setting out of works. Land information systems, modern methods of gathering, processing and presenting information for engineering purposes.

CIVIL 202 15 Points**Fluid Mechanics and Pipe Flow**

Approaches to fluids: classification, dimensional analysis and similarity, integral and differential flow analysis; fluid properties; hydrostatics: pressure distribution in fluids, manometry, forces on plane and curved surfaces; conservation of mass; conservation of energy: Bernoulli equation, energy losses and gains, laminar and turbulent pipe friction losses, local losses, pipes in series and parallel, pipe networks, pumps, cavitation; conservation of momentum: Newton's Second Law, dynamic forces, fluid transients, Joukowski equation.

Restriction: CIVIL 230, 331

CIVIL 203 15 Points**Transport Design and Geomatics**

Introduction to Transportation Engineering (mobility for people and goods, sea, land and air transportation systems). Design and construction of longitudinal infrastructure (plans, longitudinal sections and cross sections, earthworks, quantities, mass haul). Transport geometric design (horizontal, vertical and cross sectional design). Geomatic surveying systems (levelling, theodolites, GPS, drones, digital topographical survey systems and remote sensing).

Restriction: CIVIL 201, 360

CIVIL 210 15 Points**Introduction to Structures**

Structural forms and systems. Analysis of determinate systems, elasticity. Engineering beam theory, elasticity, failure theories. Introduction to structural design.

Prerequisite: ENGGEN 121 or 150

Restriction: ENVENG 210

CIVIL 211 10 Points**Structures and Design 1**

Introduction to structural design – philosophy, loads, codes; design of simple structural elements in various materials.

CIVIL 220 10 Points**Introductory Engineering Geology**

Principles of physical and structural geology. Elementary stratigraphy. Applied geomorphology. Geologic surveying and mapping. Elementary seismology; microzoning and seismotectonic hazard evaluation. Engineering properties, description and identification of geologic materials. General applications of geology to engineering.

CIVIL 221 10 Points**Geomechanics 1**

The basic concepts and principles governing the mechanical behaviour of soil, including phase relationships, permeability and seepage, the principle of effective stress, soil strength, compressibility and basic stability analysis.

CIVIL 230 10 Points**Fluid Mechanics 1**

Fluid properties and definitions. Hydrostatics and stability of floating bodies. Fluid flow, energy and continuity relationships. Viscosity. Force and momentum relationship. Dimensional analysis and similarity. Introduction to turbomachinery.

CIVIL 250 10 Points**Civil Engineering Materials and Design**

Properties and manufacturing of concrete, steel and timber structural products. Design principles and examples for concrete, steel and timber members.

CIVIL 270 5 Points**Directed Study****CIVIL 271** 10 Points**Directed Study****CIVIL 299** 0 Points**Workshop Practice**

Restriction: ENGGEN 299

Stage III**CIVIL 300** 15 Points**Geotechnical Engineering**

Compaction, settlement and rate of consolidation. Stability analysis in geotechnical engineering, including slope stability, earth pressures on retaining structures and bearing capacity of shallow foundations. Environmental and sustainability considerations.

Prerequisite: CIVIL 200

Restriction: CIVIL 322

CIVIL 301 15 Points**Foundation Engineering**

Design of foundations, both shallow and pile, for buildings and other structures. Assessment of foundation ultimate capacity and working load settlement. Site investigation methods, with particular emphasis on the use of penetrometer tests to estimate soil parameter values. Current foundation construction methods.

Design of embedded retaining walls. Special aspects of house foundation design and construction. Observed foundation performance.

Prerequisite: CIVIL 300, and STRCTENG 300 or 301 or 304

Restriction: CIVIL 721

CIVIL 302 15 Points**Hydrology and Open Channel Flow**

Engineering hydrology: Hydrologic processes, analysis of rainfall-runoff relationships, statistical analysis of hydrological data, groundwater flow. Open channel flow: energy and momentum, uniform flow and flow resistance, critical flow, specific energy and flow force, backwater analysis, channel transitions. Environmental and sustainability considerations.

Prerequisite: CIVIL 202

Restriction: CIVIL 331, ENVENG 333

CIVIL 303 15 Points**Transport Operations and Pavements**

Traffic engineering, transportation planning and road pavement design. Topics include the main transport planning and traffic design techniques, criteria and fundamentals used in transportation engineering practice, traffic studies, public transport and active modes and transport modelling (micro and macro simulation). Additionally, pavement design, surfacings, traffic loading, mechanistic approaches and rehabilitation of road pavements, and environmental and sustainability considerations, are included.

Prerequisite: CIVIL 203

Restriction: CIVIL 360, 361

CIVIL 304 15 Points**Climate Adaptation Design**

Fundamental understanding of the impact of climate change on the built environment and strategies, and design for adaptation. Topic areas include assessing climate change impacts, vulnerability studies, and climate change adaptation strategies, adaptation design and asset management for major infrastructure and infrastructure networks. Awareness and consideration of holistic adaptation strategies including indigenous knowledge perspectives and nature-based solutions.

Prerequisite: CIVIL 200, 203, ENVENG 200

Corequisite: CIVIL 303

CIVIL 305 15 Points**Construction Informatics**

The application of digital and automation technologies (such as building information modelling, virtual reality/augmented reality, internet of things, laser scanning, drones, artificial intelligence, big data, robotics) in civil engineering and management.

CIVIL 312 15 Points**Structures and Design 2**

Structural analysis of indeterminate structures. Moment-area method for deformations. Loading actions as per NZS 1170 and load collation. Design of structural members in timber portal frames.

Prerequisite: CIVIL 211

CIVIL 313 15 Points**Structures and Design 3**

Design of structures in reinforced concrete, prestressed concrete and structural steel. Computer analysis of structures; use of a commercial analysis program. Design project.

Prerequisite: CIVIL 211

CIVIL 314 10 Points**Structural Dynamics**

Dynamics of single and multi-degree-of-freedom systems. Ground motion, response spectra, time-history and spectral modal analysis; introduction to seismic design.

CIVIL 322 10 Points**Geomechanics 2**

Stability analysis in geotechnical engineering; slope stability, soil pressures on retaining structures, bearing capacity. Consolidation and settlement.

Prerequisite: CIVIL 221

CIVIL 324 10 Points**Geomechanics 3**

Shear strength of soil – triaxial testing, measurement of pore water pressures, and interpretation of test data. Effective

and total stress paths for drained and undrained loading in laboratory tests and field applications. Consolidation. Application of elastic solutions in geomechanics. Geotechnical numerical modelling.

Prerequisite: CIVIL 322 or equivalent

Restriction: CIVIL 420, 728

CIVIL 331 10 Points**Hydraulic Engineering**

Pipe flow – fluid resistance, friction factor, simple pipe flow and minor losses, steady-state pipe flow and pipe networks. Open channel flow – energy and momentum, uniform flow and flow resistance, critical flow, specific energy and flow force, backwater analysis, channel transitions.

Prerequisite: CIVIL 230 or equivalent

CIVIL 332 10 Points**Fluid Mechanics 2**

Laminar and turbulent flow. Ideal fluid flows. Boundary layer theory and separation, drag and lift. River morphology and flows. River pollution. Unsteady flow in channels.

CIVIL 360 10 Points**Transportation Engineering 1**

Highway alignment geometrics (horizontal, vertical and cross sectional design). Basis of the main pavement design techniques, pavement materials, stabilisation, compaction and bituminous surfacings.

CIVIL 361 10 Points**Transportation Engineering 2**

Planning for land transport facilities and urban development. Arrangement of street networks and environmental areas. Basic operational analyses at priority and signalised intersections for vehicles and pedestrians. Highway capacity analyses. Parking design. Introduction to transportation planning modelling.

CIVIL 370 5 Points**Directed Study****CIVIL 371 10 Points****Directed Study**

Postgraduate 700 Level Courses**CIVIL 700 15 Points****Geotechnical Analysis**

Shear strength of soil – triaxial testing, measurement of pore water pressures, and interpretation of test data for use in analysis. Introduction to numerical modelling in geotechnical engineering. The use of traditional methods versus numerical modelling in design.

Prerequisite: CIVIL 300

Restriction: CIVIL 324

CIVIL 701 15 Points**Studies in Civil Engineering 1**

Advanced course on topics to be determined each year by the Head of Department of Civil and Environmental Engineering.

CIVIL 702 15 Points**Design of Earthquake Resistant Foundations - Level 9**

Observed behaviour of foundations during earthquakes. Site investigation and laboratory testing to estimate values for required soil parameters. Earthquake induced foundation actions. Shallow and deep foundations subject to earthquake excitation. Soil-foundation-structure-interaction. Force-based and displacement-based design. Earthquake induced earth pressures on stiff retaining

structures. An independent foundation design project is required.

Prerequisite: CIVIL 301, STRCTENG 300 or 304

CIVIL 703 15 Points
Project Management in Built Environments

Application of different project management domains and principles in civil engineering projects, including the theory and practice of planning and control of civil engineering projects from inception to completion.

Restriction: ENGGEN 740, 742

CIVIL 704 15 Points
Advanced Topics in Project Management - Level 9

Advanced topics in project management are analysed such as: advanced scheduling techniques, integrated project delivery, lean construction, building-information modelling, negotiation techniques, dispute resolution and innovative project delivery models. Independent research is undertaken in an advanced project in project management.

CIVIL 705A 15 Points

CIVIL 705B 15 Points

Research Project - Level 9

Restriction: CIVIL 408

To complete this course students must enrol in CIVIL 705 A and B

CIVIL 706 15 Points
Special Topic: Water-sensitive Cities

CIVIL 707 15 Points
Construction Supply Chain Management - Level 9

Advanced topics in construction supply chain management such as construction logistics, buffer management, relational contracts and behavioural dimensions, analytical models for construction, information technologies and sustainable supply chains. Independent research is undertaken by developing individual research projects in which students study logistics and supply chain problems by analysing real production scenarios or the current literature available in this topic.

CIVIL 710 15 Points
Advanced Structural Dynamics - Level 9

Advanced topics in structural dynamics, such as wave guide representation, holistic consideration of structural behaviour including soil, main and secondary structures interaction, nonlinearities of soil-foundation-structure systems including uplift, pile-soil separation, plastic hinge or pounding. The core skills are taught and accompanied by an individual project in which independent research is undertaken to solve a challenging structural dynamics problem.

Prerequisite: Departmental approval

CIVIL 711 15 Points
Structures Seminar

Selected topics from recent developments in structural analysis and design, including an introduction to the advanced behaviour and design of thin-walled steel sections and composite components made from cold-formed sheet and light-weight fillers.

CIVIL 713 15 Points
Structures and Design 4

Continuation of the design and detailing of structural assemblages in structural steel, reinforced concrete, reinforced masonry and timber, including connections in steelwork, composite steel/concrete beams and reinforced masonry structures. Emphasis on good load

paths, application of seismic design, techniques for the checking of existing structures and lessons learnt from failures. Introduction to the NZ Standard for light timber frame construction and concepts for light steel frame construction.

Prerequisite: either CIVIL 312 and 313, or STRCTENG 301 and 302 and 303

Restriction: CIVIL 411

CIVIL 714 15 Points
Multistorey Building Design

Techniques for the design of structures to resist seismic loading. Derivation of design actions, alternative structural systems for resisting these loads, design of structural components subject to cyclic inelastic action, detailing of members and joints to enhance earthquake resistance. Techniques of seismic isolation. Design project.

Prerequisite: either CIVIL 313, or STRCTENG 302 and 303

CIVIL 715 15 Points
Advanced Structural Concrete - Level 9

Design and detailing of prestressed and precast concrete components. Advanced mechanics of reinforced concrete members subject to axial, flexure, shear, and torsion actions. Design of state-of-art low-damage concrete structural systems. Includes an independent concrete design project and an independent research project on past failures of concrete structures.

Prerequisite: CIVIL 313 or STRCTENG 303

CIVIL 716 15 Points
Construction Risk Management - Level 9

A broad-based understanding of the critical elements of risk and risk management within the civil engineering industry. Risk analysis tools and techniques for the construction engineer, and risk response. Risk monitoring techniques, risk control and transference of risk methods. An independent project is undertaken in which students apply risk principles to civil engineering projects.

Restriction: ENGGEN 737

CIVIL 717 15 Points
Advanced Structural Timber - Level 9

Advanced topics in timber design such as: shearwalls, diaphragms, special glulam beams, bolted connections, new fasteners, engineered wood products, laminated bridges, inspection of timber structures. Emphasis will be placed on latest international developments. The core skills are taught and accompanied by an individual project in which independent research is undertaken to solve a challenging timber connection problem.

Prerequisite: CIVIL 451 or 750 or equivalent

CIVIL 718 15 Points
Light Gauge Steel

Use of thin steel load bearing structural components in walls, floors and roofs. Behaviour of members and connections under the full range of structural actions. Theory and design application including the Direct Strength Method of design. Use of light gauge steel acting compositely with other materials such as concrete and structural foams.

Prerequisite: CIVIL 313 or STRCTENG 302

CIVIL 719 15 Points
Matrix Structural Analysis

Direct stiffness method applied to linear, nonlinear and stability analyses. Introduction to variational principles and finite element method. Projects in practical modelling

of major structures such as bridges and multi-storey buildings. Use of commercial software.

Restriction: CIVIL 416

CIVIL 720

15 Points

Earthquake Engineering

Earthquakes and the effects on civil infrastructure. The passage of seismic waves from inception, propagation, arrival at site bedrock, site specific response, infrastructure response. Including engineering seismology, seismotectonic setting of NZ, probabilistic seismic hazard analyses, NZS 1170.5, infrastructure dynamics, base isolation, effects of site geology, geophysical and geotechnical site characterisation, concepts of soil-structure interaction, the Canterbury series of earthquakes.

Prerequisite: either CIVIL 313 and ENGSCI 311, or ENGSCI 311 and at least 15 points from STRCTENG 301-304 or equivalent

CIVIL 721

15 Points

Foundation Engineering

Foundation performance requirements. Foundation types. Foundation design loads. Limit state design. Design of shallow foundations. Design of deep foundation. Case histories illustrating construction, performance and failure of foundations. Design and performance of gravity retaining structures, embedded retaining walls and reinforced earth walls.

Prerequisite: CIVIL 312 or equivalent

Restriction: CIVIL 323, 421

CIVIL 722

15 Points

Slope Engineering

Slope failure mechanisms, geological controls and classification. Shear strength of rock and soil materials. Laboratory testing of earth materials for slope stability. Limit equilibrium techniques, including analytical, numerical and graphical methods. Effects of water and earthquake on slope stability. Slope monitoring, stabilisation and remediation. Landslide risk management.

Prerequisite: CIVIL 300 or 322

Restriction: CIVIL 422, ENVENG 324

CIVIL 724

15 Points

Soil Behaviour - Level 9

Advanced topics in soil behaviour including stress-strain-strength response of remoulded and natural geomaterials when subject to monotonic and cyclic loading; critical state soil mechanics; advanced soil testing; and partially saturated soils. Includes an independent research project related to an applied topic in soil behaviour.

Prerequisite: CIVIL 324 or equivalent

CIVIL 725

15 Points

Geotechnical Earthquake Engineering - Level 9

Advanced topics in earthquake effects on geotechnical structures, including: dynamic properties of soils; earthquake-induced ground response; seismic stability of slopes, embankments; earth-retaining structures; soil liquefaction; ground deformations; remediation and mitigation techniques. Design applications and advanced methods of analysis with case history analyses of major earthquakes. An independent research project will be used to solve a challenging geotechnical earthquake engineering problem.

Prerequisite: CIVIL 300

CIVIL 726

15 Points

Engineering Geology

Introduction to fundamentals in soil and rock mechanics and their application to engineering projects. Discussion

of natural hazards and their implications on infrastructure design. Practical exercises in field mapping, core logging, aerial photograph interpretation, and basic laboratory tests.

Restriction: CIVIL 404, EARTHSCI 372, GEOLOGY 372

CIVIL 727

15 Points

Dynamics of Structures in Earthquakes

Dynamic behaviour of structures and the means of predicting their response to the effects of earthquakes. Fundamental principles of earthquake engineering, including the effects of structural properties, and the roles of ductility, damping and isolation in mitigating earthquake damage. An individual research project on the impact of earthquakes on civil infrastructure is undertaken.

Prerequisite: STRCTENG 200

Restriction: CIVIL 314, STRCTENG 300

CIVIL 728

15 Points

Geotechnical Engineering in Professional Practice

Shear strength of soil – triaxial testing, measurement of pore water pressures, and interpretation of test data. Effective and total stress paths for drained and undrained loading in laboratory tests and field applications. Consolidation. Application of elastic solutions in geomechanics. Geotechnical numerical modelling. Includes a project.

Prerequisite: Departmental approval

Restriction: CIVIL 324

CIVIL 729

15 Points

Humanitarian Engineering

Evaluate frameworks used in the humanitarian engineering field to assist with human crises, including shelter, standards, law, human rights, resilience, appropriate engineering. Rapid assessments, application of minimum international standards for engineering, engineered shelter solutions, water, sanitation and hygiene and the engineering management of humanitarian crises.

CIVIL 731

15 Points

Water Resources Modelling

Risk and uncertainty in water resources systems; evaluation of alternatives in water resources; hydrologic modelling; hydraulic modelling; river basin modelling; water resources economics.

CIVIL 732

15 Points

Coastal Engineering Design

Deriving design conditions, wave pressures and forces, design of structures, beaches and control structures, introduction to port, introduction to coastal modelling.

Prerequisite: CIVIL 733

CIVIL 733

15 Points

Coastal Engineering Dynamics

Waves, wave theories, surf zone processes, sediment transport, dynamics of coastal systems.

Restriction: CIVIL 431

CIVIL 734

15 Points

River Engineering

Scales; flows; fluvial processes; mixing; ecohydraulics.

CIVIL 735

15 Points

Transport Modelling and Design

The planning, modelling, design and operation of current and future transport systems. Topics include transport models and their applications, Intelligent Transport Systems and emerging technologies, transport planning process and travel demand modelling. Transport models are developed to plan, design and manage transport

networks based on fundamental modelling concepts, New Zealand specifications and international best practices.

Prerequisite: CIVIL 303

Restriction: CIVIL 758

CIVIL 736 15 Points
Transport Safety and Mobility

Develop a sound understanding of safety and mobility of transport systems. Transport safety topics include safe systems, crash reduction studies, road safety audits and at-grade intersection geometric design, economic appraisal methods and transport infrastructure funding. Planning for transport mobility and sustainable transport systems, public transport systems, active modes and travel behaviour.

Prerequisite: CIVIL 203

Restriction: CIVIL 759

CIVIL 737 15 Points
Coastal Modelling

Computer simulation of coastal and wave processes. Introduces modelling software for coastal engineering, ranging from simplified wave propagation codes to sophisticated computational fluid dynamics (CFD) solvers. The learning approach is mostly hands-on, building on information delivered in lectures to allow the student to gain practical knowledge of the software in computer laboratory sessions.

Prerequisite: CIVIL 733

CIVIL 738 15 Points
Construction 4.0: The Future of Construction - Level 9

Advanced knowledge in Construction 4.0 and the deployment of related technologies (Internet of Things (IoT) smart construction sites, reality capture tools such as drones, 3D scanning, robotics, visualisation) in engineering and construction projects. Applications of technologies in addressing health and safety, productivity, efficiency and sustainability. Best practices of technology implementation in built environments. Independent research is undertaken in Construction 4.0.

CIVIL 740 15 Points
Studies in Civil Engineering 3 - Level 9

Advanced course on topics to be determined each year by the Head of Department of Civil and Environmental Engineering. The course will include the independent application of highly specialised knowledge and skills related to the study area.

CIVIL 741 15 Points
Ground Improvements and Geosynthetics Engineering

Advanced ground improvement techniques including: densification, consolidation, preloading and surcharge, soil reinforcement, stabilisation and thermal ground improvement.

Prerequisite: CIVIL 300 or 322

Restriction: CIVIL 403

CIVIL 742 15 Points
Bridge Design

Comprehensive overview of road and rail bridge typologies, design philosophies, performance requirements in key areas of strength and serviceability, calculation methods to address these topics and the analysis and strengthening of existing bridges. Bridge technology used in New Zealand and associated legislative requirements.

Prerequisite: CIVIL 713, 715 or equivalent

CIVIL 743 15 Points

Special Topic: Building Information Modelling

Introduction to the main principles and tools of Building Information Modelling (BIM) in the Architecture-Engineering-Construction (AEC) industry. This course is suitable for different AEC professionals such as civil and structural engineers, architects, among others.

CIVIL 744 15 Points

Special Study in Earthquake Engineering

An advanced course on topics in earthquake engineering to be determined each year by the Head of Department of Civil and Environmental Engineering.

CIVIL 745 15 Points

Seismic Assessment of Existing Buildings - Level 9

Principles of assessing the response of buildings to earthquakes and identification of vulnerabilities for different building types. Example buildings will be assessed using these advanced methodologies and independent research conducted on appropriate forms of retrofit.

Prerequisite: STRCTENG 303 or equivalent

CIVIL 746 15 Points

Nonlinear Structural Analysis - Level 9

Nonlinear behaviour of structures and the formulation of elements to model such behaviour; solution strategies; nonlinear material and section response; nonlinear dynamic analysis; nonlinear geometry; application of nonlinear analysis in engineering practice. Research and critically compare modeling approaches used for real buildings. Includes an independent research project involving nonlinear analysis of a real structure as a 'blind prediction'.

CIVIL 750 15 Points

Timber Engineering

The practical understanding of timber and its use in the construction industry. Design and detailing techniques for connections in timber structures, plywood structures, pole structures, timber floor systems, bridges, multi-storey buildings, formwork and falsework, arches and cable stayed systems.

Prerequisite: CIVIL 312 or STRCTENG 301

Restriction: CIVIL 451

CIVIL 754 15 Points

Geotechnical Modelling

Analysis of stress and strain in two and three dimensions, the idea of a constitutive law, elastic and plastic models for geomaterials. Numerical modelling of consolidation. Implementation of realistic models for soil and rock mass stress-strain-strength behaviour in numerical analysis software and evaluation of geotechnical software against known solutions.

CIVIL 756 15 Points

Capstone Project

Final year team exercise with students in multi-disciplinary civil and environmental roles integrating technical learning into realistic design outcomes. Comprehensive investigation of an open ended, complex, real or synthetic civil engineering problem with simulated professional design office constraints. Includes technical, economic, cultural, social, ethical, and environmental impact components to complete a scheme assessment report, incorporating safety in design concepts.

Prerequisite: 90 points from Part III courses listed in the BE(Hons) Schedule for Civil Engineering or Structural Engineering

CIVIL 761 15 Points**Planning and Design of Transport Facilities**

Selected topics from: traffic signal practice/safety audits, two way highway planning, arterial traffic management, modelling and simulation and traffic flow.

CIVIL 762 15 Points**Transportation Planning**

Provides an in-depth exploration of various components of the urban transportation planning process, with emphasis on theories on modelling. The principle behind the conventional four-stage transport planning model, namely, trip generation, trip distribution, modal split and trip assignment, is covered in detail.

CIVIL 763 15 Points**Smart Infrastructure Analytics**

Develops fundamental knowledge in the use of computer programming and data analytics to solve real-world infrastructure problems, such as reducing traffic congestion, predicting water usage and infrastructure failures. Group and independent projects are undertaken in which students study complex smart infrastructure analytics problems using real-world data.

CIVIL 764 15 Points**Highway Safety and Operations - Level 9**

Advanced planning, design, operation and safety management of predominantly two way two lane highways, including: passing and overtaking models analysis and treatments, collision modification and mitigation, roadway design, skid resistance, delineation, temporary traffic control, evaluation methods, and environmental management measures. An independently applied research project will use advanced analytical skills to critically evaluate factors which impact highway safety.

Prerequisite: CIVIL 360, 361, and 15 points from 661, 759, or equivalent

CIVIL 765 15 Points**Infrastructure Asset Management - Level 9**

Advanced theories and techniques fundamental to the management of infrastructure assets, with a primary focus on Asset Management Plans. Covers the entire spectrum of infrastructure, including roads, water networks and buildings. A major independent project incorporates a literature review and selection, and then critical review, of an Asset Management Plan from industry.

CIVIL 766 15 Points**Transportation Asset Management - Level 9**

Focuses on advanced topics in transportation asset management. Develops a critical awareness of the key issues encountered, including those related to the evaluation of performance; risk management; predictive modelling and calibration; prioritisation and optimisation; and life cycle analysis. The core skills are extended by an independent applied project in which students undertake to solve a complex transportation asset management problem.

CIVIL 767 15 Points**Pavement Analysis and Design**

Selected topics from: pavement design philosophy; stresses, strains and deflections in pavements; pavement material properties and characterisation; traffic loading and volume; pavement failure mechanisms; structural and functional assessment of pavements; empirical and

mechanistic pavement design methods; pavement overlay design; asphalt mix design.

Prerequisite: 15 points from CIVIL 661, 759, or equivalent

CIVIL 769 15 Points**Highway Geometric Design - Level 9**

An advanced course in highway geometric design techniques. Through the use of an independent applied project, students will apply advanced theory, methods, processes and design tools to the safe design of highway geometric alignments that includes an understanding of human / driver behaviour characteristics.

Prerequisite: CIVIL 360, 361, and 15 points from 661, 759, or equivalent

CIVIL 770 15 Points**Transport Systems Economics - Level 9**

Advanced specialist topics in transportation economics including economic analysis, the theory of demand and supply of transport, government intervention policies, and the theory of externalities and agglomeration. Students are required to undertake a major research project by analysing two major transportation infrastructure projects to determine the likely future social and real time benefits and dis-benefits which accrue to the wider community.

CIVIL 771 15 Points**Planning and Managing Transport - Level 9**

An advanced course on integrating land use planning and transport provisions, including planning for different land use trip types and parking, travel demand management techniques, and intelligent transport systems applications. An independent project applies this specialised knowledge towards planning, designing and managing transport infrastructure in a Territorial Local Authority (TLA) area.

CIVIL 773 15 Points**Sustainable Transport: Planning and Design**

Pedestrian planning and design; cycling facilities and planning; land use and trips; travel behaviour change and travel plans; integrated transport assessment; transport impact guidelines for site development.

CIVIL 774 15 Points**Studies in Transportation 1**

A graduate course on a range of selected topics to be determined each year by the Head of the Department of Civil and Environmental Engineering.

CIVIL 779A 15 Points**CIVIL 779B 30 Points****Research Project in Transportation - Level 9**

Students are required to submit a report on a topic in transportation assigned by the Head of Department.

To complete this course students must enrol in CIVIL 779 A and B

CIVIL 781 15 Points**Civil Engineering Planning and Execution**

Coverage of legislation, regulatory processes and best practice pertaining to the project lifecycle of civil engineering projects, including stakeholder analysis, feasibility and financial assessment, multi-criteria analysis, mana whenua, sustainable use of natural resources, health and safety, procurement, critical path programming, engineering contracts, contract administration and professional engineering ethics. Case studies are used to reinforce the practical application of theoretical ideas.

Restriction: CIVIL 790

CIVIL 782 15 Points**Water Resources Engineering**

A selection from the following: reservoir design and optimisation, flood control and design of flood control structures, micro to large scale hydroelectric engineering, river engineering and sedimentation. A water resources engineering design project.

Prerequisite: either CIVIL 302, or CIVIL 331 and ENVENG 333

Restriction: CIVIL 480, 482

CIVIL 783 15 Points**Water Distribution System Modelling and Analysis**

Fundamental theory of hydraulics and water quality in pipe networks, its implementation in software simulation tools and the application of models to the design and management of water distribution systems. Network theory, simulation practice, consumer and fire demand, water loss management, design, optimisation and master planning.

Prerequisite: CIVIL 202

CIVIL 787 15 Points**Project X - Level 9**

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval required

CIVIL 788 30 Points**CIVIL 788A 15 Points****CIVIL 788B 15 Points****Research Project - Level 9**

Prerequisite: Departmental approval required

To complete this course students must enrol in CIVIL 788 A and B, or CIVIL 788

CIVIL 789 30 Points**Project Z - Level 9**

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval required

CIVIL 790 15 Points**Civil Engineering Administration**

The application of legal, cultural, social and ethical principles to problems in civil engineering and environmental engineering management. Examines the administration of national and international engineering contracts. Discusses statutes affecting engineering business. Investigates the implications of resource management and natural resource allocation legislation on engineering projects. Analyses processes for resolving engineering disputes.

Restriction: CIVIL 401, 490, ENGGEN 734

CIVIL 791 15 Points**Construction Management**

Understanding topics necessary for effective construction management. Using a generic construction project life cycle, essential aspects of construction projects including the tendering process, planning, resource allocation, teamwork, site safety, and contract types are covered. Case studies are used to reinforce the application of theoretical ideas to the successful running of construction projects with considerations of cultural, social and ethical responsibilities.

Restriction: CIVIL 409

CIVIL 792 15 Points**Discrete-event Simulation in Construction - Level 9**

Application of discrete-event simulation (DES) modelling

to advanced planning and design construction operations and management of the construction supply chain. Critical assessment of the improvements in efficiency of planning methods and decisions patterns in construction management using DES. Individual and team research projects will apply advanced DES concepts and methods to complex, real-world construction projects.

CIVIL 793A 30 Points**CIVIL 793B 60 Points****Thesis - Level 9**

To complete this course students must enrol in CIVIL 793 A and B

CIVIL 794A 45 Points**CIVIL 794B 45 Points****Thesis - Level 9**

To complete this course students must enrol in CIVIL 794A and B

CIVIL 795 45 Points**CIVIL 795A 15 Points****CIVIL 795B 30 Points****Research Project (Civil) - Level 9**

Students are required to submit a report on a topic relevant to the specialisation, as assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in CIVIL 795 A and B, or CIVIL 795

CIVIL 796A 60 Points**CIVIL 796B 60 Points****Thesis - Level 9**

Students are required to submit a thesis on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in CIVIL 796 A and B

Computer Systems Engineering

Stage II**COMPSYS 201 15 Points****Fundamentals of Computer Engineering**

Digital systems and binary coding; binary numbers; Boolean algebra and computer logic; combinational logic circuits; sequential logic circuits; hardware description language; digital design flow; register transfer level descriptions and design; data paths and control units; from circuits to microprocessors; basic computer organisation; introduction to modern microprocessors; timers and interfacing; C and assembly language for microprocessors; designing digital systems using microprocessors.

Prerequisite: ELECTENG 101

COMPSYS 202 15 Points**Object Oriented Design and Programming**

A project-based course with extensive hands-on programming experience. Includes: an introduction to object oriented design including UML, sequence diagrams, use-case analysis; an introduction to object oriented programming in a modern high level language, algorithms, data abstraction and elementary data structures.

Prerequisite: ENGGEN 131 or ENGSCI 131

Restriction: MECHENG 270

COMPSYS 209 15 Points**Computer Systems Design**

Project-based course introducing real-world design aspects of hardware and software components of computer systems using appropriate design methodology. Practical skills will be gained in computer aided design tools, printed circuit board design and construction. Professional issues introduced in ENGGEN 204 (health and safety, sustainability, cultural diversity/awareness, communication, leadership, teamwork, financial awareness) and design for repair are reinforced and developed.

Prerequisite: COMPSYS 201 and ELECTENG 202, or COMPSYS 201 and ELECTENG 291, or PHYSICS 140 and 244

Restriction: ELECTENG 209

COMPSYS 299 0 Points**Workshop Practice**

Restriction: ENGGEN 299

Stage III**COMPSYS 301** 15 Points**Design: Hardware Software Systems**

An appreciation of the engineering design process as applied to computer systems. Design skills are enhanced through engineering projects which typically include elements of: computer hardware/software design, system design and control, sensing, actuation and interfacing. Professional issues introduced in ENGGEN 204 and 303 (health and safety, ethics, sustainability, cultural diversity/awareness, communication, leadership, teamwork, financial awareness) are reinforced and developed.

Prerequisite: COMPSYS 305, and COMPSYS 209 or ELECTENG 209, and COMPSYS 202 or SOFTENG 281

COMPSYS 302 15 Points**Design: Software Practice**

A project-based course to gain experience in software design emphasising problem solving techniques and applications in computer systems engineering. The course includes practical, real-world project(s) involving a representative subset of the following topics: algorithm and data structure selection and implementation, parsing and translation, object-oriented and multi-threaded programming, scripting languages, peer-to-peer communication over internet.

Prerequisite: COMPSYS 202 or SOFTENG 281

COMPSYS 303 15 Points**Microcomputers and Embedded Systems**

Embedded applications. Microprocessors, microcontrollers, architecture, organisation, programming memories, I/O interfacing. Sensors, actuators, analog interfaces. Hardware/Software partitioning and interfacing. Concurrency. Implementing data transformations and reactivity. Case studies.

Prerequisite: COMPSYS 201, and COMPSYS 202 or SOFTENG 251 or 281

COMPSYS 304 15 Points**Computer Architecture**

Modern processor architectures. Principles of modern processor design; pipelining; memory hierarchies; I/O and network interfacing; compiler and OS support; embedded processors; performance; multiprocessing.

Prerequisite: COMPSYS 201

Restriction: COMPSYS 313

COMPSYS 305 15 Points**Digital Systems Design**

Digital Systems implementation technologies with

emphasis on hardware description languages and design abstraction levels; structural, architectural and behavioural modelling; register-transfer level design; datapath and control units; functional and timing simulations; FPGA-based implementation design flow and case studies.

Prerequisite: COMPSYS 201

COMPSYS 306 15 Points**Artificial Intelligence and Machine Learning**

Fundamentals of artificial intelligence, including topics from artificial neural networks, fuzzy models, genetic algorithms. Using machine learning as an application of artificial intelligence to use data for training and inference, including topics from convolutional neural networks, deep learning, pattern classification and recognition.

Prerequisite: COMPSYS 201, and COMPSYS 202 or SOFTENG 281

Postgraduate 700 Level Courses**COMPSYS 700A** 15 Points**COMPSYS 700B** 15 Points**Research Project - Level 9**

Students are required to submit a report on project work carried out on a Computer Systems Engineering topic assigned by the Head of Department. The work shall be supervised by a member of staff.

Prerequisite: COMPSYS 301, and 45 points from COMPSYS 302-305, ELECTENG 303, 331, 332

Restriction: COMPSYS 401

To complete this course students must enrol in COMPSYS 700 A and B

COMPSYS 701 15 Points**Advanced Digital Systems Design - Level 9**

Advanced concepts in digital design including: System-on-Chip (system level description, behavioural and register-transfer descriptions); advanced modelling techniques and design flows; design space exploration and optimisation; hardware-software partitioning and trade-offs; component reusability; reconfigurable systems; low-power systems; case studies (speech, image, video algorithms implementation, application specific processor design); individual research projects to analyse the problem, model and implement the required hardware-software components.

Prerequisite: COMPSYS 305

COMPSYS 704 15 Points**Advanced Embedded Systems - Level 9**

Selected advanced topics from current research in embedded systems such as: embedded systems based on formal models of computation; centralised and distributed architectures for embedded systems; static and dynamic embedded systems; languages and frameworks for distributed embedded systems; actor and agent systems; verification. Includes a significant individual research project.

Prerequisite: COMPSYS 723, and 202 or SOFTENG 281

COMPSYS 705 15 Points**Formal Methods for Safety Critical Software - Level 9**

Formal methods for the validation/verification of safety critical software, including machine learning algorithms. Topics covered will include mathematical modelling for embedded, automation, and mechatronic systems; advanced techniques for validation and verification; techniques for formal specification; methods of verification such as Bisimulation and model checking; state space explosion problem and solutions such as BDDs, symbolic

model checking, and modular verification; verification of HDL/C using model checking tools. Includes a significant individual research project.

Prerequisite: COMPSYS 202 or ENGSCI 233 or MECHENG 270 or 313 or SOFTENG 211 or 281 or 282

COMPSYS 708 15 Points
Special Topic

An advanced course on topics to be determined each year by the Head of Department.

COMPSYS 710 15 Points
Studies in Computer Systems Engineering 1

Advanced courses on topics to be determined each year by the Head of Department.

COMPSYS 711 15 Points
Studies in Computer Systems Engineering 2

Advanced courses on topics to be determined each year by the Head of Department.

COMPSYS 713 15 Points
Studies in Computer Systems Engineering 4

Advanced courses on topics to be determined each year by the Head of Department.

COMPSYS 714 15 Points
Studies in Computer Systems Engineering 5

Advanced courses on topics to be determined each year by the Head of Department.

COMPSYS 715 15 Points
Studies in Computer Systems Engineering 6

Advanced courses on topics to be determined each year by the Head of Department.

COMPSYS 721 15 Points
Machine Intelligence and Deep Learning

Explores essential concepts and technologies in state-of-the-art deep neural network architectures, including convolutional neural networks, decision trees, random forests, similarity learning, recurrent neural networks, and long short-term memory networks. Includes hands-on experience combining hardware components with software implementations.

Prerequisite: COMPSYS 306, and COMPSYS 302 or SOFTENG 306 or 351

Restriction: COMPSYS 726

COMPSYS 722 15 Points
Special Topic

An advanced course on topics to be determined each year by the Head of Department.

COMPSYS 723 15 Points
Embedded Systems Design

Concurrency and models of computation, task models and race conditions, real-time operating systems based approach, synchronous approach, safe state machines, key properties: determinism and reactivity, SoPC and MPSoC, cyber-physical embedded systems, static analysis techniques, case studies in smart grid, automotive, medical devices and the like.

Prerequisite: COMPSYS 303 or 304 or SOFTENG 370

Restriction: COMPSYS 402, 403, 727

COMPSYS 725 15 Points
Distributed Cyber-Physical Systems Design

Network layers and protocols. Packet switching. Broadband network principles. Low versus high bandwidth services.

Network interfaces and instrumentation. Wireless networks in embedded applications. Industrial networking.

Prerequisite: COMPSYS 201, and 202 or SOFTENG 281

Restriction: COMPSYS 405

COMPSYS 726 15 Points
Robotics and Intelligent Systems - Level 9

Fundamentals of robotic and intelligent systems, including reactive and deliberative functionality, navigation techniques, planning and programming of robot actions, machine learning, artificial neural networks and may include topics in sensors and actuators, kinematic analysis, fuzzy systems, genetic algorithms. Core concepts are extended by an individual research project where a challenging robotics problem is analysed and a solution implemented and tested.

Prerequisite: 15 points from COMPSYS 302, 306, ENGSCI 331, MECHENG 313, SOFTENG 306

Restriction: COMPSYS 406, 721

COMPSYS 727 15 Points
Model-based Embedded Systems Design - Level 9

Traditional and advanced methods of embedded systems modelling and design, models of computation, hardware-software co-design, real-time and safety-critical systems, principles of embedded and real-time operating systems, design using the real-time operating systems approach and the synchronous approach, use of the networks in real-time embedded systems. The assessment includes a significant individual research project.

Prerequisite: COMPSYS 303

Restriction: COMPSYS 402, 403, 723

COMPSYS 728 15 Points
Special Topic - Level 9

An advanced course on a topic to be determined each year by the Head of Department. Includes a substantial individual research project.

Prerequisite: Departmental approval

COMPSYS 729 15 Points
Special Topic - Level 9

An advanced course on a topic to be determined each year by the Head of Department. Includes a substantial individual research project.

Prerequisite: Departmental approval

COMPSYS 730 15 Points
Robotics and Society

Explores the moral, ethical and societal impacts of increasing automation in our society, and how both work and leisure will be impacted as robots become more commonplace. Topics also include legal issues, privacy, safety, standards, and indigenous and cultural issues and opportunities.

COMPSYS 731 15 Points
Human-Robot Interaction

Human aspects of robotic systems, including how humans and robots can live and interact together. Cultural considerations around the perception of robots and expected robot behaviours in different domains such as agriculture, education, healthcare, and manufacturing.

Prerequisite: 15 points from COMPSYS 302, 306, ENGSCI 331, MECHENG 313, SOFTENG 306

COMPSYS 732 15 Points
Mobile Autonomous Robotics

Techniques and principles for designing and developing mobile robots that interact autonomously with their environment. Topics include sensors and actuators,

kinematic analysis, computer vision, state estimation and planning. Includes significant hands-on experience through the design and development of a mobile robot.

Prerequisite: 15 points from COMPSYS 302, 306, ENGSCI 331, MECHENG 313, SOFTENG 306

COMPSYS 770 15 Points

Capstone Project

Final year team exercise with students in multi-disciplinary roles, with focus on computer systems engineering and integrating technical learning into realistic design outcomes. Comprehensive investigation of an open ended, complex, real or synthetic computer, electrical and software engineering problem with simulated professional design office constraints. Includes technical, economic and environmental impact components to complete a scheme assessment report.

Prerequisite: 75 points from Part III courses listed in the BE(Hons) Schedule for the Computer Systems Engineering specialisation

COMPSYS 787 15 Points

Project X - Level 9

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

COMPSYS 788 30 Points

COMPSYS 788A 15 Points

COMPSYS 788B 15 Points

Research Project - Level 9

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in COMPSYS 788 A and B, or COMPSYS 788

COMPSYS 789 30 Points

Project Z - Level 9

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

COMPSYS 792 45 Points

COMPSYS 792A 15 Points

COMPSYS 792B 30 Points

Research Project (Robotics and Automation) - Level 9

Prerequisite: CHEMMAT 751 or CIVIL 705 or COMPSYS 700 or ELECTENG 700 or ENGEN 769 or ENGSCI 700 or MECHENG 700 or SOFTENG 700

To complete this course students must enrol in COMPSYS 792 A and B, or COMPSYS 792

COMPSYS 795 45 Points

COMPSYS 795A 15 Points

COMPSYS 795B 30 Points

Research Project (Computer Systems) - Level 9

Students are required to submit a report on a topic relevant to the specialisation, as assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in COMPSYS 795 A and B, or COMPSYS 795

COMPSYS 796A 60 Points

COMPSYS 796B 60 Points

ME Thesis (Computer Systems) - Level 9

Students are required to submit a thesis on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in COMPSYS 796 A and B

Design

Stage I

DESIGN 100 30 Points

Design Methods and Processes 1

Introduces students to human-centred design methods and tools that range from problem framing to prototyping, modelling, and validating solution ideas. Students will address a variety of briefs based on real-world problems and contexts, exploring their personal creative potential through a series of hands-on projects supported by presentations.

DESIGN 101 15 Points

Design Theory and Fundamentals

Introduces historical and contemporary drivers of design as a maker of socio-cultural meaning. Students will learn fundamental design principles used for communication and sense-making, applied across a variety of mediums and technologies. Students will be introduced to tikanga Māori and to the main ethical, socio-cultural, economic and environmental propellants of design.

DESIGN 102G 15 Points

Design for Sustainable Futures

New opportunities are continually emerging in the field of design. This course introduces design as strategy, demonstrating how contemporary design practices have evolved, responded to, and influenced change. By developing a design project that responds to the United Nations Sustainable Development Goals, students will learn how design thinking complements current practice and expands career prospects.

Stage II

DESIGN 200 30 Points

Design Methods and Processes 2

A studio-based course in which students learn new design methods and technologies. Students also develop customised design strategies in response to real-world challenges. By working on a detailed case study, students learn to address issues that affect local communities. Students present their design solutions, learn to pitch design concepts, and evaluate potential outcomes.

Prerequisite: DESIGN 100, 101

DESIGN 201 15 Points

Creative Communities

Introduces how the digital revolution has empowered people to organise themselves, collaborate and co-operate in non-hierarchical, creative ways. Students will explore the role of designers as catalysts for bottom-up, self-determined and distributed creativity within this scenario. They will learn to design for purpose and positive impact, co-creating open and resilient systems within their local communities.

Prerequisite: DESIGN 100, 101

DESIGN 210 15 Points**Identity, Indigeneity and Place**

Encourages students to identify their own positionality within Aotearoa and the wider Pacific. Using decolonising methods to critically analyse design solutions, students will explore their own identity and position themselves as cultural practitioners with obligations towards local communities.

Prerequisite: DESIGN 100, 101

DESIGN 211 15 Points**Aotearoa New Zealand Narratives**

An introduction to cultural narratives of Aotearoa New Zealand, and the role that contemporary design is playing as a participatory method for community-led change, both from bottom-up and institutional perspectives. Students will explore design as a practice for facilitating self-determination, and learn ways to enable genuine, respectful partnerships in order to tackle complex local and global challenges.

Prerequisite: DESIGN 100, 101

DESIGN 212 15 Points**Local Making**

Examines historic and contemporary making techniques, materials, and networks to understand the scope, scale and value of local traditions, with an emphasis on Māori and Pacific practices. Students will collate a personalised database of local inspirations and resources for continued development and professional reference. This will form the inspiration for the students' own made outcomes.

Prerequisite: DESIGN 100, 101

DESIGN 213 15 Points**Food Design**

Explores the complex global social, technical, and ecological relationships of food production, management, and consumption, with a focus on Aotearoa and the Pacific. Narrative, place-based, cultural, economic and creative perspectives on food design will provide frameworks for problem identification and prototype development to enhance local food systems.

Prerequisite: DESIGN 100, 101

DESIGN 214 15 Points**Special Topic****DESIGN 220** 15 Points**Design Innovation**

Introduces students to entrepreneurship within creative industries, focusing on the role of strategic design as a driver for purpose-led, sustainable innovation. Students will learn trends, methods and tools for organisational innovation, whether funding, launching, and managing new start-up companies, or dealing with change within existing organisations (intrepreneurship).

Prerequisite: DESIGN 100, 101

DESIGN 221 15 Points**Professional Design Practice**

Examines personal career paths, design team and project operations and responsibilities in small studios through to large organisations, the role of professional networks, and resources for designers to present themselves and their work to future collaborators.

Prerequisite: DESIGN 100, 101

Corequisite: DESIGN 200

DESIGN 222 15 Points**Business Tools for Designers**

Examines the most relevant tools that designers use for project management and business development. This includes services and technologies involved in strategic planning, content management, scheduling, communicating, collaborating, costing, client relations, impact planning, and product and market research.

Prerequisite: DESIGN 100, 101

DESIGN 223 15 Points**Game Design**

Provides students with a practical foundation in game design with a focus on concept development, design decomposition, and prototyping. Using game design theory, analysis, physical prototyping, playtesting, and iteration students learn how to translate game ideas, themes, and metaphors into gameplay and player experiences. Students will further be exposed to the basics of effective game design and learn the basics of game development.

Prerequisite: DESIGN 100, 101

DESIGN 224 15 Points**Special Topic: Visual Communication**

Provides extended visual communication concepts and skills for application across a range of design practices and technologies. Practical experiments with a range of materials and technologies explore the elements and principles of visual communication to strengthen skills in effective sense-making, organisation, encoding, and expression of information to convey meaning.

Prerequisite: DESIGN 100 and 101, or 60 points passed in the Bachelor of Communication

DESIGN 230 15 Points**Design, Wellbeing and Communities**

Students will identify and analyse how selected design interventions contribute to the health and wellbeing of communities in a range of contexts. Using service and experience design methods students will present ethical and feasible design strategies that examine notions of wellbeing, health, happiness and freedom, from individual to community level perspectives.

Prerequisite: DESIGN 100, 101

DESIGN 231 15 Points**The Future of Work and Play**

Students will analyse how global techno-social changes such as automation and climate change could impact the way we work and play, now and in the future. Students will critically speculate about possible and probable futures by developing fictional scenarios which test a range of design concepts for transition into preferable futures.

Prerequisite: DESIGN 100, 101

Corequisite: DESIGN 200

DESIGN 232 15 Points**Smart Homes and Cities**

Introduces the main drivers, strategies, and technologies that make smart cities efficient and sustainable. Students will analyse case studies to understand how these cities work from a systems-level perspective to a human-scale, experiential level. They will propose concept solutions to identified problems and opportunities, demonstrating how future homes and cities may operate synergistically through a connected system of interfaces and services.

Prerequisite: DESIGN 100, 101

Corequisite: DESIGN 200

DESIGN 233 15 Points**Design for the Natural Environment**

An overview of the ways that design can promote and actualise the regeneration of our natural environment through collaborative, systemic, and circular innovation. Students will learn fundamental theory, frameworks and methods to create positive impact using design strategy within the fields of environmental sustainability and conservation.

Prerequisite: DESIGN 100, 101

DESIGN 240 15 Points**Designing with Data**

Introduces students to the impact data representation has on public perception of global issues. Students will engage and experiment with computational methodologies to interpret, visualise and interact with data sources corresponding to a specific Sustainable Development Goal. Students will produce provocative data-driven visualisations that promote a call-to-action related to a foreseeable local or global crisis.

Prerequisite: DESIGN 100, 101

Corequisite: DESIGN 200

DESIGN 241 15 Points**Designing Mixed Realities**

Introduces an overview of new materials, products and processes connecting virtual and physical worlds. Students will explore these alternative realities as catalysts for positive impact. Students will experiment with technologies to design projects that augment human experiences in hybrid environments.

Prerequisite: DESIGN 100, 101

DESIGN 242 15 Points**Design and Autonomous Technology**

Introduces the major social, ethical, and technical trends driving the adoption of autonomous technologies and artificial intelligence. Students will explore the expanding role design can play within this field, through a purpose-led, human-centred perspective. Students will produce a prototypical device designed to have autonomous capabilities to affect human or ecological advancement.

Prerequisite: DESIGN 100, 101

Corequisite: DESIGN 200

DESIGN 243 15 Points**Design and Assistive Technologies**

Students will investigate design interventions that have successfully employed assistive strategies to improve or extend human movement, sensation or mental capacity for a range of individuals and communities. Students will experiment with a range of technologies, experiences and services to design an assistive or rehabilitative intervention that reduces inequalities amongst individuals.

Prerequisite: DESIGN 100, 101

Corequisite: DESIGN 200

Stage III**DESIGN 300 15 Points****Design Research Methodologies**

Introduction to a range of key design methodologies that inform contemporary design thinking, research and practice within Aotearoa New Zealand, with reference to Mana Moana philosophies of making and community. Drawing on methodological principles, students learn how to develop design strategies, apply design processes and test their design concepts. Consideration will be given to the phasing

and planning of design investigations from data analytics to design concepts to practical methods and proposed solutions.

Prerequisite: DESIGN 100, 101 and 90 points from DESIGN 200-243

DESIGN 303 15 Points**Design Research Practice**

Explores design research methods for conducting practical, material, and technological investigations to test prototype concepts. Provides a framework for investigations to inform the development of a design project proposal in preparation for DESIGN 304.

Prerequisite: DESIGN 200, 201

Corequisite: DESIGN 300

Restriction: DESIGN 302

DESIGN 304 45 Points**Advanced Design Methods Capstone**

Facilitates completion of a major design project in collaboration with local stakeholders. Provides frameworks for development of a design strategy in response to a real-world issue. Design research methodologies, methods and tools are applied to prototype solutions and document studio practice. Presentation and critique skills are honed through interaction with design professionals.

Prerequisite: DESIGN 300, 303

Restriction: DESIGN 301

Postgraduate 700 Level Courses**DESIGN 700 15 Points****Design Research Methodologies**

A study of how to adopt and adapt different methodologies for context analysis, concept development, design iteration, deployment and evaluation.

DESIGN 701 15 Points**Design Practices**

A survey of current contexts, resources and networks to be applied in advanced design practice.

DESIGN 702 30 Points**Design Technologies**

A studio-based study of process and production technologies for advanced design outcomes.

DESIGN 704 15 Points**Design Impacts**

A studio-based investigation that considers design as a catalyst for change and the models for measuring the impacts of design interventions.

Prerequisite: DESIGN 700-702

DESIGN 705 15 Points**Design Futures**

Applying speculative design methods to develop future scenarios and solutions for emerging societal and environmental challenges.

Prerequisite: DESIGN 700-702

DESIGN 706 30 Points**Design Innovation**

A studio-based study of enterprise practices for the stable deployment and viable adoption of design products and services.

Prerequisite: DESIGN 700-702

DESIGN 709 15 Points**Project Design**

The formulation and development of a design project, from

ideation to research design, in preparation for undertaking the DESIGN 710 Capstone Project.

Prerequisite: DESIGN 700-702

DESIGN 710	60 Points
DESIGN 710A	30 Points
DESIGN 710B	30 Points

Capstone Project - Level 9

An advanced, supervised design project that combines research, prototyping, tangible design work and in-depth stakeholder engagement toward investigation of a specific issue that would benefit from an advanced design response. Students will integrate appropriate research and design methods, synthesised findings and impact analysis at an in-depth level through a capstone report or case book.

Prerequisite: DESIGN 709

To complete this course students must enrol in DESIGN 710 A and B, or DESIGN 710

DESIGN 711	15 Points
Special Topic	

DESIGN 794A	30 Points
DESIGN 794B	60 Points

Thesis - Level 9

Prerequisite: DESIGN 700-702

To complete this course students must enrol in DESIGN 794 A and B

DESIGN 795A	30 Points
DESIGN 795B	60 Points

Research Portfolio - Level 9

Prerequisite: DESIGN 700-702

To complete this course students must enrol in DESIGN 795 A and B

Disaster Management

Postgraduate 700 Level Courses

DISMGT 701	15 Points
Disaster Risk Management - Level 9	

A broad based understanding of the critical elements of risk and risk management in pre- and post-disaster scenarios. Key elements include risk identification with regard to the forms and types of risk inherent in areas prone to disasters. Risk management approaches are explored and applied to different aspects of disaster management.

DISMGT 703	15 Points
Disaster Management and Resilience - Level 9	

Disaster management concepts and approaches related to urban resilience, including societal and infrastructure resilience. Key elements include exploring holistic approaches to disaster management and assessment of the relationship between resilience and disaster management. This includes systems and complexity, policy and general regulatory environment. This course involves group work and a course project.

DISMGT 704	45 Points
DISMGT 704A	15 Points
DISMGT 704B	30 Points

Research Project - Level 9

Supervised research project addressing a topic relevant to disaster management.

To complete this course students must enrol in DISMGT 704 A and B, or DISMGT 704

DISMGT 705	15 Points
Special Topic	

DISMGT 706	15 Points
Special Topic	

Electrical and Electronic Engineering

Stage I

ELECTENG 101	15 Points
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Electrical and Digital Systems

An introduction to electrical, computer and electronic systems and technology. Digital circuits and analysis techniques, computer organisation. Analog circuits and analysis techniques. Inductive power transfer, power systems and electric machines. Communication systems.

Restriction: ELECTENG 202, 204, 208, 210

Stage II

ELECTENG 202	15 Points
Circuits and Systems	

Aims to provide a good understanding of the way electrical circuits work. It covers DC and AC circuit theorems and analysis; transient analysis, including the Laplace transform; transfer functions; AC power calculations; and time and frequency representation of signals.

Prerequisite: ELECTENG 101

ELECTENG 204	15 Points
Engineering Electromagnetics	

Electrostatics (Coulomb's and Gauss's Laws, scalar potential, energy, capacitance, dielectrics), magnetostatics (Biot-Savart and Ampere's Laws, moving conductors, magnetic forces/torques, ferromagnetic hysteresis, inductance, magnetic materials), electromagnetic induction (Faraday's and Lenz's Laws). Transmission lines subjected to pulse excitation, magnetic circuits and single-phase transformers. Introduction to computational electromagnetics.

Prerequisite: ELECTENG 101

ELECTENG 208	15 Points
Electric Circuit Analysis	

Aims to provide a good understanding of the way electrical circuits work. The course covers DC and AC circuit theorems and analysis. It also introduces some semiconductor devices (diodes, transistors and operational amplifiers) and gives examples of their applications.

Prerequisite: ELECTENG 101

Restriction: ELECTENG 202 or 291

ELECTENG 209	15 Points
Analogue and Digital Design	

Project-based course introducing the process of electrical engineering design. Students will research a diverse range of practical problems and develop solutions and prototypes, test and evaluate hardware and software solutions, and communicate the design and results. Professional issues introduced in ENGGEN 204 (health and safety, sustainability, cultural diversity/awareness, communication, leadership, teamwork, financial awareness) and design for repair are reinforced and developed.

Prerequisite: COMPSYS 201 and ELECTENG 202, or COMPSYS 201 and ELECTENG 291, or PHYSICS 140 and 244

ELECTENG 210	15 Points
Electronics 1	

Semiconductor devices and applications, diodes, bipolar

junction transistors and operational amplifiers. Elementary device physics. Linear and non-linear devices, terminal characteristics, small-signal modelling and analysis. Frequency-dependent behaviour of circuits and analysis methods. Linear and non-linear circuits such as amplifiers and switching circuits. Biasing, coupling and bypass techniques. Operational amplifiers, frequency-dependence and characteristic limitations, frequency selective and non-linear switching circuits.

Prerequisite: ELECTENG 101

ELECTENG 291 15 Points

Fundamentals of Electrical Engineering

AC and DC circuit analysis in the context of linear electrical and electronic systems. Time and frequency domain approaches to describing and analysing electrical networks and systems.

Prerequisite: ELECTENG 101

Restriction: ELECTENG 202

ELECTENG 292 15 Points

Electronics

Electronic devices and circuits for solving engineering problems. Analysis of linear and non-linear microelectronic circuits and their practical applications.

Prerequisite: ELECTENG 202 or 291, or PHYSICS 121 and 244

Restriction: ELECTENG 210

ELECTENG 299 0 Points

Workshop Practice

Restriction: ENGEN 299

Stage III

ELECTENG 303 15 Points

Systems and Control

Introduction to linear, time-invariant, continuous-time system theory from both a time-domain and frequency domain standpoint. This leads on to the fundamental body of knowledge underlying the control and enhancement of system behaviour, with application to the analysis and control of electrical systems.

Prerequisite: ELECTENG 202

ELECTENG 305 15 Points

Applied Electronics

An advanced treatment of electronic circuits including a rigorous treatment of feedback, device limitations, noise effects, stability, and design considerations. Emphasis on common practical circuits taken from analog and switching applications.

Prerequisite: ELECTENG 202 or 291, and 210 or 292

ELECTENG 307 15 Points

Fields and Waves

Transmission lines subjected to AC excitation, the Smith chart, introduction to matching network design and introduction to antennas for radio systems. Maxwell's equations in differential and integral form, divergence and Stokes' theorems, skin effect and uniform plane waves (lossless/lossy media, reflection and transmission, polarisation). Case studies in computational electromagnetics.

Prerequisite: ELECTENG 204

ELECTENG 309 15 Points

Power Apparatus and Systems

Introduces students to three-phase electric machines and power system components. Covers theory, modelling and practical aspects for synchronous machines, induction

machines, transformer connections, transmission lines and substation components.

Prerequisite: ELECTENG 204

ELECTENG 310 15 Points

Electrical Engineering Design 1

An appreciation of the design process as applied to electrical and electronic engineering systems. Design skills are enhanced through engineering projects which typically involve modelling, simulation and analogue/digital electronic hardware design. Professional issues introduced in ENGEN 204, 303 and 403 (ethics, sustainability, cultural awareness, communication, leadership, teamwork, financial awareness, safety in design) and design for repair are reinforced and developed.

Prerequisite: COMPSYS 201, and COMPSYS 209 or ELECTENG 209, and ELECTENG 202 or 291, and COMPSYS 202 or SOFTENG 281

ELECTENG 311 15 Points

Electrical Engineering Design 2

The formal introduction to the design process is completed by one or more open-ended projects which typically include elements of design from concept to working prototype. Professional issues introduced in ENGEN 303 (health and safety, sustainability, cultural diversity/awareness, communication, leadership, teamwork, financial awareness) and design for repair are reinforced and developed.

Prerequisite: ELECTENG 310

ELECTENG 331 15 Points

Signals and Systems

Introduction to continuous-time and discrete-time signals and systems. Spectral analysis and representation of analog and digital signals, and linear, time-invariant systems. Conversion between analog and digital signals. Systems for manipulating and filtering signals in hardware and software.

Prerequisite: ELECTENG 202 or 291, or PHYSICS 140 and 244

Restriction: ELECTENG 303

ELECTENG 332 15 Points

Control Systems

Introduction to modelling in the time-domain and frequency domain. The fundamental body of knowledge underlying the control and enhancement of system behaviour, with application to the analysis and control of systems.

Prerequisite: ELECTENG 202 or 291

Restriction: ELECTENG 303

Postgraduate 700 Level Courses

ELECTENG 700A 15 Points

ELECTENG 700B 15 Points

Research Project - Level 9

Students are required to submit a report on project work carried out on a topic assigned by the Head of Department. The work shall be supervised by a member of staff.

Prerequisite: ELECTENG 310, 311, and 30 points from ELECTENG 303, 305, 309, 331, 332

Restriction: ELECTENG 401

To complete this course students must enrol in ELECTENG 700 A and B

ELECTENG 701 15 Points

Mobile Wireless Engineering

Aspects of the design and planning of mobile radio systems. Radio propagation for mobile radio systems (multipath, narrowband and wideband channels, channel characterisation and measurements), propagation

modelling (free-space, plane-earth, diffraction). Frequency reuse and interference, outage probabilities, system performance evaluation, space diversity, MIMO and millimetre-wave systems.

Prerequisite: ELECTENG 307 or 721 or 737

ELECTENG 703 15 Points

Advanced Power Systems - Level 9

Electricity markets: structure, pricing, optimisation, ancillary services; power system protection practices; distribution network development: smart grid, demand side participation; HVDC and FACT devices theory and application; renewable energy grid integration. Includes a substantial individual research project.

Prerequisite: ELECTENG 731

Restriction: ELECTENG 738

ELECTENG 704 15 Points

Advanced Control Systems - Level 9

Advanced theory of modern control systems with emphasis on optimisation techniques for both deterministic and stochastic processes. State-space modelling of dynamic systems and choice of suitable performance criteria. Adaptive, nonlinear and sliding mode control systems. Core concepts are extended by an individual research project in which a challenging control problem is analysed and solved.

Prerequisite: ELECTENG 722

ELECTENG 706 15 Points

Topics in Digital Signal Processing - Level 9

An advanced treatment of digital signal processing topics with an emphasis on state of the art techniques. Case studies of digital signal processing methods used to solve practical problems in science and engineering. Includes a substantial individual research project.

Prerequisite: ELECTENG 733

ELECTENG 711 15 Points

Studies in Electrical and Electronic Engineering 1

Advanced course on topics to be determined each year by the Head of Department.

ELECTENG 712 15 Points

Studies in Electrical and Electronic Engineering 2

Advanced course on topics to be determined each year by the Head of Department.

ELECTENG 713 15 Points

Studies in Electrical and Electronic Engineering 3

Advanced course on topics to be determined each year by the Head of Department.

ELECTENG 714 15 Points

Studies in Electrical and Electronic Engineering 4

Advanced course on topics to be determined each year by the Head of Department.

ELECTENG 715 15 Points

Studies in Electrical and Electronic Engineering 5

Advanced course on topics to be determined each year by the Head of Department.

ELECTENG 716 15 Points

Studies in Electrical and Electronic Engineering 6

Advanced course on topics to be determined each year by the Head of Department.

ELECTENG 721 15 Points

Radio Engineering

Matching networks, waveguides, transmitter/receiver design, noise, non-linear behaviour, antennas, applications

in computational electromagnetics. Fundamentals of radio propagation, tropospheric effects, diffraction, link budgets, point-to-point link design, multipath propagation, introduction to area coverage (mobile radio) systems. Introduction to radar systems, the radio spectrum and exposure standards.

Prerequisite: ELECTENG 307

Restriction: ELECTENG 421, 737

ELECTENG 722 15 Points

Modern Control Systems

State space analysis, relationship to transfer function methods, controllability and observability, multivariable plant. Computer simulation. Stability considerations. State variable feedback. Digital control system, design and realisation of digital controllers, adaptive controllers. Nonlinear systems, phase-plane and describing function techniques, Lyapunov's method of stability analysis, design of controllers for non-linear systems. Variable structure systems.

Prerequisite: ELECTENG 303 or 331 or 332

Restriction: ELECTENG 422, MECHENG 720, 724

ELECTENG 724 15 Points

Special Topic

An advanced course on topics to be determined each year by the Head of Department.

Prerequisite: Departmental approval

ELECTENG 726 15 Points

Digital Communications

Advanced principles and techniques in digital transmission systems: baseband and passband digital systems. Geometric representation of signals: theory of orthonormal signals, correlation demodulators, optimal detector. Digital phase (PSK) and frequency (FSK) modulation. Digital communication systems with noise. Information theory, capacity theorem and applications. Signal and information coding: data compression, digital transmission, error detection and correction, block and convolutional codes. Noise, thermal noise, noise figure. Traffic theory. Digital networks and OSI model.

Prerequisite: 15 points from ELECTENG 303, 331, 332

Restriction: ELECTENG 426, 741

ELECTENG 731 15 Points

Power Systems

Builds on the knowledge of three-phase power systems components to understand modelling, formulation and typical analysis carried out by electricity transmission, distribution and generation entities. Load flow, fault, stability and power quality. Supplemented by laboratories where students learn to use professional software to implement the theoretical aspects.

Prerequisite: ELECTENG 309

Restriction: ELECTENG 411

ELECTENG 732 15 Points

Communication Systems

Analog AM and FM modulation. Noise in AM and FM systems. AM modulators and demodulators. Coherent and non-coherent receivers. Superheterodyne receivers. Multiplexing: FDM, TDM, CDMA. Pulse modulation. Nyquist theorem; PCM modulation and multiplexing. Baseband digital transmission; optimal filtering; matched filter detection; probability of error. Intersymbol interference, waveform coding and data compression, base-band

data transmission. Introduction to digital systems and modulations.

Prerequisite: ELECTENG 303 or 331

Restriction: ELECTENG 412

ELECTENG 733 15 Points
Digital Signal Processing

Analysis and manipulation of discrete-time signals and systems. Spectral representations and analysis using the z-transform, discrete Fourier transform and fast Fourier transform. Introduction to stochastic processes. Hardware systems for processing digital signals.

Prerequisite: ELECTENG 303 or 331 or ENGSCI 311 or 313

Restriction: ELECTENG 413

ELECTENG 734 15 Points
Power Electronics - Level 9

Selected advanced concepts in power electronics are introduced through a practical and research based individual design project, utilising modern power converter topologies with supporting lectures that include: inductive power transfer and control, DC-DC converter design and control, high frequency magnetics design, semiconductor switches, practical design issues, controlled rectifiers and PWM converters with application to conventional and brushless DC motors.

Prerequisite: ELECTENG 305, 310, 311

Restriction: ELECTENG 414

ELECTENG 735 15 Points
Green Energy Technologies

Advanced green energy technologies with examples from current industry practice and cutting edge research developments. Topics include: renewable energy systems, distributed power generation, energy storage techniques, transportation electrification, power converters for renewable energy integration, soft-switched resonant converters, wireless power transfer, new semiconductor devices, motor drives, and LED lighting.

Prerequisite: ELECTENG 734

ELECTENG 736 15 Points
Analog and Digital Filter Synthesis

Filter concepts and network functions, a review of approximation techniques and frequency transformations, leading to a thorough treatment of passive, active and digital filter implementations.

Prerequisite: ELECTENG 303 or 331

Restriction: ELECTENG 416

ELECTENG 737 15 Points
Advanced Radio Engineering - Level 9

Advanced topics in radio system and high frequency electromagnetic design including: Matching networks, waveguides, transmitter/receiver design, noise, non-linear behaviour, antennas, applications in computational electromagnetics. Fundamentals of radio propagation, tropospheric effects, diffraction, link budgets, point-to-point link design, multipath propagation, introduction to area coverage (mobile radio) systems. Introduction to radar systems, the radio spectrum and exposure standards. Students will also undertake an individual research project involving high frequency systems design.

Prerequisite: ELECTENG 307

Restriction: ELECTENG 421, 721

ELECTENG 738 15 Points
Selected Topics in Advanced Power Systems - Level 9

Electricity markets: structure, pricing, optimisation, ancillary services; Power system protection practices;

Distribution Network Development: Smart Grids, Demand Side Participation, Integration of DG/renewable sources and Electric Vehicles. Core concepts are extended by an individual research project, a self-guided protection laboratory and industry engagement in advanced power system practices.

Prerequisite: ELECTENG 731

Restriction: ELECTENG 703

ELECTENG 739 15 Points
Special Topic - Level 9

An advanced course on a topic to be determined each year by the Head of Department. Includes a substantial individual research project.

Prerequisite: Departmental approval

ELECTENG 740 15 Points
Special Topic - Level 9

An advanced course on a topic to be determined each year by the Head of Department. Includes a substantial individual research project.

Prerequisite: Departmental approval

ELECTENG 741 15 Points
Advanced Digital Communications - Level 9

Advanced topics in modern digital communication systems and networks including: Advanced digital modulation theory and practice in single and multi-user communications systems; advanced information theory including single and multiple source coding; modern error control coding methods and applications; traffic theory and application in communication systems and networks. Theoretical knowledge is extended by an advanced laboratory programme and research projects.

Prerequisite: 15 points from ELECTENG 303, 331, 332

Restriction: ELECTENG 426, 726

ELECTENG 770 15 Points
Capstone Project

Final year team exercise with students in multi-disciplinary roles, with focus on electrical and electronic engineering, integrating technical learning into realistic design outcomes. Comprehensive investigation of an open-ended, complex, real or synthetic computer, electrical and software engineering problem with simulated professional design office constraints. Includes technical, economic and environmental impact components to complete a scheme assessment report.

Prerequisite: 75 points from Part III courses listed in the BE(Hons) Schedule for the Electrical and Electronic Engineering specialisation

ELECTENG 787 15 Points
Project X - Level 9

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

ELECTENG 788 30 Points

ELECTENG 788A 15 Points

ELECTENG 788B 15 Points

Research Project - Level 9

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in ELECTENG 788 A and B, or ELECTENG 788

ELECTENG 789 30 Points
Project Z - Level 9
 Students are required to submit a report on a topic assigned by the appropriate Head of Department.
Prerequisite: Departmental approval

ELECTENG 795 45 Points
ELECTENG 795A 15 Points
ELECTENG 795B 30 Points
Research Project (Electrical and Electronic) - Level 9
 Students are required to submit a report on a topic relevant to the specialisation, as assigned by the appropriate Head of Department.
Prerequisite: Departmental approval
 To complete this course students must enrol in **ELECTENG 795 A and B**, or **ELECTENG 795**

ELECTENG 796A 60 Points
ELECTENG 796B 60 Points
ME Thesis (Electrical and Electronic) - Level 9
 Students are required to submit a thesis on a topic assigned by the appropriate Head of Department.
Prerequisite: Departmental approval
 To complete this course students must enrol in **ELECTENG 796 A and B**

Energy

Postgraduate 700 Level Courses

ENERGY 721 15 Points
Energy Resources
 Past, present and likely future uses of various forms of energy focused on electricity generation. Energy resources. Energy economics, prices and markets. Environmental considerations in energy production and use. Climate change, carbon sequestration, carbon trading and carbon taxes.

ENERGY 722 15 Points
Energy Technology
 First and second laws of thermodynamics and thermodynamic cycles. Chemical and biological thermodynamics. Geotechnology for resource exploration and delineation. Engineering technology for production and use of oil and gas, coal, wind, geothermal, tidal, solar, nuclear, bio-fuels. Energy storage, batteries, fuel cells. Energy efficiency.

ENERGY 785A 15 Points
ENERGY 785B 30 Points
Research Project - Level 9
 Supervised research project addressing a topic relevant to the technical, economic, environmental, regulatory or business aspects of energy.
Prerequisite: Departmental approval
Restriction: ENERGY 786
 To complete this course students must enrol in **ENERGY 785 A and B**

ENERGY 786A 30 Points
ENERGY 786B 15 Points
Research Project - Level 9
 Supervised research project addressing a topic relevant

to the technical, economic, environmental, regulatory or business aspects of energy.
Prerequisite: Departmental approval
Restriction: ENERGY 785
 To complete this course students must enrol in **ENERGY 786 A and B**

ENERGY 794A 30 Points
ENERGY 794B 60 Points
Thesis - Level 9
Prerequisite: Departmental approval
 To complete this course students must enrol in **ENERGY 794 A and B**

ENERGY 795A 60 Points
ENERGY 795B 30 Points
Thesis - Level 9
Prerequisite: Departmental approval
 To complete this course students must enrol in **ENERGY 795 A and B**

Energy Technology

Diploma Courses

GEOTHERM 601 15 Points
Geothermal Resources and their Use
 Worldwide occurrence of geothermal systems, introductory geology, volcanoes and volcanic rocks, New Zealand geothermal systems, structure of the TVZ, hydrothermal alteration, permeability and porosity, introduction to geochemistry of geothermal systems, geothermal surface manifestations, water compositions, geothermometry, silica geochemistry, overview of geophysics for geothermal exploration, geothermal resource assessment.
Corequisite: GEOTHERM 602, and 603 or 620
Restriction: GEOTHERM 785

GEOTHERM 602 15 Points
Geothermal Energy Technology
 Worldwide geothermal development, types of geothermal systems, thermodynamics, properties of water and steam tables, heat transfer, fluid mechanics, steam-field equipment, geothermal power stations, geothermal drilling, wellbore processes, completion tests, downhole measurements, reinjection, corrosion, stored heat, Darcy's law, cold groundwater, geothermal reservoirs, direct use, reservoir modelling, reservoir monitoring and steam-field management.
Corequisite: GEOTHERM 601
Restriction: GEOTHERM 785

GEOTHERM 603 15 Points
Geothermal Exploration
 Hydrothermal alteration, clays, fluid inclusions, direct use, subsidence, scaling and corrosion in geothermal wells, production geochemistry, environmental aspects of geothermal development, feasibility study, physical properties of rocks and self-potential (SP), magnetics, thermal methods, gravity, seismic methods, electrical methods, magneto-tellurics (MT).
Corequisite: GEOTHERM 601, 602
Restriction: GEOTHERM 785

GEOTHERM 620 15 Points
Geothermal Engineering
 Completion tests, wellbore flow, two-phase flow, geothermal power cycles, flow measurements, direct use of geothermal energy, environmental effects, scaling and corrosion in geothermal wells, drilling engineering, flow

measurements, steam-field operation and maintenance, subsidence, waste heat rejection, heat exchangers, geothermal well-test analysis, stimulation, pipeline design, feasibility study, reservoir modelling theory, TOUGH2, reservoir modelling process, case study (data and conceptual model, natural state modelling), Wairakei model.

Corequisite: GEOTHERM 601, 602

Restriction: GEOTHERM 785

GEOTHERM 689 15 Points **Geothermal Project**

Based on a study using field, lab or theoretical methods, students are required to submit a report on some aspect of geothermal exploration, development or exploitation.

Postgraduate 700 Level Courses

GEOTHERM 785 15 Points **Geothermal and Reservoir Engineering**

Topics include: worldwide geothermal development, types of geothermal systems, geothermal geology, resource estimation, thermodynamics, properties of water and steam, steam-field equipment, geothermal power cycles, direct use of geothermal energy, completion tests, two-phase flow, flow measurements, geothermal reservoir engineering modelling theory, reinjection, scaling and corrosion, drilling engineering, heat exchangers, geothermal well-test analysis, stimulation, sedimentary geology, oil and gas formation, petroleum reservoir engineering.

Prerequisite: CHEMMAT 302 or 313 or ENGSCI 343 or MECHENG 311, and ENGSCI 311 or 313 or 314

Restriction: GEOTHERM 601, 602, 603, 620

Engineering General

Stage I

ENGGEN 102 15 Points **Basic Skills for Engineering**

An introduction to key concepts in areas such as mathematics and physics relevant to intending engineers. This course upskills students who wish to complete an engineering degree but have little prior knowledge of core areas such as differentiation, integration, and mechanical systems. Recommended preparation: Achievement standards 91261 Apply algebraic methods in solving problems and 91262 Apply calculus methods in solving problems, or equivalent.

Restriction: ENGSCI 111, 211, MATHS 102, 108, 110, 120, 130

ENGGEN 115 15 Points **Principles of Engineering Design**

An introduction to the principles of design as a fundamental part of engineering practice and a foundation for subsequent design courses. Students are also introduced to essential drawing skills and CAD, and complete group-based design projects. Topics include systems life cycle, design, and introductions to professional issues such as health and safety, ethics, sustainability, cultural diversity, communication, leadership, and teamwork.

ENGGEN 121 15 Points **Engineering Mechanics**

An introduction to planar mechanics including: free body diagrams, planar equilibrium of rigid bodies, friction, distributed forces, internal forces, shear force and bending moment diagrams, kinematics and kinetics of particles,

work and energy, relative motion, kinematics and kinetics of rigid bodies.

Restriction: CIVIL 210, MECHENG 222

ENGGEN 131 15 Points **Introduction to Engineering Computation and Software Development**

Introduction to problem solving in engineering through the use of the software package MATLAB, and the programming language C.

Restriction: ENGSCI 233, 331

ENGGEN 140 15 Points **Fundamentals of Engineering in Society**

An introduction to chemistry and biology as applied to solving fundamental engineering problems from first principles using conservation laws and with appropriate consideration for uncertainty. Problems will also be addressed from a social perspective, considering the environment, the Treaty of Waitangi, social license to operate, and the role of professional engineering skills in the community and society.

ENGGEN 199 0 Points **English Language Competency**

To complete this course students must attain a level of competency in the English language as determined by the Faculty of Engineering.

Stage II

ENGGEN 204 15 Points **Professional Skills, Communication, and Collaboration**

A system-wide view of the role of the professional engineer in society and business. The skills of advocacy, and individual and group-based communication are put into practice. Scenarios representative of real-world issues are addressed through team-based projects and problem solving. The professional issues introduced in ENGGEN 115 (health and safety, ethics, sustainability, cultural diversity, communication, leadership, and teamwork) are continued and developed.

Prerequisite: ENGGEN 115, 199

ENGGEN 299 0 Points **Workshop Practice**

Restriction: BIOMENG 299, CHEMMAT 299, CIVIL 299, COMPSYS 299, ELECTENG 299, ENGSCI 299, MECHENG 299, MECHTRON 299, SOFTENG 299, STRCTENG 299

Stage III

ENGGEN 303 15 Points **Innovation and Business Cases**

Introduction to theory and practice of managing projects, innovation, product development and service delivery. Students work in interdisciplinary teams to complete a project based on a complex real-world systems scenario. Project management and innovation topics are integrated with design studies covered in previous courses, and extended to wider business issues of risk and opportunities, entrepreneurship, financial management, and regulatory issues.

Prerequisite: ENGGEN 199, 204

ENGGEN 388 0 Points **Leadership in Engineering**

Prepares engineers for roles as future leaders. Enhances skills in seeing problems from non-engineering perspectives and dealing with situations without ideal solutions.

Develops skills from other disciplines and increases awareness of the broader context of how engineering supports society.

Prerequisite: Programme Director approval

Stage IV

ENGGEN 403 15 Points

Systems Thinking

An introduction to the commercial drivers and business practices which prepare students for successful roles in the commercial, government, and non-profit sectors after graduation. Students are presented with a systems thinking approach to managing large, complex, multidisciplinary challenges. Professional issues (such as health and safety, sustainability, resilience, ethics, leadership, and cultural diversity) from previous courses are expanded.

Prerequisite: BUSINESS 101 and 102, or BUSINESS 111 and 112, or DESIGN 220 or 221 or 222, or ECON 151 and GLOBAL 101, or COMMS 320 or ENGGEN 303 or LAW 241 or MUS 186 or 365 or PROPERTY 231 or SCIGEN 201 or 201G

ENGGEN 499 0 Points

Practical Work

Students are required to complete 800 hours of engineering practical work and complete formal written reports reflecting on their work experience. This enables students to gain workplace experience, practical knowledge, and hands-on engineering experience by working in an organisation.

Diploma Courses

ENGGEN 601 15 Points

Case Studies in Engineering 1

The case study may include aspects of design or analysis, a survey and/or evaluation of a problem in any branch of engineering. Students are required to submit a report.

ENGGEN 602 15 Points

Case Studies in Engineering 2

The case study may include aspects of design or analysis, a survey and/or evaluation of a problem in any branch of engineering. Students are required to submit a report.

ENGGEN 622 15 Points

Advanced Topics in Engineering 1

Courses on topics determined each year by the Associate Dean Postgraduate in the Faculty of Engineering.

ENGGEN 623 15 Points

Advanced Topics in Engineering 2

Courses on topics determined each year by the Associate Dean Postgraduate in the Faculty of Engineering.

ENGGEN 698 0 Points

Practical Work for Experienced Engineers

Students will demonstrate via formal records at least 800 hours of relevant practical work experience in Engineering completed in the last 5 years.

Prerequisite: At least 800 hours of practical work in responsible engineering employment

Restriction: ENGGEN 699

ENGGEN 699 0 Points

Practical Work

Students will complete 800 hours of relevant practical work experience in Engineering and reflect on the connections between their work and their study. The work experience can be undertaken at any time during the degree programme or via a combination of some prior

work experience and ongoing work experience gained concurrently with the degree.

Restriction: ENGGEN 698

Postgraduate 700 Level Courses

ENGGEN 701 15 Points

Professional Project

A comprehensive investigation, analysis and reporting of a complex engineering design, development or professional engineering problem.

Prerequisite: Departmental approval

Restriction: ENGGEN 401, 405, 410, 705

ENGGEN 705 15 Points

Engineering Product Development

Advanced topics in the engineering design and development of new manufactured products, taking an integrated approach including technical, commercial, and user aspects. Theory is linked to practice through multidisciplinary teams engaging in projects and case studies.

Prerequisite: B grade or higher in ENGGEN 303

Restriction: ENGGEN 401, 405, 410, 701, MGMT 305

ENGGEN 720 15 Points

Special Topic

ENGGEN 721 15 Points

Special Topic

Restriction: ENGGEN 769

ENGGEN 722 15 Points

Special Study in Engineering Management 1

Directed study of an engineering management topic approved by the Programme Coordinator.

Restriction: CIVIL 716

ENGGEN 723 15 Points

Special Study in Engineering Management 2

Directed study of an engineering management topic approved by the Programme Coordinator.

ENGGEN 724 15 Points

Special Study in Technology Management 1

Directed study of an engineering technology topic approved by the Programme Coordinator.

ENGGEN 725 15 Points

Special Study in Technology Management 2

Directed study of an engineering technology topic approved by the Programme Coordinator.

ENGGEN 726 15 Points

Climate Adaptation of Infrastructure

Impacts of climate change on infrastructure and adaptation strategies to respond to these changes. Impact assessments, vulnerability studies, and development of adaptation strategies and techniques for whole of life asset management. Decision-making, management and climate resilience of transport, potable water provision, stormwater and wastewater systems, buildings and other physical infrastructure systems.

ENGGEN 730 15 Points

Management Skills for Project Professionals

Core theories and their implications for the art and practice of project management in organisations.

ENGGEN 731 15 Points

Agile and Lean Project Management

The culture, structures, roles, tools and techniques required

for effective management of projects in uncertain, volatile and ambiguous environments where the project scope evolves or the timescale is the primary driver. Students will learn advanced techniques and apply them to reinforce their learning.

Restriction: ENGGEN 740

ENGGEN 732 15 Points

Systems Thinking and Project Business Case

The business case as the tool of choice for many businesses for turning strategy into projects and the subsequent investment appraisals. Topics include systems thinking, the theory of constraints, value, cost/benefit analysis, quadruple bottom line, sensitivity analysis, risk analysis, investment appraisal, performance measurement and benefit realisation.

ENGGEN 733 15 Points

Strategy, Portfolios, Programmes and Projects

The practical application of strategic management principles to enable the successful delivery of portfolios, programmes and projects in demand and supply side organisations in the public and private sectors. Examination of international examples from different industry sectors illustrates how theoretical concepts and practical applications can relate to the success or failure of portfolios of resources, programmes of work, and individual projects, sometimes in conditions of uncertainty and ambiguity.

Restriction: ENGGEN 741

ENGGEN 734 15 Points

Engineering Contracts for Project Managers

Theoretical concepts in engineering commercial contracts, how those concepts apply to the work environment and manifest in the contracts in use in the project environment. Students will study relevant case law, NZS3910, NEC3 and FIDIC.

Restriction: CIVIL 790

ENGGEN 735 15 Points

Project Management Case Studies

Examination of examples from industry to show how theoretical concepts relate to the success or failure of projects. Students will study a range of projects from across the world that highlight critical success factors.

Restriction: ENGGEN 741

ENGGEN 736 15 Points

Research Implementation and Dissemination - Level 9

Critical reflections on undertaking a research project focussing on elements of project implementation and dissemination of research findings and outcomes. Leverage the benefits of the research project by focussing on the communicating the findings of the project to appropriate audiences and maximising the impact of the project for key stakeholders. Critically evaluate own performance in undertaking a project and adoption of a philosophy of continuous improvement during implementation stage of a project. Identification of lessons learned in order to inform future research.

Corequisite: ENGGEN 792 or 794 (ENGGEN 736 must be taken in the same semester as ENGGEN 792 or 792B or 794 or 794B)

ENGGEN 737 15 Points

Engineering Risk Management - Level 9

The theory and practice of risk management, providing a comprehensive approach to identify, analyse, and treat risks inherent in engineering projects. Critical analysis and synthesis of risk management frameworks to deliver outcomes in scenarios of uncertainty and to communicate

plans at a professional level. An independent project is undertaken in which students apply risk management theories to engineering projects.

Restriction: CIVIL 716

ENGGEN 738 15 Points

Work Based Learning - Level 9

Studies in professional and interpersonal skills within the context of engineering and project management practice. Develops ability to critically self-assess competencies. Fosters and enhances competencies in preparation towards membership of a professional body via application of theory and exploration of work practices. Students prepare a portfolio of independent work demonstrating competencies required of a Chartered professional at an advanced level.

Restriction: CIVIL 708

Note: Students must be in professional employment or have completed at least three years' professional employment within engineering.

ENGGEN 739 15 Points

Cost Engineering - Level 9

Advanced topics in cost engineering such as engineering economics, cost planning, cost estimating, cost control, cost analysis and lifecycle costing. These topics are extended by independent and group applied projects in which students solve complex engineering management problems. The core taught skills are complemented by independent research to solve cost engineering problems or critically analyse alternative cost engineering approaches.

Restriction: CIVIL 709

ENGGEN 740 30 Points

Project Management Bodies of Knowledge

A comprehensive and critical review of existing and emerging project management bodies of knowledge including Waterfall, Agile, Lean and Extreme Project Management approaches. Comparison of a range of project management frameworks and methodologies for management of risk, including the applied application of a range of tools, techniques and knowledge to open-ended project scenarios.

Restriction: CIVIL 703, ENGGEN 731, 742

ENGGEN 741 30 Points

Project, Programme and Portfolio Management

Critical elements of project delivery including leadership, organisation, owner profile and participation, project objectives, investment decisions and change management. Project, Programme and Portfolio Management frameworks and their practical application to organisations in managing strategy implementation. Examples from industry show how theoretical concepts relate to the success or failure of projects, programmes and portfolios under conditions of uncertainty and ambiguity.

Restriction: ENGGEN 733, 735

ENGGEN 742 15 Points

Project Management

Planning, organisation and control of projects in ordered environments. Application of project management principles, concepts, disciplines, tools, techniques and processes to the typical project lifecycle. Studies in the knowledge areas/domains defined by the Project Management Institute (PMI). Development of a range of skills, tools and techniques to become an effective project manager.

Restriction: CIVIL 703, ENGGEN 740

ENGGEN 743 15 Points**Applied Creative Thinking**

Application of inventive problem solving and creative thinking to formulate novel engineering solutions. Theories, tools and techniques to assist with generating innovative ideas. Techniques for improving the creativity of teams. Develops skills in the facilitation of workshops to help teams solve complex problems. Practical application of the concepts are synthesised to solve case study industry problems, and students' individual scenarios.

Restriction: ENGGEN 722

ENGGEN 766 45 Points**ENGGEN 766A 15 Points****ENGGEN 766B 30 Points****Research Project in Engineering Management - Level 9**

A major project which should relate to a practical situation in an organisation or company selected by the candidate. The project must be approved by the Master of Engineering Management Programme Director, and may take the form of a survey and evaluation of modern advances in engineering management practices, the development and/or implementation of new management strategies, or a management oriented industrial case study.

Restriction: ENGGEN 763, 764, 765

To complete this course students must enrol in ENGGEN 766 A and B, or ENGGEN 766

ENGGEN 769 15 Points**Research Methods for Engineers**

Development of research methods knowledge and skills including research philosophy and design, research ethics, data collection and analysis techniques, identification of limitations, and writing up and reporting. Qualitative and quantitative research methods are addressed.

Restriction: CHEMMAT 751, CIVIL 705, COMPSYS 700, ELECTENG 700, ENGGEN 721, ENGSCI 700, MECHENG 700, SOFTENG 700

ENGGEN 770 15 Points**Medical Device and Technology Development - Level 9**

Clinical and technical aspects of medical device development. Identification and definition of a medical device, examples and case studies. Evidence based technology, justification and motivation for developing medical devices. Techniques and issues concerning medical device research and design processes. Includes individual research related to medical device and technology development.

ENGGEN 771 15 Points**Medical Device Industry Practice - Level 9**

Commercial lifecycle considerations in medical device design. Clinical evaluation of systems; safety and ethics issues. Medical and regulatory requirements and international standards for medical devices; quality assurance and controlled design. Examples drawn from surgical assistance and medical intervention systems, training systems, prosthetics, orthotics, exoskeleton devices, and healthcare robotics.

ENGGEN 784 30 Points**ENGGEN 784A 15 Points****ENGGEN 784B 15 Points****Capstone Project - Level 9**

An extensive team-based project within a virtual or real-world organisation, where students will apply highly specialised theories, frameworks, and tools to analyse complex problems and develop practical solutions to industry standards. Students will formulate plans, reports,

and deliver presentations that convey their findings and facilitate critical reflective analysis of their learning experiences throughout the project.

To complete this course students must enrol in ENGGEN 784 A and B, or ENGGEN 784

ENGGEN 785 30 Points**ENGGEN 785A 15 Points****ENGGEN 785B 15 Points****Professional Capstone - Level 9**

An advanced course comprising an integrating project with students working independently and inter-dependently in teams to research, investigate and apply engineering knowledge to develop solutions. A comprehensive investigation of an open-ended, complex, real or synthetic engineering problem within a simulated professional office. Completion of a comprehensive report and presentation covering technical, economic, environmental, health and safety and management components.

Prerequisite: 60 points from 700 level courses in the BE(Hons) and MProfEng Schedules

To complete this course students must enrol in ENGGEN 785 A and B, or ENGGEN 785

ENGGEN 790 45 Points**ENGGEN 790A 15 Points****ENGGEN 790B 30 Points****Research Project - Level 9**

To complete this course students must enrol in ENGGEN 790 A and B, or ENGGEN 790

ENGGEN 791A 30 Points**ENGGEN 791B 30 Points****Dissertation in Medical Devices - Level 9**

A structured supervised research project addressing a topic relevant to the development and commercialisation of medical devices and technologies.

Prerequisite: Departmental approval

To complete this course students must enrol in ENGGEN 791 A and B

ENGGEN 792 30 Points**ENGGEN 792A 15 Points****ENGGEN 792B 15 Points****Research Project - Level 9**

A research project which requires students to undertake a practical application in a temporary endeavour to deliver a product, service or specified outcome. May take the form of surveys, interviews, action research, project implementation and evaluation of modern advances in project management practices, or a project management oriented case study. Projects conducted by students working in pairs. Each student must prepare a separate individual report.

To complete this course students must enrol in ENGGEN 792 A and B, or ENGGEN 792

ENGGEN 794 30 Points**ENGGEN 794A 15 Points****ENGGEN 794B 15 Points****Research Project - Level 9**

A research project which requires a student to undertake a practical application in a temporary endeavour to deliver a product, service or specified outcome. May take the form of action research, project implementation and evaluation of modern advances in project management practices, or a project management oriented case study. Project will

be conducted by students working individually within an existing project orientated team.

Prerequisite: Departmental approval

To complete this course students must enrol in ENGGEN 794 A and B, or ENGGEN 794

ENGGEN 796A 60 Points

ENGGEN 796B 60 Points

ME Thesis (Engineering) - Level 9

Students are required to submit a thesis on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in ENGGEN 796 A and B

Engineering Science

Stage I

ENGSCI 111 15 Points

Mathematical Modelling 1

Introduction to mathematical modelling. Differentiation and integration (polynomials, trigonometric, exponential, logarithmic, and rational functions). Integration by parts, substitution and partial fractions. Differential equations and their solutions (including Euler's method). Vector and matrix algebra, transformations, solving systems of linear equations. Modelling using probability.

Restriction: ENGSCI 211, 213, 311, 313, 314

Stage II

ENGSCI 205 15 Points

Engineering-Centric Machine Learning

Introduction to machine learning algorithms with a focus on their applicability to engineering problems. Implementation of machine learning pipelines using high-level software libraries. Project-based application of the data science process to engineering problems. Data- and signals-based model development and calibration. Interpretable machine learning. Evaluation of machine learning models for engineering-centric applications. Physics-informed machine learning.

ENGSCI 211 15 Points

Mathematical Modelling 2

First and second order ordinary differential equations and solutions. Laplace transforms. Taylor series and series in general. Multivariable and vector calculus including divergence, gradient and curl. Further linear algebra. Eigenvalues and eigenvectors. Fourier series. Application of the techniques through appropriate modelling examples. Introductory data analysis and statistics.

Prerequisite: ENGGEN 150, or ENGSCI 111, or a B+ grade or higher in MATHS 108 or 110, or a B+ grade or higher in MATHS 120 and 130

Restriction: ENGSCI 213

ENGSCI 233 15 Points

Computational Techniques and Computer Systems

Introduction to computer architecture and computational techniques. Data representation, memory, hardware, interfacing, and limitations. Numerical computation and algorithms, coding design and paradigms.

Prerequisite: ELECTENG 101 and ENGGEN 131, and ENGGEN 150 or ENGSCI 111

Corequisite: ENGSCI 211 or 213

ENGSCI 255 15 Points

Modelling and Analytics in Operations Research

Emphasises the relationship between business and industrial applications and their associated operations research models. Software packages will be used to solve practical problems. Topics such as: linear programming, transportation and assignment models, network algorithms, queues, inventory models, simulation, analytics and visualisation will be considered.

Prerequisite: 15 points at Stage I in Engineering General or Engineering Science

Restriction: STATS 255

ENGSCI 263 15 Points

Engineering Science Design I

Introduction to concepts of model design for engineering problems, including model formulation, solution procedures, validation, and shortcomings, with examples from topics in computational mechanics, operations research and data science. Further development of problem-solving skills, group project work, and group communication skills. The use of computational models to support design-focused decision making while considering ethical, societal, cultural, and environmental factors.

Prerequisite: ENGGEN 115 and ENGSCI 233

Corequisite: ENGSCI 211 or 213

ENGSCI 270 15 Points

Special Topic

ENGSCI 299 0 Points

Workshop Practice

Restriction: ENGGEN 299

Stage III

ENGSCI 309 15 Points

Image and Digital Signal Processing

Fundamentals of image processing and digital signal processing. One dimensional signals and digital filters. Digital filtering with FIR and IIR filters and the Digital Fourier Transform (DFT). Two-dimensional signals, systems and analysis methods. 2D images, spatial sampling, grey-scale quantification, point operations, spatial operations, high pass filtering, sharpening images, noisy images, nonlinear image processing.

Prerequisite: ENGSCI 211 or 213

ENGSCI 311 15 Points

Mathematical Modelling 3

A selection from: ordinary differential equations, systems of equations, analytical and numerical methods, non-linear ODEs, partial differential equations, separation of variables, numerical methods for solving PDEs, models for optimisation, industrial statistics, data analysis, regression, experimental design reliability methods.

Prerequisite: ENGSCI 211

Restriction: ENGSCI 313, 314

ENGSCI 313 15 Points

Mathematical Modelling 3ECE

Complex Analysis, including complex numbers, analytic functions, complex integration, Cauchy's theorem, Laurent series, residue theory; Laplace transforms; Modelling with partial differential equations, including electronic and electrical applications; Fourier Analysis, Fourier transform, Fast Fourier transform; Optimisation,

including unconstrained and constrained models, linear programming and nonlinear optimisation.

Prerequisite: ENGSCI 271

Restriction: ENGSCI 311, 314

ENGSCI 314 15 Points

Mathematical Modelling 3ES

Mathematical modelling using ordinary and partial differential equations, calculus of variations and statistical methods. Topics include: eigenvalues, eigenvectors, systems of equations, stability, separation of variables, wave and heat equations, Euler-Lagrange equation, Hamilton's Principle, probability, random variables, common distributions, Poisson process, exploratory data analysis, confidence intervals, hypotheses tests, linear models including one-way and two-way ANOVA, ANCOVA and multiple regression, introduction to logistic regression.

Prerequisite: ENGSCI 271

Restriction: ENGSCI 311, 313, 321

ENGSCI 331 15 Points

Computational Techniques 2

Methods for computing numerical solutions of mathematical models and data analytics problems with focus on translating algorithms to computer code. A selection of topics from numerical solution of linear and non-linear equations, eigen problems, ordinary and partial differential equations, databases, inverse problems and parameter estimation.

Prerequisite: ENGSCI 233

Corequisite: ENGSCI 311 or 313 or 314

ENGSCI 343 15 Points

Mathematical and Computational Modelling in Mechanics

Development of macroscopic models of physical systems using fundamental mathematical techniques and physical laws. Topics include vector and tensor calculus including indicial notation and integral theorems, conservation laws, control volumes and constitutive equations, continuum assumptions, isotropy and homogeneity. Possible applications include deformation, strain and stress, fluid flow, electromagnetism, reactive chemical transport, and kinetics.

Prerequisite: BIOMENG 221 or MECHENG 242, and ENGSCI 271 or 213

Restriction: BIOMENG 321

ENGSCI 344 15 Points

Computational Design for Physical Systems

Integrate sustainability and environmental considerations into computational engineering. This will develop skills in: analysing complexity and selecting an appropriate model representation of the physical problem; choosing the correct computational tool with which to solve the model; designing and executing appropriate numerical experiments using the chosen tool; validating, interpreting and communicating the simulation results. Enhance skills in sustainable decision-making and addressing environmental challenges.

Prerequisite: BIOMENG 321 or ENGSCI 343

Restriction: ENGSCI 746

ENGSCI 355 15 Points

Simulation Modelling for Process Design

Use of simulation models to design complex processes including consideration of cultural, environmental, societal and ethical factors as appropriate. Focus on

practical problem solving, translational methods and the development of real-world modelling skills.

Prerequisite: ENGSCI 255 or STATS 255

Restriction: OPSRES 385

ENGSCI 370 15 Points

Special Topic

ENGSCI 391 15 Points

Optimisation in Operations Research

Linear programming, the revised simplex method and its computational aspects, duality and the dual simplex method, sensitivity and post-optimal analysis. Network optimisation models and maximum flow algorithms. Transportation, assignment and transhipment models, and the network simplex method. Introduction to integer programming.

Prerequisite: 15 points from ENGGEN 150, ENGSCI 111, 211, MATHS 108, 208, 250, 253, and 15 points from COMPSCI 101, ENGGEN 131, MATHS 162, STATS 220

Restriction: ENGSCI 765

Postgraduate 700 Level Courses

ENGSCI 700A 15 Points

ENGSCI 700B 15 Points

Research Project - Level 9

An investigation carried out under the supervision of a member of staff on a topic assigned by the Head of Department of Engineering Science. A written report on the work must be submitted.

Prerequisite: 60 points from non-elective courses listed in Part III of the BE(Hons) Schedule for either Engineering Science or Biomedical Engineering

To complete this course students must enrol in ENGSCI 700 A and B

ENGSCI 701 15 Points

Studies in Engineering Science

An advanced course on topics to be determined each year by the Head of Department of Engineering Science.

Prerequisite: Departmental approval

ENGSCI 705 15 Points

Special Topic

ENGSCI 706 15 Points

Special Topic

ENGSCI 711 15 Points

Advanced Mathematical Modelling

A selection of modules on mathematical modelling methods in engineering, including theory of partial differential equations, integral transforms, methods of characteristics, similarity solutions, asymptotic expressions, theory of waves, special functions, non-linear ordinary differential equations, calculus of variations, tensor analysis, complex variables, wavelet theory and other modules offered from year to year.

Prerequisite: 15 points from ENGSCI 311, 313, 314

ENGSCI 712 15 Points

Computational Algorithms for Signal Processing

Advanced topics in mathematical modelling and computational techniques, including topics on singular value decomposition, Principle Component Analysis and Independent Component Analysis, eigen-problems, and signal processing (topics on neural network models such as the multi-layer perception and self organising map).

Prerequisite: 15 points from ENGSCI 311, 313, 314

ENGSCI 713 15 Points**Mathematical Modelling for Professional Engineers**

Mathematical modelling techniques required by professional engineers, such as partial and ordinary differential equations, differentiation and integration, vector calculus, linear algebra, analytical and numerical methods, industrial statistics, and data analysis.

Prerequisite: ENGSCI 211 or 213

Restriction: ENGSCI 311, 313, 314

ENGSCI 721 15 Points**Data-centric Engineering for Physical Systems**

Mathematical modelling of complex physical systems, including model development, parameterisation and evaluation, illustrated using examples from current research and industry. Inverse problems and uncertainty quantification for physical models in engineering and science, including principles of uncertainty propagation for linear and nonlinear physical models given real-world data, and connections to physics-informed machine learning.

Prerequisite: 15 points from COMPSCI 101, ENGGEN 131, MATHS 162, 199; and either 15 points from ENGSCI 311, 313, 314, or MATHS 260 and either STATS 210 or 225

ENGSCI 740 15 Points**Computational Engineering for Physical Systems**

Principles and practice for modelling complex physical systems. Applications in biomechanics, fluid mechanics and solid mechanics. Including topics such as large deformation elasticity theory applied to soft tissues, inviscid flow theory, compressible flows, viscous flows, meteorology, oceanography, coastal ocean modelling, mixing in rivers, fracture, composite materials and geomechanics. Underlying theories, computational techniques and industry applications explored using commercial software.

Prerequisite: BIOMENG 321 or ENGSCI 343

ENGSCI 742 15 Points**Studies in Continuum Mechanics**

An advanced course in continuum mechanics covering topics in the mechanics of solids and fluids and other continua.

Prerequisite: Departmental approval

ENGSCI 746 15 Points**Advanced Modelling and Simulation in Computational Mechanics**

Solution of real-world continuum mechanics problems using computational tools commonly used in engineering practice. Develops skills in analysing complexity; selecting a model representation of the physical problem; choosing the correct computational tool to solve the model; designing and executing appropriate numerical experiments; validating, interpreting and communicating simulation results. Advanced solver methods, and modelling of advanced materials such as large-deformation elastic/plastic materials.

Prerequisite: BIOMENG 321 or ENGSCI 343

Restriction: ENGSCI 344

ENGSCI 755 15 Points**Decision Making in Engineering**

Introduction to techniques for decision making in engineering systems including decision heuristics, simple prioritisation, outranking approaches, analytic hierarchy process, application to group decision making.

Prerequisite: ENGSCI 211 or MATHS 250

ENGSCI 760 15 Points**Algorithms for Optimisation**

Meta-heuristics and local search techniques such as Genetic Algorithms, Simulated Annealing, Tabu Search and Ant Colony Optimisation for practical optimisation. Introduction to optimisation under uncertainty, including discrete event simulation, decision analysis, Markov chains and Markov decision processes and dynamic programming.

Prerequisite: 15 points from COMPSCI 101, ENGGEN 131, MATHS 162, 199, and 15 points from COMPSCI 120, ENGSCI 111, STATS 125

ENGSCI 761 15 Points**Integer and Multi-objective Optimisation**

Computational methods for solving optimisation problems. Algorithms for integer programming including branching, bounding, cutting and pricing strategies. Algorithms for linear and integer programmes with multiple objective functions.

Prerequisite: ENGSCI 391 or 765

ENGSCI 763 15 Points**Advanced Simulation and Stochastic Optimisation**

Advanced simulation topics with an emphasis on optimisation under uncertainty. Uniform and non-uniform random variate generation, input distribution selection, output analysis, variance reduction. Simulation-based optimisation and stochastic programming. Two-stage and multi-stage programs with recourse. Modelling risk. Decomposition algorithms. Scenario construction and solution validation.

Prerequisite: ENGSCI 391 or 765

ENGSCI 765 15 Points**Advanced Optimisation in Operations Research**

Linear programming, the revised simplex method and its computational aspects, duality and the dual simplex method, sensitivity and post-optimal analysis. Network optimisation models and maximum flow algorithms. Transportation, assignment and transshipment models, and the network simplex method. Integer programming. The implementation and solution of optimisation models for practical applications.

Prerequisite: 15 points from ENGGEN 150, ENGSCI 111, MATHS 208, 250, 253, and 15 points from COMPSCI 101, ENGGEN 131, MATHS 162, STATS 220

Restriction: ENGSCI 391

ENGSCI 768 15 Points**Advanced Operations Research and Analytics**

Advanced Operations Research and Analytics topics including selected theory, algorithms and applications for non-linear programming, smooth and non-smooth optimisation, equilibrium programming and game theory.

Prerequisite: ENGSCI 391 or 765

ENGSCI 773 15 Points**Capstone Project**

Group based projects involving the application and integration of knowledge in computational engineering, data analytics and operations research for design, prototyping and performance testing of a new product. Topics include social and Te Tiriti considerations, engineering design practice, optimisation methods in robust design, material selection and structural analysis, risk management, communication skills, prototype manufacturing and design validation.

Prerequisite: 60 points from non-elective courses listed in Part III of the BE(Hons) Schedule for Engineering Science, including at least 15 points from ENGSCI 344, 355

Restriction: ENGSCI 363

ENGSCI 787 15 Points
Project X - Level 9
 Students are required to submit a report on a topic assigned by the appropriate Head of Department.
Prerequisite: Departmental approval

ENGSCI 788 30 Points
ENGSCI 788A 15 Points
ENGSCI 788B 15 Points

Research Project - Level 9
 Students are required to submit a report on a topic assigned by the appropriate Head of Department.
Prerequisite: Departmental approval
 To complete this course students must enrol in ENGSCI 788 A and B, or ENGSCI 788

ENGSCI 789 30 Points
Project Z - Level 9
 Students are required to submit a report on a topic assigned by the appropriate Head of Department.
Prerequisite: Departmental approval

ENGSCI 793A 45 Points
ENGSCI 793B 45 Points
Thesis (Operations Research and Analytics) - Level 9
Prerequisite: Departmental approval
 To complete this course students must enrol in ENGSCI 793 A and B

ENGSCI 794A 30 Points
ENGSCI 794B 60 Points
Thesis (Operations Research and Analytics) - Level 9
Prerequisite: Departmental approval
 To complete this course students must enrol in ENGSCI 794 A and B

ENGSCI 795 45 Points
ENGSCI 795A 15 Points
ENGSCI 795B 30 Points
Research Project - Level 9
Prerequisite: Departmental approval
 To complete this course students must enrol in ENGSCI 795 A and B, or ENGSCI 795

ENGSCI 796A 60 Points
ENGSCI 796B 60 Points
Thesis - Level 9
Prerequisite: Departmental approval
 To complete this course students must enrol in ENGSCI 796 A and B

Environmental Engineering

Stage II

ENVENG 200 15 Points
Fundamentals of Environmental Engineering
 Introduction to environmental engineering principles. Role of environmental engineers in the twenty-first century. Environmental measurements, environmental standards and impact assessment. Material mass balance. Drinking water, wastewater and stormwater treatment. Air quality parameters. Solid waste management. Sustainability. Environmental Impact Assessment.
Prerequisite: ENGGEN 140
Restriction: ENVENG 244

ENVENG 244 15 Points
Environmental Engineering 1
 Water quality, water and wastewater characteristics

– physical, chemical and biological treatments (unit operations and processes). Solid waste characteristics and disposal, hazardous waste treatment. Stormwater management.
Restriction: ENVENG 243

Stage III

ENVENG 300 15 Points
Natural and Built Environment Processes
 Chemical and biological treatment processes. Surface water quality modelling. Soil chemistry. Contaminant fate and transport in soil and groundwater. Contaminated sites remediation. Environmental responsibilities and sustainability considerations.
Prerequisite: ENVENG 200
Restriction: ENVENG 341

ENVENG 331 15 Points
Three Waters: Quality and Treatment
 Drinking-water treatment, stormwater and agricultural runoffs, biological wastewater treatment, small-scale water treatment systems, nutrient removal, micropollutants, emerging contaminants, water quality standards.

ENVENG 333 10 Points
Engineering Hydrology
 Hydrologic processes, analysis of rainfall-runoff relationships. Statistical analysis of hydrological data. Groundwater movement.

ENVENG 341 15 Points
Environmental Engineering 2
 Examines natural environmental processes and their relevance to engineering. Soil and water chemistry, equilibrium and organic chemistry, microbiology, biochemistry and biological processes will be examined, focusing on the application of these in engineering design, practice and management.

ENVENG 342 15 Points
Environmental Engineering Design
 The applications of design practice in environmental engineering with a number of design projects. Elements of water and wastewater engineering. Landfill design and air pollution control.
Restriction: ENVENG 405

Stage IV

ENVENG 400 15 Points
Special Topic

Postgraduate 700 Level Courses

ENVENG 701 15 Points
Urban Stormwater Management - Level 9
 Design and application of stormwater runoff quantity and quality control systems for urban development including: bioretention, living roofs, swales, permeable/porous pavement, detention ponds, and constructed wetlands. An independent project couples technical design, safety, maintenance, construction, hydrologic and water quality modelling, and stakeholder engagement in an application of "Low Impact Design" from the site to the catchment scale.
Prerequisite: either CIVIL 302 and ENVENG 200, or ENVENG 244 and 333

ENVENG 702 15 Points**Engineering Decision Making in Aotearoa - Level 9**

Advanced systems engineering based decision making; complex problem framing including ontology analysis; cultural opportunity mapping; absolute sustainability analysis; risk threshold determination; temporal cumulative effects; and effective consultation. Independent research is undertaken to solve a complex engineering decision making problem.

ENVENG 705 15 Points
Special Topic

A course on a topic in environmental engineering to be determined each year by the Head of Department of Civil and Environmental Engineering. The course will include the independent application of highly specialised knowledge and skills related to the study area.

Restriction: ENVENG 402

ENVENG 706 15 Points
Special Topic

A course on a topic in environmental engineering to be determined each year by the Head of Department.

Restriction: ENVENG 403

ENVENG 707 15 Points**Advanced Water Treatment and Reuse - Level 9**

Advanced water, wastewater, greywater, stormwater treatment technologies including advanced oxidation processes, photochemistry, electrochemistry, membrane treatment, and fundamentals of water reuse, applications, and case studies for potable reuse, industrial reuse, and aquifer recharge. Includes an individual research project.

Prerequisite: either ENVENG 300 and 331, or ENVENG 244 and 342

ENVENG 708 15 Points**Environmental Engineering for Sustainable Futures**

Addresses emerging engineering solutions to challenges facing humankind including climate change, sustainability and resilience of our society, and persistent waste and pollution in the environment. Includes applications of systems modelling through a holistic thinking lens, sustainability innovations, risk assessment and impact in various technologies and processes, climate change adaptation and mitigation.

ENVENG 740 15 Points**Water and Wastewater Engineering**

Chemistry and microbiology of water and wastewater treatment, flow models and reactors. Unit operations and process analysis and design. Treatment plant design and operation. Nutrient removal processes. Effluent and residues disposal.

ENVENG 744 15 Points**Environmental Engineering Processes Laboratory**

Laboratory research methods (safety, sampling procedures, sample preservation, data analysis and report writing). Laboratory experiments exploring various physical, chemical and biological processes, such as sedimentation, chemical coagulation and precipitation, chlorination, reactor residence time distribution, activated carbon and anaerobic digestion.

ENVENG 746 15 Points**Surface Water Quality Modelling - Level 9**

Advanced specialist topics in modelling of lakes and rivers. Specific topics covered include response to different loadings applied to surface water systems, and modelling

of organic matter, dissolved oxygen consumption, eutrophication, and toxic substances. The core taught skills are extended by an individual project in which independent research is undertaken to solve a challenging surface water quality engineering problem.

Prerequisite: either ENVENG 300, or ENVENG 341 and 342

ENVENG 747 15 Points**Environmental Fate of Chemicals and Mitigation - Level 9**

Focuses on modelling sorption, degradation kinetics, and leaching of chemicals in the soil environment. Topics include deriving sorption parameters, parent and metabolite fitting with statistical rigours, calculating degradation end-points, novel adsorbents for removing contaminants in soil and water. The core taught skills are extended by an individual project in which independent research is undertaken to solve an environmental issue.

Prerequisite: ENVENG 300 or 341

ENVENG 752 15 Points**Sustainability and Life Cycle Assessment**

Assessment and applications of sustainability principles in the design of products and/or infrastructures, including the use of sustainability tools. Provides an overview of life cycle assessment (LCA) based on ISO 14040 and ISO 14044 standards. Introduces LCA software to assist in analysing the data, interpreting the results and writing LCA reports.

ENVENG 760 15 Points**Water-Sensitive Cities**

Presents a range of water-sensitive and sustainable engineering solutions for the management of water, and explores their viability and effectiveness in the New Zealand context, both under current and future climate scenarios. Explores how population growth, climate change and economics put pressure on urban water systems, and the need for urban water systems design to be resilient to such pressures.

ENVENG 787 15 Points**Project X - Level 9**

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

ENVENG 788A 15 Points**ENVENG 788B 15 Points****Project Y - Level 9**

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in ENVENG 788 A and B

ENVENG 789 30 Points**Project Z - Level 9**

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

ENVENG 795 45 Points**ENVENG 795A 15 Points****ENVENG 795B 30 Points****Research Project (Environmental) - Level 9**

Students are required to submit a report on a topic relevant to the specialisation, as assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in ENVENG 795 A and B, or ENVENG 795

ENVENG 796A 60 Points
ENVENG 796B 60 Points
ME Thesis (Environmental) - Level 9
 Students are required to submit a thesis on a topic assigned by the appropriate Head of Department.
Prerequisite: Departmental approval
To complete this course students must enrol in ENVENG 796 A and B

Heritage Conservation

Postgraduate 700 Level Courses

HERCONS 700 15 Points
Heritage Processes
 Examines heritage conservation legislation, policy, guidelines and processes. Includes international context as well as New Zealand laws and processes.
Restriction: ARCHGEN 750

HERCONS 701 15 Points
Heritage Assessment and Conservation Planning - Level 9
 Examines the assessment of cultural heritage value and the use and preparation of conservation plans to guide heritage conservation work. Coursework comprises the researching and writing of a conservation plan.
Restriction: ARCHGEN 751

HERCONS 702 15 Points
Conservation of Materials
 Examines the theory and practice of conserving materials commonly found in heritage buildings and artefacts, including stone, brick, timber, concrete and steel.
Restriction: ARCHGEN 752

HERCONS 703 15 Points
Diagnosis and Adaptation
 Examines the investigation of existing building fabric, diagnosis of issues impacting upon the state of repair or the level of comfort, and the adaptation of heritage buildings, including strengthening, energy upgrading, reuse and the design of additions and alterations.
Restriction: ARCHGEN 753

HERCONS 790 30 Points
Research Project - Level 9
 A research project in the field of heritage conservation which may include an internship. Placements and topics to be approved by the Head of School of Architecture and Planning.
Prerequisite: ARCHGEN 750, 751, or HERCONS 700, 701
Restriction: ARCHGEN 754

Mechanical Engineering

Stage II

MECHENG 201 15 Points
Introduction to Mechatronics
 Introduces mechatronics to mechanical and mechatronics engineers. Covers sensors and actuators, analogue and digital circuit elements for signal processing and programming.
Prerequisite: ELECTENG 101, ENGGEN 131

MECHENG 211 15 Points
Thermofluids
 The fundamentals of fluid mechanics, thermodynamics and

heat transfer with practical applications to engineering devices and systems.

MECHENG 222 15 Points
Dynamics
 Kinematics of particles, rectilinear and curvilinear motion, kinematics of rigid bodies in the plane. Kinetics of particles, systems of particles and rigid bodies. Impulse and momentum, mechanism motion in the plane. Vibration of a particle.
Prerequisite: ENGGEN 121 or 150

MECHENG 235 15 Points
Design and Manufacture 1
 The engineering design process as a teamwork and problem-solving activity involving analysis, synthesis, evaluation and critical thinking. Design methodology and communicating design intent through written and graphical means. Introduction to selected motive power sources, machine elements for mechanical power systems, and production and fabrication processes.
Prerequisite: ENGGEN 115

MECHENG 236 15 Points
Design and Manufacture 2
 Applying the engineering design process to mechanical parts and assemblies, with consideration of risk management and manufacturing impacts. Design for common production processes and fabrication methods. Design of machine elements including hydraulic and pneumatic systems and components. Documenting and communicating detailed design process and outputs.
Prerequisite: ENGGEN 115

MECHENG 242 15 Points
Mechanics of Materials 1
 Principles of elastic material behaviour in the design of load carrying elements. Statically determinate stress systems; stress-strain relations. Bending of beams: stress-moment and moment-curvature relations; beam deflections; buckling of struts. Shear in joints, couplings, beams and circular shafts. General analysis of plane stress. Introduction to failure criteria by yield and fracture.
Prerequisite: ENGGEN 121 or 150

MECHENG 270 15 Points
Software Design
 Fundamentals of software design and high-level programming making use of case studies and programming projects. Includes: requirements analysis, specification methods, software architecture, software development environments, software quality, modularity, maintenance, reusability and reliability; models of software development.
Prerequisite: ENGGEN 131
Restriction: COMPSYS 202, SOFTENG 281

MECHENG 299 0 Points
Workshop Practice
Restriction: ENGGEN 299

Stage III

MECHENG 306 15 Points
Design of Sensing and Actuating Systems
 A range of projects on mechatronic elements and systems, involving sensors, actuators and microcontrollers, as well as their interfacing. The design of mechatronic sub-systems, including interfacing, signal conditioning and processing,

sensors, actuators, control technologies, software, systems modelling, simulation, analysis and design.

Prerequisite: MECHENG 235 and 270

Restriction: MECHENG 312

MECHENG 311 15 Points
Thermal Engineering

Second Law of Thermodynamics, entropy. Cycles and applications. Heat transfer, heat exchangers.

Prerequisite: MECHENG 211

MECHENG 313 15 Points
Design of Real-Time Software

Introduces the principles of software design in a real-time environment. Main topics include computer/microcontroller architecture, programming in a real-time environment, software design and data acquisition systems.

Prerequisite: MECHENG 270

MECHENG 322 15 Points
Control Systems

An introduction to classical control of mechanical and mechatronic systems. Topics include: transfer functions, block diagrams, time response characteristics, stability, frequency response characteristics, and controller design (e.g., pole placement, lead-lag compensation, PID). Applications in MATLAB/Simulink and with physical systems.

Prerequisite: ENGSCI 211, MECHENG 222

MECHENG 325 15 Points
Dynamics of Fluids and Structures

3D rigid body dynamics - inertia tensor, Euler's equations, gyroscopic motion. Vibration of single and two degree of freedom systems. Applications to vibration engineering. Introductory acoustics and New Zealand sound insulation standards. Mass, linear momentum, angular momentum and energy equations. Application to internal and external flows, boundary layers, pumps, turbines and lifting bodies. Experimental and numerical methods, dimensional analysis, similarity, and flow measurement.

Prerequisite: MECHENG 211, 222

MECHENG 334 15 Points
Design and Manufacture 3

Good practice and standard methods in mechanical engineering design. Conceptual and detailed design in projects involving machine elements, engineering sciences and engineering mechanics. Some of the advanced computer-aided tools (e.g., CAD, CAM, CAE) will be introduced and utilised in some projects.

Prerequisite: MECHENG 235, 236, 242

MECHENG 340 15 Points
Mechanics of Materials 2

Complex material behaviour and structural analysis, extending capability from two to three dimensions. States of stress and strain at a point in a general three-dimensional stress system. Generalised stress-strain relations for linearly elastic isotropic materials. Failure theories for ductile and brittle materials, elementary plasticity, and fatigue. Analytical techniques and numerical analysis of complex mechanical elements.

Prerequisite: MECHENG 242

MECHENG 352 15 Points
Manufacturing Systems

An introduction to the procedures and technological aspects of a typical manufacturing system; basic concepts and practice of plant and work design, automation, CAD/CAM, planning and simulation; selected

IoT technologies; and project-based introduction to the tools and techniques applied by professional engineers in a modern manufacturing setting.

MECHENG 370 15 Points
Electronics and Signal Processing

An introduction to the design, analysis and implementation of electronic circuits or systems for various applications such as signal generation and processing, interfacing, and high power electronics.

Prerequisite: ELECTENG 101

MECHENG 371 15 Points
Digital Circuit Design

Fundamental concepts in the design of combinational and sequential logic circuits. Modern approach to design using CAD tools that exploit the advantage of automation. Students will be exposed to the use of FPGA to rapid prototype digital systems using schematic and hardware description language entries.

Prerequisite: ELECTENG 101

Postgraduate 700 Level Courses

MECHENG 700A 15 Points

MECHENG 700B 15 Points

Research Project - Level 9

Supervised research on a topic in engineering culminating in an independent written project report that includes a literature review, a description of the research and its findings, and a statement of research contribution. Further supporting technical material will be provided as a compendium.

Prerequisite: 75 points from Part III courses in the BE(Hons) Schedule

Restriction: MECHENG 407, 408, 461, 462, 762, 763

To complete this course students must enrol in MECHENG 700 A and B

MECHENG 701 15 Points
Directed Study

Supervised research on a topic or topics approved by the Academic Head or nominee.

MECHENG 705 15 Points
Mechatronics Systems

Fundamentals of digital control and signal processing as applied to mechatronics systems. Modelling and analysis of mechatronics systems that includes transducers and applications. Issues related to mechatronics systems such as thermal management, signal detection, filtering and integrity, etc.

Prerequisite: MECHENG 322, 370

MECHENG 706 15 Points
Mechatronics Design Projects

A range of projects that demonstrate the application and integration of engineering knowledge to create practical intelligent devices, machines and systems. AI based control techniques will be introduced.

Prerequisite: MECHENG 306, 313, 370

MECHENG 707 15 Points
Special Topic

MECHENG 708 15 Points
Special Topic

MECHENG 709 15 Points
Industrial Automation

Automation technologies widely used in manufacturing and

processing industries. Topics include industrial robotics; programmable logic controllers (PLCs); pneumatics; machine vision systems; automated assembly; design for automation; and Industry 4.0 (such as machine-to-machine communications and data analysis). Students will participate in a number of hands-on labs throughout the course.

Restriction: MECHENG 710, 753, 754

MECHENG 710 15 Points

Advanced Industrial Automation - Level 9

Automation technologies widely used in manufacturing and processing industries. Topics include: industrial robotics; programmable logic controllers (PLCs); pneumatics; machine vision systems; automated assembly; design for automation; and Industry 4.0 (such as machine-to-machine communications and data analysis). Students will participate in a number of hands-on labs, including an individual research project related to the application of advanced automation techniques.

Restriction: MECHENG 709, 753, 754

MECHENG 711 15 Points

Advanced Computational Fluid Dynamics - Level 9

Application of computational methods to fluid dynamics and heat transfer. Finite volume and finite difference methods. Convergence and stability. Mesh generation and post-processing. Application of commercial computer programs to industrial problems. An individual project in which the student will be required to apply a commercial CFD code to a research problem of the student's choice.

Restriction: MECHENG 718

MECHENG 712 15 Points

Aerohydrodynamics

The study of fluid mechanics relevant to external flows, e.g., wind turbines, yachts, aircraft or wind loadings on buildings, boundary layers, computational fluid dynamics.

Prerequisite: MECHENG 325

MECHENG 713 15 Points

Energy Technology

Industrial thermodynamics and energy conversion/efficiency, power cycles, availability and irreversibility, simple combustion analysis, mass transfer, energy studies, boiling and condensation.

Prerequisite: MECHENG 311

MECHENG 714 15 Points

Wind Engineering - Level 9

Advanced specialist topics in wind engineering such as: the wind-loading chain - planetary boundary-layer flow, extreme winds, wind structure, wind loads, dynamic response, bluff body aerodynamics, vortex shedding, aero-elasticity, wind-tunnel testing, pedestrian level winds, wind energy. The core taught skills are extended by an individual project in which independent research is undertaken to solve a challenging wind engineering problem.

Prerequisite: MECHENG 712

MECHENG 715 15 Points

Building Services

Principles and practice of heating, ventilation, air-conditioning and refrigeration (HVAC&R), psychrometry, heating/cooling loads, mass transfer and air quality, refrigeration/heat pump systems, cooling towers, pumps, fans, valves, pipes and ducts.

Prerequisite: MECHENG 325

MECHENG 718 15 Points

Computational Fluid Dynamics

Application of computational methods to fluid dynamics and heat transfer. Finite volume and finite difference methods. Convergence and stability. Mesh generation and post-processing. Application of commercial computer programs to industrial problems.

Restriction: MECHENG 711

MECHENG 719 15 Points

Advanced Engineering Vibrations - Level 9

Selected topics in advanced vibration engineering: multiple degree of freedom and continuous systems, spectral analysis, analytical, approximate and numerical methods, including FEA, vibration instrumentation, measurement and testing, modal analysis, vibration treatment. Includes an individual project in which independent research is undertaken to solve a challenging advanced vibration problem.

Prerequisite: MECHENG 325

Restriction: MECHENG 722

MECHENG 720 15 Points

Advanced Multivariable Control Systems - Level 9

Advanced control of mechanical and mechatronic systems. Topics include: state-space representations, linearisation, discretisation, stability, state feedback control design, optimal control, state estimation and Kalman filters. Applications in MATLAB/Simulink and with physical systems. Includes an individual research project related to the design of advanced control systems encountered in practice.

Prerequisite: MECHENG 322

Restriction: ELECTENG 722, MECHENG 724

MECHENG 722 15 Points

Engineering Vibrations

Selected topics in vibration engineering: Multiple degree of freedom and continuous systems; Spectral analysis; analytical, approximate and numerical methods, including FEA; vibration instrumentation, measurement and testing; modal analysis; vibration treatment.

Prerequisite: CIVIL 314 or ELECTENG 303 or MECHENG 325 or equivalent

Restriction: MECHENG 719

MECHENG 724 15 Points

Multivariable Control Systems

Advanced control of mechanical and mechatronic systems. Topics include: state-space representations, linearisation, discretisation, stability, state feedback control design, optimal control, state estimation and Kalman filters. Applications in MATLAB/Simulink and with physical systems.

Prerequisite: MECHENG 322

Restriction: ELECTENG 722, MECHENG 720

MECHENG 726 15 Points

Acoustics for Engineers

The wave equation and solutions. Noise sources. Sound reflection and propagation. The ear and hearing system. Psychology of hearing. Measurement of sound fields and acoustic properties of rooms. Legal and standards requirements. Sound fields in enclosures. Sound transmission. Materials as absorbers and reflectors. Electro-acoustics. Digital signal processing for audio and acoustics.

Prerequisite: ELECTENG 331 or MECHENG 325

MECHENG 728 15 Points**Advanced MEMS and Microsystems - Level 9**

Working principles and fabrication of MEMS/microsystems such as microsensors, microactuators, microfluidics, etc. Exposure to engineering design principles including engineering mechanics, fluidics, materials, etc., at microscale. Includes an individual research project related to the design and fabrication of a device for an advanced application.

Prerequisite: MECHENG 325

Restriction: MECHENG 735

MECHENG 730 15 Points**Advanced Biomechatronic Systems - Level 9**

Advanced mechatronic principles and techniques for measuring and manipulating biological systems. Human biomechanics and motion control, advanced serial and parallel robots, compliant soft robots, software and functional safety, human robot interaction and force control, novel sensors and actuators, and biomechatronic design principles. Includes an individual research project related to the analysis, selection and successful implementation of one of these advanced technologies.

Restriction: MECHENG 736

MECHENG 731 15 Points**Mechanical Design Projects**

Team design projects requiring the ideation, development, prototyping and communication of design solutions. The projects will involve application of project management tools and techniques alongside selection and appropriate application of suitable engineering methods, while accounting for a range of design issues such as suitability, quality, safety and regard for the environment, with consideration to stakeholder values in the New Zealand context.

Prerequisite: MECHENG 334

MECHENG 735 15 Points**MEMS and Microsystems**

Introduction to working principles and fabrication of MEMS/microsystems such as microsensors, microactuators, microfluidics, etc. Exposure to engineering design principles including engineering mechanics, fluidics, materials, etc. at microscale. Exposure to microfabrication processes as part of a laboratory component.

Prerequisite: MECHENG 325

Restriction: MECHENG 728

MECHENG 736 15 Points**Biomechatronic Systems**

Mechatronic principles and techniques for measuring, assisting, augmenting and mimicking biological systems. Topics include: brain machine interfaces, sensors and actuators, biomechanics and motion control, wearable and assistive devices, bioinstrumentation, soft robotic technologies, human factors, safety/ethical aspects, and biomechatronic design principles. Significant hands-on experience through the design, modelling and development of paradigmatic biomechatronic systems.

Restriction: MECHENG 730

MECHENG 742 15 Points**Advanced Materials Manufacturing - Level 9**

Properties and processing of polymers and polymer composites. Analysis of selected manufacturing processes such as injection moulding, extrusion and liquid composites moulding. Viscous flow, flow through porous media and heat transfer. Includes an individual research project

related to recent developments in advanced composites in terms of processability/manufacturability, functionality and performance/potential.

MECHENG 743 15 Points**Composite Materials**

Applications and manufacturing of composite materials. Mechanics of composite lamina/laminate. Failure prediction, design and finite element analysis of composite laminates and structures. Analysis and design of sandwich structures.

Prerequisite: MECHENG 340

MECHENG 747 15 Points**Manufacturing and Industrial Processes**

Analysis and design of manufacturing processes, with a focus on techniques to manipulate metals and polymers. Application of solid mechanics, fluid mechanics and heat transfer to current additive, subtractive, forming and injection/casting manufacturing technologies. Topics include: bulk and sheet forming, extrusion, injection moulding, 2D and 3D printing processes.

Prerequisite: MECHENG 340

MECHENG 751 15 Points**Advanced CAD/CAM/CNC - Level 9**

Advanced computer-aided design (CAD), computer-aided manufacturing (CAM) and computer numerical control (CNC). Intelligent CAD, feature-based design and manufacturing, CAD data interoperability, advanced CAM methodologies, smart CNC systems, and integration of the above technologies. Includes an independent research project to demonstrate mastery of the philosophy, analysis, selection and successful implementation of manufacturing technologies.

Prerequisite: MECHENG 352 or 752

MECHENG 752 15 Points**Technology Management**

An appreciation of the strategic systems and technology management aspects of manufacturing systems. Industry based projects that explore the design and optimisation of manufacturing operations form a major part of the course.

Prerequisite: B grade or higher in ENGGEN 303

MECHENG 753 15 Points**Advanced Industry 4.0 Smart Manufacturing - Level 9**

New or emerging technologies and their applications in manufacturing enterprises, including Industry 4.0, product modelling technologies, smart manufacturing systems, industrial IoT (Internet of Things) sensing and data analysis technologies, digital twins, and applications of RFID (Radio Frequency Identification) and interoperability standards such as OPC UA in a modern manufacturing setting. Students will work on research projects individually and independently on a topic related to Industry 4.0.

Prerequisite: MECHENG 352 or 752

Restriction: MECHENG 709, 710, 754

MECHENG 754 15 Points**Industry 4.0 Smart Manufacturing**

New information technologies and their applications in manufacturing enterprises, including introduction to Industry 4.0, product modelling technologies, smart manufacturing systems, industrial IoT sensing and data analysis technologies, digital twins and applications of RFID in a modern manufacturing setting.

Restriction: MECHENG 709, 710, 753

MECHENG 755 15 Points**Design for Additive Manufacturing**

Design for additive manufacturing (AM), metal AM, polymer AM, AM technologies, material extrusion, powder bed fusion, vat photopolymerisation, material jetting, binder jetting, AM thought process, economics of AM, support generation, residual stress reduction, post-processing, computational design, light-weighting, topology optimisation, lattice structures, mass-customisation, tooling, conformal cooling, heat exchangers, part consolidation, specialised AM software: nTopology Magics, Inspire, CAD for AM.

Prerequisite: MECHENG 235

MECHENG 787 15 Points**Project X - Level 9**

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

MECHENG 788 30 Points**MECHENG 788A** 15 Points**MECHENG 788B** 15 Points**Research Project - Level 9**

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in MECHENG 788 A and B, or MECHENG 788

MECHENG 789 30 Points**Project Z - Level 9**

Students are required to submit a report on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

MECHENG 795 45 Points**MECHENG 795A** 15 Points**MECHENG 795B** 30 Points**Research Project (Mechanical) - Level 9**

Students are required to submit a report on a topic relevant to the specialisation, as assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in MECHENG 795 A and B, or MECHENG 795

MECHENG 796A 60 Points**MECHENG 796B** 60 Points**ME Thesis (Mechanical) - Level 9**

Students are required to submit a thesis on a topic assigned by the appropriate Head of Department.

Prerequisite: Departmental approval

To complete this course students must enrol in MECHENG 796 A and B

Mechatronics Engineering

Stage II**MECHTRON 299** 0 Points**Workshop Practice**

Restriction: ENGGEN 299

Postgraduate 700 Level Courses**MECHTRON 796A** 60 Points**MECHTRON 796B** 60 Points**ME Thesis (Mechatronics) - Level 9**

Students are required to submit a thesis on a topic assigned by the appropriate Head of Department.

To complete this course students must enrol in MECHTRON 796 A and B

Polymer Engineering

Postgraduate 700 Level Courses**POLYMER 700** 15 Points**Polymer Materials Engineering**

Microstructure and morphology of semi-crystalline and amorphous polymers, including alloys and thermoplastic elastomers. The study of structure/property/processing inter-relationships for polymer materials.

Restriction: CHEMMAT 740

POLYMER 704 15 Points**Advanced Polymer Processing**

In-depth coverage of advanced polymer processing techniques. Study of additives, degradation processes and the prevention of degradation, formulation of products (thermosets and speciality polymers) and mixing of materials. Advanced moulding techniques, reaction injection moulding and processing biopolymers and speciality polymers as well as liquid moulding.

Restriction: CHEMMAT 741, 743

POLYMER 705 15 Points**Polymer Process and Product Design**

Material properties and selection for polymers. Drying and heat transfer. Polymer part and mould design, moulding simulation software. Fabrication and lifecycle considerations. Specialised polymers, processes and products.

Restriction: CHEMMAT 742

POLYMER 706 15 Points**Polymer Testing and Characterisation**

Focuses on applying characterisation techniques to polymer materials, especially spectroscopic, thermal and rheological analysis and mechanical testing to understand the behaviour of polymer materials for design, processing and use.

Restriction: CHEMMAT 740, 743

Software Engineering

Stage II**SOFTENG 206** 15 Points**Software Engineering Design 1**

Project work. Skills and tools in systematic development of software, including testing, version control, build systems, working with others. Professional issues introduced in ENGGEN 204 (ethics, communication, and teamwork) are reinforced and developed while simulating a client-facing software development process.

Prerequisite: SOFTENG 251 or 281

SOFTENG 211 15 Points**Software Engineering Theory**

Sets. Formal languages, operations on languages. Deterministic and nondeterministic automata, designing

automata, determinisation. Regular expressions. Logic. Induction. Recursion. Program correctness. Computability. Counting. Elements of graph algorithms.

Prerequisite: ENGGEN 131 or COMPSCI 101

SOFTENG 250 15 Points

Introduction to Data Structures and Algorithms

Introduction to the analytical and empirical behaviour of basic algorithms and data structures.

Prerequisite: ENGGEN 131 or COMPSCI 101

Corequisite: ENGSCI 211

SOFTENG 251 15 Points

Object Oriented Software Construction

An introduction to Object Oriented software development. Programming with classes; objects and polymorphism. Evolutionary and test-driven development. Analysis and design. Modelling with UML. Design patterns. Design for reuse, for testing, and for ease of change.

Prerequisite: ENGGEN 131 or COMPSCI 101

SOFTENG 254 15 Points

Quality Assurance

Software verification and validation. Static and dynamic QA activities as part of the software lifecycle. Unit, integration, system, and usability testing. Use of visual notations, automation, and tools to support development activities. Metrics to quantify strength of testing and complexity of programs.

Prerequisite: SOFTENG 250, 251

SOFTENG 281 15 Points

Object-Oriented Programming

Computer programming using objects as the mechanism for modularity, abstraction, and code reuse. Review of control structures for conditionals and iteration. Instance variables, methods, and encapsulation. Interfaces, inheritance, polymorphism, and abstract classes. Exception handling. Introduction to basic data structures and basic algorithms including sorting and searching.

Prerequisite: COMPSCI 101 or ENGGEN 131

Restriction: COMPSCI 230, COMPSYS 202, MECHENG 270, SOFTENG 251

SOFTENG 282 15 Points

Software Engineering Theory

Theoretical foundations of software engineering, including sets, formal languages, operations on languages, deterministic and nondeterministic automata, designing automata, determinisation, regular expressions, logic, induction, recursion, program correctness, computability, counting, elements of graph algorithms.

Prerequisite: COMPSCI 101 or ENGGEN 131

Restriction: COMPSCI 225, SOFTENG 211

SOFTENG 283 15 Points

Software Quality Assurance

Software verification and validation. Static and dynamic quality assurance activities as part of the software lifecycle. Unit, integration, system, and usability testing. Metrics to quantify strength of testing and complexity of programs. Techniques for engineering of software systems including requirements, specification, validation, verification. Modelling paradigms including information, behaviour, domain, function and constraint models. Specification languages.

Prerequisite: COMPSYS 202 or SOFTENG 251 or 281

Restriction: SOFTENG 254

SOFTENG 284 15 Points

Data Structures and Algorithms

Data structures including linked-lists, stacks, queues, trees, hash tables; graph representations and algorithms, including minimum spanning trees, traversals, shortest paths; introduction to algorithmic design strategies; correctness and performance analysis.

Prerequisite: COMPSYS 202 or SOFTENG 251 or 281

Restriction: COMPSCI 220, 717, SOFTENG 250

SOFTENG 299 0 Points

Workshop Practice

Restriction: ENGGEN 299

Stage III

SOFTENG 306 15 Points

Software Engineering Design 2

Working in project teams to develop software to meet changing requirements for a large application. Project planning. Requirements gathering. Estimating, costing and tracking. Acceptance and unit testing. Evolutionary design and development. Collaborative development tools. Professional issues introduced in ENGGEN 204 and 303 (communication, leadership, teamwork, safety in design) are reinforced and developed.

Prerequisite: SOFTENG 206, and SOFTENG 254 or 283

SOFTENG 310 15 Points

Software Evolution and Maintenance

Design and maintenance of multi-version software, debugging techniques, design and documentation for software re-use, programme migration and transformation, refactoring, tools for software evolution and maintenance.

Prerequisite: SOFTENG 254 or 283

SOFTENG 325 15 Points

Software Architecture

Taxonomy of software architecture patterns, including client/server and multi-tier. Understanding quality attributes. Methodologies for design of software architectures. Technologies for architecture level development, including middleware.

Prerequisite: COMPSYS 302 or SOFTENG 254 or 283

Restriction: COMPSCI 331

SOFTENG 350 15 Points

Human Computer Interaction

Human behaviour and humans' expectations of computers. Computer interfaces and the interaction between humans and computers. The significance of the user interface, interface design and user centred design process in software development. Interface usability evaluation methodologies and practice. Includes an evaluation project, group design project, and implementation using current techniques and tools.

Prerequisite: SOFTENG 206 or 283

Restriction: COMPSCI 345, 370

SOFTENG 351 15 Points

Fundamentals of Database Systems

Relational model, Relational algebra, Relational calculus, SQL, SQL and programming languages, Entity-Relationship model, Normalisation, Query processing, Query optimisation, Distributed databases, Transaction management, Concurrency control, Database recovery.

Prerequisite: SOFTENG 251 or 281

Restriction: COMPSCI 351

SOFTENG 364 15 Points
Networks and Security
 Physical networks, TCP/IP protocols, switching methods, network layering and components, network services. Information security, computer and network security threats, defence mechanisms and encryption.
Prerequisite: COMPSYS 201, and SOFTENG 251 or 281

SOFTENG 370 15 Points
Operating Systems
 History of operating systems. Multi-user systems. Scheduling. Concurrent processes, threads and synchronisation. Memory allocation and virtual memory. Managing files, disks and other peripherals. Security, protection and archiving. Engineering distributed systems; location, migration and replication transparency. Real-time programming and embedded systems.
Prerequisite: COMPSYS 201, and SOFTENG 251 or 281
Restriction: COMPSCI 340

Postgraduate 700 Level Courses

SOFTENG 700A 15 Points
SOFTENG 700B 15 Points
Research Project - Level 9
 Students are required to submit a report on project work carried out on a Software Engineering topic assigned by the Head of Department.
Prerequisite: SOFTENG 306
To complete this course students must enrol in SOFTENG 700 A and B

SOFTENG 701 15 Points
Advanced Software Engineering Development Methods - Level 9
 Advanced studies in methods and techniques for developing complex software systems including topics in software engineering environments, advanced software design, tool construction and software architectures. The core taught skills are extended by individual projects in which independent research is undertaken to address challenging software system problems.
Prerequisite: COMPSYS 302 or SOFTENG 306

SOFTENG 710 15 Points
Studies in Software Engineering 1
 Advanced courses on topics to be determined each year by the Head of Department.
Prerequisite: Departmental approval

SOFTENG 711 15 Points
Studies in Software Engineering 2
 Advanced courses on topics to be determined each year by the Head of Department.
Prerequisite: Departmental approval

SOFTENG 715 15 Points
Special Topic

SOFTENG 751 15 Points
High Performance Computing - Level 9
 Advanced parallel and high performance computing concepts and techniques such as parallel system architecture; parallelisation concepts, algorithms and methodology; parallel programming paradigms and technologies. Core concepts and skills are deepened by a hands-on research project in which a challenging parallel computing problem is analysed and solved.
Prerequisite: COMPSYS 302 or SOFTENG 306

SOFTENG 752 15 Points
Formal Specification and Design - Level 9
 Formal specification, design, and (automatic) analysis of software systems. Quality assurance through precise description and rigorous verification on the design. Introduction to the Z, OCL and CSP notations. Comparison of approaches, with emphasis on their practical application. Includes a substantial individual research project.
Prerequisite: COMPSYS 302 or SOFTENG 306

SOFTENG 753 15 Points
Machine Learning Techniques and Applications
 Examines classic and state of the art algorithms in the field of machine learning. Topics may include: Bayesian classification, regression and state estimation; clustering and mixture models; kernel-based methods; sequential models; graphical models; neural networks and deep architectures.
Prerequisite: COMPSYS 302 or 306 or SOFTENG 306

SOFTENG 754 15 Points
Advanced Software Requirements Engineering - Level 9
 Advanced software engineering concepts focusing on techniques for requirements analysis and requirements engineering (RE) of software systems. Topics will include: requirements elicitation, analysis, specification, validation, verification, user experience design, test-driven development and continuous integration. Includes a substantial individual research project.
Prerequisite: COMPSYS 302 or SOFTENG 306

SOFTENG 755 15 Points
Special Topic

SOFTENG 761 15 Points
Advanced Agile and Lean Software Development - Level 9
 Advanced software engineering concepts focussing on Agile and Lean software development; including hands-on iterative and incremental software development, self-organising teamwork, project management, and an individual research component to explore challenging issues in this discipline.
Prerequisite: COMPSYS 302 or SOFTENG 306

SOFTENG 762 15 Points
Robotics Process Automation
 Covers the fundamentals of Robotic Process Automation (RPA) systems. Students explore what RPA is and where it is useful, how RPA fits into current information technology setups, extracting and manipulating data from both external and internal sources, generating reports and statistics, and orchestrating multi-robot installations.
Prerequisite: COMPSYS 302 or SOFTENG 306
Restriction: INFOSYS 300

SOFTENG 770 15 Points
Capstone Project
 Final year team exercise with students in multi-disciplinary roles, with focus on software engineering, integrating technical learning into realistic design outcomes. Comprehensive investigation of an open ended, complex, real or synthetic computer, electrical and software engineering problem with simulated professional design office constraints. Includes technical, economic and environmental impact components to complete a scheme assessment report.
Prerequisite: 75 points from Part III courses listed in the BE(Hons) Schedule for the Software Engineering specialisation

SOFTENG 787	15 Points
Project X - Level 9	
Students are required to submit a report on a topic assigned by the Head of Department.	
<i>Prerequisite: Departmental approval</i>	
SOFTENG 788	30 Points
SOFTENG 788A	15 Points
SOFTENG 788B	15 Points
Research Project - Level 9	
Students are required to submit a report on a topic assigned by the appropriate Head of Department.	
<i>Prerequisite: Departmental approval</i>	
<i>To complete this course students must enrol in SOFTENG 788 A and B, or SOFTENG 788</i>	
SOFTENG 789	30 Points
Project Z - Level 9	
Students are required to submit a report on a topic assigned by the Head of Department.	
<i>Prerequisite: Departmental approval</i>	
SOFTENG 795	45 Points
SOFTENG 795A	15 Points
SOFTENG 795B	30 Points
Research Project (Software Engineering) - Level 9	
Students are required to submit a report on a topic relevant to the specialisation, as assigned by the appropriate Head of Department.	
<i>Prerequisite: Departmental approval</i>	
<i>To complete this course students must enrol in SOFTENG 795 A and B, or SOFTENG 795</i>	
SOFTENG 796A	60 Points
SOFTENG 796B	60 Points
ME Thesis (Software Engineering) - Level 9	
Students are required to submit a thesis on a topic assigned by the Head of Department.	
<i>Prerequisite: Departmental approval</i>	
<i>To complete this course students must enrol in SOFTENG 796 A and B</i>	

Structural Engineering

Stage II

STRCTENG 200	15 Points
Introductory Structural Mechanics	
Introduction to structural analysis for civil engineers. Equilibrium, internal actions and deformations, structural forms, structural systems, analysis of determinate systems, plane section properties, elasticity, engineering beam theory, failure theories. Prepares students to embark on further studies in structural design.	
<i>Prerequisite: ENGGEN 121</i>	
<i>Restriction: CIVIL 210</i>	
STRCTENG 201	15 Points
Civil Engineering Materials and Design	
Properties and manufacturing of civil engineering material including concrete, steel, timber structural products and roading material. Design principles and examples for concrete, steel and timber members.	
<i>Restriction: CIVIL 250</i>	
STRCTENG 299	0 Points
Workshop Practice	
<i>Restriction: ENGGEN 299</i>	

Stage III

STRCTENG 300	15 Points
Design Loads and Dynamic Response of Structures	
Determination of design loads according to AS/NZS1170 and the response of structures under dynamic loadings.	
<i>Prerequisite: CIVIL 210 or STRCTENG 200</i>	
<i>Restriction: CIVIL 314</i>	
STRCTENG 301	15 Points
Timber Structures Design	
Structural analytical techniques including computer based approaches to simple indeterminate structures. Design procedures for members and structural systems of timber and engineered wood products including environmental and sustainability considerations in design. Design project.	
<i>Prerequisite: CIVIL 210 or STRCTENG 200</i>	
<i>Restriction: CIVIL 312</i>	
STRCTENG 302	15 Points
Steel Structures Design	
Mechanical properties of steel and contextualises the application of steel and steel/concrete into buildings and bridges including material environmental and sustainability considerations. Comprehensive introduction to design of structural steel members and connections and their use in structures. Application to vertical load carrying systems and steel building behaviour in earthquake and fire.	
<i>Prerequisite: CIVIL 210 or STRCTENG 200</i>	
<i>Restriction: CIVIL 313</i>	
STRCTENG 303	15 Points
Concrete Structures Design	
Design of reinforced concrete members including beams, columns, walls, foundations. Introduction to prestressed and precast concrete design and applications. Use of the New Zealand Concrete Structures Standard, NZS 3101. Discussion of environmental and sustainability considerations when using concrete as a building material.	
<i>Prerequisite: CIVIL 210 or STRCTENG 200</i>	
<i>Restriction: CIVIL 313</i>	

STRCTENG 304	15 Points
Structural Design for Civil Engineers	
Structural loading for gravity and wind in accordance with the loading code AS/NZS1170. Design principles and examples for concrete and timber members and design for timber framed buildings using NZS3604 including the concept of safety in design. Discussion of sustainability and environmental implications of selecting different building materials. Introduction to seismic building behaviour at a conceptual level.	
<i>Prerequisite: CIVIL 210 or STRCTENG 200</i>	
<i>Restriction: CIVIL 312, 313</i>	

Postgraduate 700 Level Courses

STRCTENG 710	15 Points
Low Rise Structures Design	
Structural systems for low-rise buildings, including seismic design and analysis techniques. Design and detailing of low-rise structures in structural steel, reinforced concrete, reinforced masonry, and timber including discussion of sustainability and environmental impacts of design decisions. Strut and tie for reinforced concrete. Introduction to fire engineering. Techniques in ensuring safety in design, checking of existing structures, lessons from failures, and design for repair.	
<i>Prerequisite: STRCTENG 302, and CIVIL 313 or STRCTENG 303</i>	
<i>Restriction: CIVIL 713</i>	

STRCTENG 711 15 Points**Multistorey Structures Design**

Techniques for the design of multistorey structures to resist seismic loading. Derivation of design actions and design of structural components subject to cyclic inelastic action. Includes identifying alternative structural systems for resisting seismic loads, incorporating sustainable design into seismic structural systems, detailing of members and joints to enhance earthquake resistance, design for repair, seismic isolation, and ensuring safety in design.

Prerequisite: STRCTENG 302, and CIVIL 313 or STRCTENG 303

Restriction: CIVIL 714

STRCTENG 760 15 Points**Forensic Structural Engineering**

Investigation of structural failures and disasters extending to the evaluation and assessment, restoration, and strengthening of modern and historic structures. Provides an understanding of the forensic engineering process that applies to the investigation and assessment of structural failures. Business practices including standards of care, performing critical self-assessment of capabilities, assembling a team, and professional ethics, legal testimony, and media relations are also discussed.

Prerequisite: STRCTENG 302, 303

Restriction: CIVIL 744

Transdisciplinary Artificial Intelligence and Society

Stage I**TD AIS 100** 15 Points**Artificial Intelligence and Society**

Explores the impacts of Artificial Intelligence on society. Working in teams, students will investigate how Artificial Intelligence systems work and their impacts on the legal, social, ethical, and indigenous systems. Using the health sector as an example, students will use a transdisciplinary approach to propose solutions for developing Artificial Intelligence systems that are equitable for all groups in society.

Urban Design

Postgraduate 700 Level Courses**URBDES 702** 15 Points**Urban Design Theory and Practice**

The language of urban design, urban analysis, urban history, contemporary theory, international and local practice, allied disciplines, cities in the developing world and pacific urbanism.

URBDES 703 15 Points**Directed Study****URBDES 705** 15 Points**Emerging Paradigms**

Urban morphology and exploring contemporary urban design issues and paradigms.

URBDES 710 30 Points**Urban Design Studio 1 - Level 9**

Studio-based investigation to develop critical skills and judgments on urban design principles and concepts ranging from street/block to urban design at a strategic scale.

URBDES 720 30 Points**Urban Design Studio 2 - Level 9**

An advanced urban design project involving highly specialised research related to the analysis and design of the built environment.

Prerequisite: URBDES 710

URBDES 730 30 Points**Urban Design Research Project**

Individual research project in an aspect of urban design theory or practice.

Urban Planning

Stage I**URBPLAN 101** 15 Points**Introduction to Urban Planning**

An introduction to the discipline of urban planning, examining its evolution, theory, practice, profession, ethics, values and future trends. Offers a critical exploration of the challenges facing urban planners today and into the future.

URBPLAN 122 15 Points**Introduction to Society, Civics and Governance Issues for Urban Planning**

An introduction to the concepts of civics and governance in New Zealand and its international obligations, the theories and values of democracy, natural justice and the role institutional behaviour. Provides an understanding of the basis of the New Zealand legal system, the Te Tiriti o Waitangi/Treaty of Waitangi and public policy development.

Restriction: URBPLAN 102

URBPLAN 123 15 Points**Urban Planning Economics**

An introduction to economic theory, at both the micro and macro levels, and its impact and influence on urban planning policy development and decision making. Includes reference to how economic development can be integrated into effective urban planning policy formulation.

Restriction: URBPLAN 102

URBPLAN 124 15 Points**Ecosystem, Sustainability and Environment**

Introduces ecological processes, natural hazard risk, and urban resilience in an urban context. Explores themes in ecology, climate change, biodiversity, sustainability, and Māori values and perspectives of the ecosystem and environmental processes, with a focus on the interactions between the natural and built environment, utilising a holistic and systematic approach.

Restriction: URBPLAN 105

URBPLAN 125 30 Points**Urban Planning Studio 1**

Introduces site plan, land use development, urban design theories, urban morphology and how these principles apply to building form, land use and subdivision, the space between buildings, and urban landscape management. Students undertake site analysis to develop skills at differing scales for challenges such as housing provision and diversity in relation to heritage, cultural values, natural hazards, and feasibility.

URBPLAN 126 30 Points**Urban Planning Studio 2**

An introduction to basic urban design theories and principles as applied to building form, land use and subdivision patterns, the space between buildings, the

role of open space and the public realm. Students will undertake site analysis and through a studio-based design exercise develop skills and practices for working at the differing spatial scale relevant for urban planning and urban design.

Stage II

URBPLAN 201 15 Points Urban Policy Analysis

The application of critical quantitative and qualitative research skills and methods for urban planning.

Prerequisite: URBPLAN 101-105, or 30 points passed in *Global Environment and Sustainable Development*

URBPLAN 202 15 Points Urban Planning Implementation and Law

A critical understanding of the concepts and principles of relevance to urban planning legislation, practice and decision-making.

Prerequisite: URBPLAN 101-105

URBPLAN 203 15 Points Urban Infrastructure

A critical analysis of infrastructure provision, modelling, and assets management provision.

Prerequisite: URBPLAN 101-105, or GEOG 101, 102, 140 or GISCI 140, and URBPLAN 103

URBPLAN 204 15 Points Urban Planning Social Theory and Practice

A critical analysis of the urban social issues, urban social theory, social justice and deprivation, and gender issues.

Prerequisite: URBPLAN 101-105

URBPLAN 205 15 Points Urban Infrastructure and Transportation Planning

Examines the issues surrounding the planning, development and funding of different types of social and physical infrastructure, including transportation, energy, renewable energy, and water and sewerage management, using local and international case studies and examples.

Prerequisite: URBPLAN 101-105, or BLTENV 101-103 and URBPLAN 101, 124, 125

URBPLAN 210 15 Points Urban Planning Studio Three

Research and design techniques and skills for evaluating urban design outcomes against urban design criteria at the neighbourhood scale.

Prerequisite: URBPLAN 110, 111

URBPLAN 211 15 Points Urban Planning Studio Four

Examines the complex interrelationships of urban planning issues required to achieve effective and sustainable design solutions at the town/city spatial scale.

Prerequisite: URBPLAN 110, 111

URBPLAN 221 15 Points People, Housing and Communities

Critically explores culture, democracy, and urban social theories and issues, such as social justice and cohesion, social dislocation and urban gentrification, taking into account cultural values, mātauranga Māori and kaupapa Māori. Explores urban planning responses and community engagement methods, including social impact assessments,

explorations of housing policies and practices, and transportation planning responses to social dislocation.

Prerequisite: URBPLAN 101, 122-126, or BLTENV 101-103 and URBPLAN 101, 124, 125

Restriction: URBPLAN 204

URBPLAN 222 15 Points Urban Economics

Explores economic theories at both micro and macro levels and their direct relevance to urban planning policy development and decision-making processes. Analyses urban land use economics, economic models such as cost-benefit analysis (CBA), the housing market, and the role of planning strategies in facilitating or impeding efficient land and property markets.

Prerequisite: URBPLAN 101, 122-126, or BLTENV 101-103 and URBPLAN 101, 124, 125

Restriction: URBPLAN 304

URBPLAN 223 15 Points Planning Law and Applications

Introduces the New Zealand land tenure, property and land ownership, property rights, and the relevant legislation. Provides a critical understanding of the framework, concepts, principles, functions, and development processes of the environment, resource management and urban planning legislation, practices and decision-making, and the applications of legislation and legal principles to practical planning issues and situations.

Prerequisite: URBPLAN 101, 122-126, or BLTENV 101-103 and URBPLAN 101, 124, 125

Restriction: URBPLAN 202

URBPLAN 225 30 Points Urban Planning Studio 2

Focuses on holistic and multi-dimensional approaches to community re-generation across its various dimensions and the mitigation of adverse impacts of urban gentrification and social dislocation of existing communities, including Māori whānau. Explores built environment, public realm placemaking, infrastructure provision, accessibility, and energy-efficient and socially equitable planning strategies and skills to undertake a medium-scale precinct regeneration.

Prerequisite: URBPLAN 101, 122-126, or BLTENV 101-103 and URBPLAN 101, 124, 125

URBPLAN 226 30 Points Urban Planning Studio 3

Undertake an in-depth consideration of an environmental threat currently or potentially challenging community planning practices, taking into account socially equitable outcomes and Māori resource interests, rights, and worldview. Explorations of impacts of environmental threats such as climate change, and the challenges of creating resilient, sustainable, and equitable communities for mitigating and/or adapting to impacts of natural threats.

Prerequisite: URBPLAN 101, 122-126, or BLTENV 101-103 and URBPLAN 101, 124, 125

Stage III

URBPLAN 301 15 Points Urban Economic Development

An evaluation of theories, policies and practices of community and economic development relevant for urban planning.

Prerequisite: URBPLAN 201-205, or 30 points at Stage II in *Global Environment and Sustainable Development*

URBPLAN 302 Heritage/Cultural Issues for Urban Planning A critical analysis of the history, theory and practice of heritage planning in New Zealand and relevant international contexts. <i>Prerequisite: URBPLAN 201-205</i>	15 Points
URBPLAN 303 Ecology and Resilience A critical analysis of the ecological view towards the concepts of resilience; social-ecological systems models, considering wicked problems and the impacts of climate change. <i>Prerequisite: URBPLAN 201-205</i>	15 Points
URBPLAN 304 Urban Land Use Economics Examines the principles of urban land economics focusing on economic development, property markets and property development. <i>Prerequisite: URBPLAN 201-205</i>	15 Points
URBPLAN 305 Māori Urban Planning Issues Māori attitudes, values and aspirations in urban planning with an understanding of the Treaty of Waitangi; post Treaty settlements. <i>Prerequisite: URBPLAN 201-205</i>	15 Points
URBPLAN 306 Global Contexts and Contemporary Urban Planning Issues Examines how comparative urban planning systems address contemporary urban planning issues in both the New Zealand and international contexts. <i>Prerequisite: URBPLAN 201-205, or 30 points at Stage II in Global Environment and Sustainable Development</i>	15 Points
URBPLAN 307 Negotiation, Mediation and Project Management Provides a critical understanding of negotiation, mediation and project management methods and skills for urban planning, and management types, cultures and consensus-building for private practices and in local and central government agencies. Includes analysing trade-offs or synergies, negotiating solutions and project management and planning in New Zealand as relevant to urban planning practice. <i>Prerequisite: URBPLAN 205, 221-223, 225, 226</i>	15 Points
URBPLAN 310 Urban Planning Studio Five To develop a critical understanding of regional planning practices, and develop advanced research and designs skills in proposing more sustainable urban form. <i>Prerequisite: URBPLAN 210, 211</i>	15 Points
URBPLAN 311 Urban Planning Studio Six Community engagement, data collection and analysis using a project-based approach. <i>Prerequisite: URBPLAN 210, 211</i>	15 Points
URBPLAN 321 Urban Policy Analysis, Development and Research Skills Provides a critical understanding of the role public policy plays in practice and how to analyse and develop effective, creative outcome-focused policy solutions for	15 Points

urban planning through the application of quantitative and qualitative research skills and methods.
Prerequisite: URBPLAN 221-223, 225, 226 or 30 points passed in Global Environment and Sustainable Development
Restriction: URBPLAN 301

URBPLAN 322 Urban Infrastructure Examines the issues surrounding the planning, development and funding of different types of social and physical infrastructure, including transportation, energy, renewable energy, and water and sewerage management, using local and international case studies and examples. <i>Prerequisite: URBPLAN 221-223, 225, 226</i> <i>Restriction: URBPLAN 203, 205</i>	15 Points
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URBPLAN 323 Māori Planning A critical understanding of traditional and contemporary relationships between tangata whenua and the urban environment, the theoretical and practical application of a Māori worldview for urban planning practice in Aotearoa New Zealand, and how the Treaty of Waitangi settlement process will impact and influence urban planning. <i>Prerequisite: URBPLAN 221-223, 225, 226</i> <i>Restriction: URBPLAN 305</i>	15 Points
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URBPLAN 325 Urban Planning Studio 4 Provides a critical understanding of the importance and integration of land use with transport (including active travel options), green infrastructure (including three waters and social infrastructure), and sustainability of a town centre development, while taking into account realistic funding models, costs and benefits, through a studio-based design exercise. <i>Prerequisite: URBPLAN 221-223, 225, 226</i>	30 Points
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URBPLAN 326 Urban Planning Studio 5 Explores social, environmental, design, or technological methods and processes, and applications of qualitative, quantitative, and/or geospatial research skills required for the creation of resilient, sustainable, and equitable urban places, forms and spaces. Provides an understanding of urban and rural interactions, or regional environmental, infrastructure or land use issues in light of significant urban growth pressures. <i>Prerequisite: URBPLAN 221-223, 225, 226</i>	30 Points
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Postgraduate 700 Level Courses

URBPLAN 701 Urban Planning Contexts - Level 9 An introduction to the city, urban planning and sustainability. Professional roles, practices and values. An introduction to and application of critical quantitative and qualitative research skills and methods for urban planning.	15 Points
URBPLAN 702 Urban Planning Law - Level 9 A critical understanding of the concepts and principles of relevant urban planning legislation and decision-making.	15 Points
URBPLAN 706 Māori Planning Issues - Level 9 Māori attitudes, values and aspirations in urban planning with an understanding of the Treaty of Waitangi. Indigenous development issues.	15 Points

URBPLAN 707 Urban Economic Development - Level 9 Principles of urban economics. Economic development, urban planning strategies. Asset management and property development.	15 Points	URBPLAN 718 Sustainable Urbanism Studio - Level 9 An advanced examination of sustainable urbanism, merging ecological principles with urban design, where students analyse and develop solutions for resilient, energy-efficient, and socially equitable urban environments, facilitated by collaborative studio projects and expert-led discussions. <i>Prerequisite:</i> URBPLAN 701, 706, 707, 709, 716, 717 <i>Restriction:</i> URBPLAN 712, 713	30 Points
URBPLAN 709 Housing and Community Development A comprehensive study of community design, housing development blending theory and practice to address social, cultural, and environmental aspects of urban development and different housing needs and types, where students engage in practical design exercises, sustainable urbanism, community collaboration, and critical analysis to craft inclusive, vibrant urban spaces and addressing housing and community choice and need. <i>Prerequisite:</i> URBPLAN 701	15 Points	URBPLAN 721 Project Management for Urban Planning A critical understanding of project management methods and skills, and management types and cultures, for private practice and in local and central government agencies. Includes asset management and planning for local government in New Zealand as relevant for urban planning practice. <i>Prerequisite:</i> URBPLAN 321-323, 325, 326 or Departmental approval	15 Points
URBPLAN 711 Urban Planning Theory - Level 9 A comparative exploration of urban planning theories and ethics. <i>Prerequisite:</i> URBPLAN 301-305, 310, 311, or URBPLAN 321, 323, 325, 326, or URBPLAN 701	15 Points	URBPLAN 722 Heritage/Cultural Issues Examines heritage planning history, theory, law and implementation practices in New Zealand and relevant international contexts. <i>Prerequisite:</i> URBPLAN 321-323, 325, 326	15 Points
URBPLAN 712 Sustainable Urbanism - Level 9 Research into critical and contemporary urban planning issues.	15 Points	URBPLAN 733 Sustainable Urban Design Studio - Level 9 Developing advanced urban design techniques to create sustainable urban forms. <i>Prerequisite:</i> URBPLAN 708	15 Points
URBPLAN 713 Shelter - Level 9 Housing policies and practices. Housing and urban sustainability.	15 Points	URBPLAN 734 Smart City Planning - Level 9 Smart technologies like AI, Urban Digital Twinning, and Internet of Things are reshaping urban planning, design, and decision-making processes. Explores their potential and limitations in tackling urban challenges, improving efficiency, and aligning with Sustainability Development Goals while critically examining ethical concerns surrounding their implementation in cities. <i>Prerequisite:</i> URBPLAN 301-305, 310, 311, or URBPLAN 321, 323, 325, 326, or URBPLAN 704	15 Points
URBPLAN 714 Urban Planning Methods and Plan Making Studio - Level 9 Urban planning methods and plan making implication and evaluation. Project management. <i>Prerequisite:</i> URBPLAN 301-305, 310, 311, or URBPLAN 321, 323, 325, 326, or URBPLAN 702	15 Points	URBPLAN 735 Resource Consents and Implementation, Evaluation - Level 9 The critical skills and judgments required in the urban planning implementation process, including Assessment of Environmental Effects/Social Impact Assessment development. <i>Prerequisite:</i> URBPLAN 301-305, 310, 311, or URBPLAN 321, 323, 325, 326	15 Points
URBPLAN 715 Urban Planning Research Dissertation - Level 9 An in-depth, self-guided research investigation relevant to urban planning with an advanced examination and application of critical quantitative and/or qualitative research skills for urban planning. <i>Prerequisite:</i> URBPLAN 701, 705	45 Points	URBPLAN 741 Special Topic - Level 9	15 Points
URBPLAN 716 Contemporary Wicked Problem Studio - Level 9 An advanced, in-depth exploration of sustainable urban planning concepts, focusing on environmental resilience, green infrastructure, and community involvement, through hands-on projects and strategic planning, enabling students to develop skills essential for innovative, sustainable urban development in diverse spatial contexts. <i>Prerequisite:</i> URBPLAN 321, 323, 325, 326 or URBPLAN 701 <i>Restriction:</i> URBPLAN 703, 705	30 Points	URBPLAN 742 Special Topic - Level 9	15 Points
URBPLAN 717 Community Design Studio - Level 9 An advanced, in-depth study of community design, blending theory and practice to address social, cultural, and environmental aspects of urban development, where students engage in practical design exercises, community collaboration, and critical analysis to craft inclusive, vibrant urban spaces. <i>Prerequisite:</i> URBPLAN 307, 321, 323, 325, 326 or URBPLAN 701 <i>Restriction:</i> URBPLAN 704, 708	30 Points	URBPLAN 757 Research Project - Level 9 An in-depth, self-guided research specialised investigation, with an advanced examination and application of critical quantitative and qualitative research skills for urban planning. <i>Prerequisite:</i> URBPLAN 301-311 or 321, 326	30 Points

URBPLAN 791 30 Points**Research Project - Level 9**

An in-depth, supervised research investigation relevant to urban planning with an advanced examination and application of critical quantitative and/or qualitative research skills for urban planning.

Prerequisite: URBPLAN 701, 706, 707, 709, 716, 717

URBPLAN 794A 45 Points**URBPLAN 794B** 45 Points**Thesis - Level 9**

To complete this course students must enrol in URBPLAN 794 A and B

URBPLAN 796A 60 Points**URBPLAN 796B** 60 Points**Thesis - Level 9**

To complete this course students must enrol in URBPLAN 796 A and B

Waipapa Taumata Rau

Stage 1**WTRENG 100** 15 Points**Waipapa Taumata Rau: Engineering and design for the built environment in Aotearoa New Zealand**

Ko Waipapa Taumata Rau tātou. Welcome to your study in Architecture, Design, Engineering or Urban Planning. This core course considers how knowledge of place enhances your learning, the significance of Te Tiriti o Waitangi, and how knowledge systems frame understanding. It provides foundational essential skills to support you in your first year and future studies.

Restriction: SCIGEN 102, 102G, WTR 100, 101, WTRBUS 100, WTRMHS 100, WTRSCI 100