UNDERGRADUATE COURSES 2024

SCHOOL OF ENGINEERING AND COMPUTER SCIENCE – TE KURA MĀTAI PŪKAHA, PŪROROHIKO1

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BACHELOR OF ENGINEERING WITH HONOURS

The School of Engineering and Computer Science offers a four-year Bachelor of Engineering (BE(Hons)) with three majors: *Electrical and Electronic Engineering* (formerly *Electronic and Computer Systems Engineering)*, *Cybersecurity Engineering* and *Software Engineering.* When taking the BE(Hons) degree, you will be enrolled under one of these majors.

DEGREE REQUIREMENTS

The BE(Hons) degree consists of several components which you will need to complete:

- **Part 1.** This consists of six or seven 100-level courses which provide the necessary foundations for the BE(Hons). You will need to ensure you take the right courses for your chosen major as set out on the following pages. If you are unsure about which major you like, leave your options open by taking all the courses required for any major (see page 6). **To successfully complete Part 1 of the BE(Hons), you will need to pass all Part 1 courses required by your major and achieve at least a B average in those courses.** (Students who achieve a lower average will be able to transfer their courses to a BSc.)
- **Part 2 Professional Practice.** This consists of a set of courses required for all majors (ENGR 201, 301, 302, 401 and 489) which develop a professional approach to engineering. Note that you must have successfully completed Part 1 (with at least a B average) in order to enrol in ENGR 301, 302, 401, and 489.
- **Part 2 Major Courses.** This is the core component of the BE(Hons) and is made up of various 200-, 300- and 400-level courses. The courses you take will be primarily determined by your chosen major. You may begin to take your Part 2 courses prior to completing Part 1, if you have passed any prerequisites.
- **Work Experience.** This consists of 800 hours of approved work experience in an engineering environment to help you prepare to apply for and work in appropriate employment. This will normally occur in the summers following your second and third years of study. Full details of the BE(Hons) work experience programme are on the School website (https://ecs.wgtn.ac.nz/Main/WorkExperience/WebHome)
- **Electives.** The degree requires a total of 480 points, including 120 400-level points of BE(Hons) courses. You will need to choose some elective courses to complete your degree; these may include courses from outside the BE(Hons) schedule.

If you achieve good grades during your BE(Hons) degree, and particularly in your third and fourth-year courses, you will be awarded the degree with First-Class Honours, Second-Class Honours (first division), or Second-Class Honours (second division).

WORK EXPERIENCE

Work experience is a key part of the Bachelor of Engineering with Honours degree. The goals of work experience are:

- To increase an understanding of the engineering terms and concepts introduced during the degree courses.
- To provide an actual experience of different work roles that you are likely to encounter once working as a professional engineer.

Reporting

Students must write a report for each work experience they undertake as well as managing the documentation needed to record their work experience. Templates and other guidance are provided. The report encourages students to reflect on the work experience by describing, interpreting and evaluating the experience, to develop a deeper understanding of their skills, how they dealt with situations and what they learnt.

BACHELOR OF SCIENCE

Victoria University of Wellington's Bachelor of Science (BSc) degree provides the depth of a strong science education in one or two majors, combined with the breadth of subjects from outside your science major or outside science altogether to the extent of a second major or minor or a variety of interest subjects.

The School of Engineering and Computer Science currently offers 4 majors in the BSc:

- Artificial Intelligence
- Computer Graphics and Games
- Computer Science
- Electronic and Computer Systems

BSC REGULATIONS

The BSc regulations are very flexible, to allow students to take a wide range of courses, including taking some from outside the Bachelor Science. You need to construct your course choices carefully and this document contains example programmes to help you do that.
These regulations apply to all new, returning or transferring students taking up a BSc degree:

- Minimum of 360 approved points, of which
  - 270 points must be science
  - 210 points must be above 100-level, of which 150 points must be science
  - 75 points must be 300-level science.
- At least one science major.
- 90 points may be from outside science (but there are ways to take extra non-science points, see below)
- A second major may be taken from any other first degree (though a second major from Engineering is not feasible).

What does 360 points mean in terms of courses? Almost all the courses in the School are worth 15 points, so 360 points usually mean eight courses a year for three years (8×3×15=360) for a full-time student. You should aim to take four courses in each of Trimesters 1 and 2. Note that some other Schools offer courses worth 20 points.

How can I take extra non-science points? Up to 30 non-science points taken to meet the requirements of a science major may be counted as if they were science points, and up to 60 non-science points may be counted as science if taken to meet the requirements of a major from outside Science. The total number of such points must not exceed 60.

What is a minor? A minor is a way of getting acknowledgement for completing a decent chunk of a second major without the constraint of having to meet all the requirements of that second major. A minor generally consists of 60 points above 100-level specified in the major requirements of the subject area, of which at least 15 points must be at 300-level.

MAJOR REQUIREMENTS

BACHELOR OF ENGINEERING WITH HONOURS

Overall Degree Requirements:
1st year: COMP 102 or 112, ENGR 101, 110
2nd year: ENGR 201
3rd year: ENGR 301, 302
4th year: ENGR 401, 489

Cybersecurity Engineering (CYBR):
1st Year: COMP 103, CYBR 171, (ENGR 121, 123) or (MATH 151, 161; one of MATH177, QUAN 102 or STAT 193)
2nd year: COMP 261, CYBR 271, NWEN 241, 243, SWEN 221; SWEN 225 or one of MATH 200-299
3rd year: CYBR 371, 372, 373; one of (MATH 324, NWEN 301, 302, 303, 304, SWEN 324, 326)
4th year: CYBR 471, 472, 473; one further 400-level course from (AIML, CYBR, COMP, NWEN, SWEN).

Software Engineering (SWEN):
1st Year: COMP 103, CYBR 171, (ENGR 121, 123) or (MATH 161; one of MATH 177, QUAN 102 or STAT 193); one of (CGRA 151, ENGR 141, 142, PHYS 100-199)
2nd year: COMP 261, CYBR 271, NWEN 241, 243, SWEN 221, 225
3rd year: SWEN 301; SWEN 303 or 325; SWEN 324 or SWEN 326; at least one further course from CGRA/COMP/CYBR/NWEN/SWEN 301-379
4th year: At least two courses from NWEN/SWEN 401–479; at least two further courses from AIML/CGRA/COMP/CYBR/NWEN/SWEN 401–479.

Electrical and Electronic Engineering (EEEN):
1st Year: COMP 103; (ENGR 121, 122) or (MATH 142, 151); (ENGR 141, 142) or (PHYS 142, 145)
2nd year: EEEN 201, 202, 203, 204, 220, ENGR 222, NWEN 241
3rd year: EEEN 301, 313, 315, 320
4th year: EEEN 401; at least three courses from EEEN 402 – 439, AIML 425, 429, RESE 411, 412

BACHELOR OF SCIENCE

Artificial Intelligence (AIML)
1st year: AIML 131, COMP (102 or 112), 103, (ENGR 121, 123) or (MATH 161; one of MATH 177 or QUAN 102 or STAT 193)
2nd year: AIML 231, 232; one of (COMP 261, NWEN 241, SWEN 221), (MATH 177 or STAT 292), one of (DATA 201, DATA 202, ENGR 222)
3rd year: AIML 335 or 339, 30 further points from (AIML 331-335); 15 further points from (AIML 331-338, COP 361, SWEN 303, 304, DATA 301, 303, 304)

Computer Graphics and Games (CGRG)*
1st year: CGRA 151, COMP (102 or 112), 103, (DSDN 102 or 132); (ENGR 121 or MATH 151)
2nd year: CGRA 252, NWEN 241, (COMP 261 or SWEN 221), (CGRA 259 or ANFX 201 or MATH 245), (ENGR 123 or MATH 161 or 251)
3rd year: CGRA 359; 30 further points from (CGRA 300–399, SWEN 303)

* formerly Computer Graphics (CGRA).

Computer Science (COMP)
1st year: COMP 102 or 112, 103; (ENGR 121, 123) or (MATH 161; one of MATH 177 or QUAN 102 or STAT 193)
2nd year: COMP 261; 45 further 200-level points from (CGRA, COMP, CYBR, NWEN, SWEN)
3rd year: 30 300-level points from (COMP, NWEN, SWEN); 30 further 300-level points from (AIML, CGRA, COMP, CYBR, NWEN, SWEN)

Electronic and Computer Systems (ELCO)
1st year: COMP 102 or 112; (ENGR 121, 122) or (MATH 142, 151); (ENGR 141, 142) or (PHYS 114, 115)
2nd year: EEEN 202, 203, 204; 15 further points from (AIML 231, EEEN 201-299, ENGR 201, NWEN 241)
3rd year: 60 points from (EEEN 301–399, RESE 321, 322)

PLANNING A PROGRAMME

Enquiries: Please contact the member of the academic staff in charge of the course, the relevant level coordinator, or Student Academic Services office in Cotton 144, or phone (04) 463 5101. **See page 38** for contact details.

COURSE INFORMATION INDEX

Course code	CRN	Title	Points	Trimester
COMP 112	CRN 26034	**Introduction to Computer Science**	15 PTS	**Tri 1**

Prerequisites: Courses you must have passed before taking this course (unless waived by HoS)
Restrictions: You can't enrol in this course if you have passed any of the restricted courses.

100-LEVEL COURSES

AIML 131 **Introduction to Artificial Intelligence** 15 PTS **Tri 2**

(**New course in 2023**)
This course is for everyone interested in learning and using artificial intelligence. It introduces the fundamental techniques and applications in AI and explains how AI affects individuals and society. This course will also discuss ethical issues and social impacts of AI, together with various ways of using AI to make our lives better. The assignments will introduce students to basic AI tools that can be applied in many different fields of study. The course does not assume any background in programming.

CGRA 151 CRN 28221 **Introduction to Computer Graphics and Games** 15 PTS **Tri 2**
Prerequisites COMP 102 or 112 or DSDN 142

Introduces necessary background, fundamental concepts, and basic algorithms of Computer Graphics and Game Programming, including human visual perception, representation of colour and images, representation of 2D and 3D spaces, manipulation, movement and drawing of 2D and 3D objects. Students will use an appropriate modern programming language to investigate many of the ideas presented in the lectured material.

COMP 102 CRN 943 **Introduction to Computer Program Design** 15 PTS **Tri 1**
CRN 28225 **Tri 3**
Restrictions COMP 112

This course introduces the fundamentals of programming in a high-level programming language (Java), using an object-oriented approach to program design. Students develop their programming skills by constructing computer programs for a variety of applications. The course provides a foundation for all later courses in computer science and develops programming skills useful for students in many other disciplines.

COMP 103	CRN 945	**Introduction to Data Structures**	15 PTS	**Tri 2**
	CRN 7223	**and Algorithms**		**Tri 3**
Prerequisites		COMP 112 or COMP 102		

This course builds on COMP 102, focusing on the techniques for designing, building and analysing computer programs that deal with large collections of data. The course addresses techniques for programming with collections of data, and the data structures and algorithms needed to implement these collections. The course expands programming skills and provides an understanding of the principles of data abstraction, algorithm design, and the analysis of algorithms fundamental to computer science.

COMP 132	CRN 30095	**Programming for the Natural and Social Sciences**	15 PTS	**Tri 2**

This course addresses the fundamental programming skills required to process, transform, analyse and present data. The course will explore a range of kinds of data, kinds of analysis and kinds of visualisation that can be performed on the data, and give students expertise in a variety of programming techniques and tools to accomplish this analysis and visualisation. The practical assignments will enable students to develop programming skills that they will be able to apply in many different fields of study. The course does not assume any background in programming.

CYBR 171	CRN 30039	**Cybersecurity Fundamentals**	15 PTS	**Tri 1**

This course examines how cybersecurity affects individuals and society and aims to develop understanding that the concept of cybersecurity goes beyond technology to include people, information, and processes. It will examine key concepts as well as current issues and debates about how to respond to cybersecurity. Note that this course will involve using a range of security tools but does not involve programming. Students will also write short essays related to current debates around cybersecurity issues.

ENGR 101 CRN 15243 **Engineering Technology** 15 PTS **Tri 1**

Prerequisites Enrolment in the BE(Hons)

This course provides a general introduction to the fundamental technical concepts needed to understand the design and engineering of electronic, mechatronic, networked and software systems. Experience is gained in basic engineering practice, with assembly and testing of basic hardware, software and networked systems, and construction of a personal computer.

ENGR 110 CRN 26051 **Engineering Design** 15 PTS **Tri 2**

Prerequisites COMP 102 or 112, ENGR 101
Restrictions ENGR 111, RESE 111

This course addresses the engineering design process through a collection of engineering projects that require a range of technologies and design techniques. Sustainability will be an important component of the course, with some of the projects addressing technology and design for sustainable engineering.

ENGR 121 CRN 26052 CRN 31158 **Engineering Mathematics Foundations** 15 PTS **Tri 1** **Tri 2**

Prerequisites*: 16 AS credits NCEA Level 3 Mathematics (or equivalent) or MATH 132
Restrictions: Any pair (MATH 141/QUAN 111, MATH 151/161/177)

***** *In 2021-2022, 12 credits of NCEA Level 3 in Mathematics/Statistics (or equivalent) will be accepted for entry, due to disruptions to teaching, learning and assessment caused by COVID-19.*

An introduction to the range of mathematical techniques employed by engineers, including functions and calculus, linear algebra and vector geometry, probability and statistics. There is an emphasis on applications and modelling.

ENGR 122 CRN 26053 **Engineering Mathematics with Calculus** 15 PTS **Tri 2**

Prerequisites ENGR 121 or MATH 141
Restrictions The pair (MATH 142, 151)

Further mathematical techniques employed by electronic and computer systems engineers, with emphasis on methods of calculus, differential equations, and linear algebra. There is an emphasis on engineering applications and use of software.

ENGR 123 CRN 27044 **Engineering Mathematics** 15 PTS **Tri 2**
CRN 31159 **with Logic and Statistics** **Tri 3**

Prerequisites ENGR 121
Restrictions the pair MATH 161, (MATH 177, QUAN 102 or STAT 193)

Mathematical techniques employed by network and software engineers, including methods of combinatorics, logic, probability and decision theory. The course emphasises engineering applications of these techniques.

ENGR 141 CRN 30094 **Engineering Science** 15 PTS **Tri 1**

Prerequisites 16 Achievement Standard credits NCEA Level 3 in one of Mathematics or Physics (or equivalent)

***** *In 2021-2022, 12 credits of NCEA Level 3 in mathematics/statistics or physics (or equivalent) will be accepted for entry, due to disruptions to teaching, learning and assessment caused by COVID-19.*

This course covers key topics in physics, and to a lesser extent chemistry, which are relevant to many aspects of Electronic and Software Engineering. Topics include forms and use of energy; introductory atomic theory; exploitation of chemical energy; understanding and using heat; waves and their properties. Students will obtain an appreciation for quantitative scientific reasoning; practise problem solving skills and then develop a better understanding of the role of fundamental physical laws across engineering disciplines.

ENGR 142 CRN 27045 **Engineering Physics for** 15 PTS **Tri 2**

Electronics and Computer Systems

Prerequisites either ENGR 141 and (ENGR 121 or MATH 141) or approved levels of achievement in NCEA Level 3 Physics and Calculus or equivalent

Physics theory and practice relevant to electronics and computer systems engineering. Topics covered will include electrostatics (charge, force, field, potential), magnetic field and force, DC and AC circuits, electromagnetic induction, and other selected topics. Lectures, assignments, and laboratory work will all focus on the application of physics to engineering situations.

MATH 132 CRN 17150 **Introduction to Mathematical Thinking** 15 PTS **Tri 1**
CRN 17286 **Tri 3**

Prerequisites: None
Restrictions: ENGR 121-123, MATH 100-199, QUAN 111

This course introduces or review of fundamental skills and ideas for students who require some mathematics in their degree. Topics will include elementary arithmetic, algebra, geometry, functions, and an introduction to the basic ideas of differential calculus. There will be an emphasis on the history of mathematical ideas and how they have evolved: the goal is not only to apply mathematical tools correctly, but to understand them.

MATH 141 CRN 17151 **Calculus 1A** 15 PTS **Tri 1**

Prerequisites*: 16 AS credits NCEA level 3 Mathematics (or equivalent) or MATH 132
Restrictions: ENGR 122, MATH 142, QUAN 111

** In 2021-2022, 12 NCEA Level 3 achievement standard credits in Mathematics, or 16 NCEA Level 3 achievement standard credits in Mathematics/Statistics will be accepted for entry, due to disruptions to teaching, learning and assessment caused by COVID-19.*

The properties of functions of one variable and their use for modelling continuous phenomena, including ideas and applications of differential and integral calculus.

MATH 142 CRN 17160 **Calculus 1B** 15 PTS **Tri 2**

Prerequisites: NCEA Level 3 achievement standards 3.6 (Differentiation, AS91578), 3.7 (Integration, AS91579) and one of (3.1 (Conics AS91573), 3.3 (Trigonometry, AS91575), 3.5 (Complex numbers, AS91577)), with at least two achieved with merit or excellence; or MATH 141 or QUAN 111, or equivalent background in Mathematics

Further topics in differential and integral calculus: the Riemann integral, techniques of integration, l'Hopital's Rule, differential equations, Taylor polynomials, implicit, parametric and polar representation of curves, and functions of two variables and their properties.

MATH 151 CRN 17161 **Algebra** 15 PTS **Tri 1**

Prerequisites: 16 AS credits NCEA level 3 Mathematics (or equivalent) or MATH 132

An introduction to linear algebra, including matrices and vectors, complex numbers, eigenvectors and algebraic structures.

MATH 161 CRN 17162 **Discrete Mathematics and Logic** 15 PTS **Tri 2**

Prerequisites*: 16 AS credits NCEA level 3 Mathematics (or equivalent) or MATH 132

Logic underlies all of mathematics. In this course, we will introduce the basic notions of logic, and discuss what makes some arguments good (or valid), while other arguments are invalid. This leads to a definition of a mathematical proof, particularly mathematical induction. Other topics include sets, relations, functions, elementary counting principles, properties of divisibility of the integers, and polynomials. The second half of the course introduces the fundamental concepts of graph theory, which is the study of networks.

MATH 177 CRN 19803 **Probability and Decision Modelling** 15 PTS **Tri 2**

Prerequisites: 16 AS credits NCEA level 3 Mathematics or Statistics, including AS 3.6 (differentiation, AS91578) and 3.7 (integration, AS91579), or one of (ENGR 122, 123, MATH 141, QUAN 111) or equivalent background in Mathematics.

An introduction to probability models in statistics, decision making and operations research including key concepts of probability, random variables and their distribution, decision theory and queueing systems. Goodness of fit tests is used to check the validity of fitted models.

PHYS 101 CRN tba	**Introduction to Physics**	15 PTS	**Tri 1**
Prerequisites:	16 AS credits of NCEA level 3 Mathematics (or equiv) or MATH 132.		
Restrictions:	ENGR 141, PHYS 114, 115		

PHYS 101 is designed for students who want a university level introduction to physics. It will serve students majoring in physics without requiring prior knowledge in physics. The course will also serve any (science or otherwise) student, interested in general ideas of physics as a way of understanding the (physical) world around us.
The course introduces basic concepts as well as worked examples. Exercises and assignments will reinforce key concepts. Topics covered are: mechanics (energy, Newton's laws, gravity), waves, thermodynamics and required math concepts (limits, derivatives, functions).

PHYS 142 CRN tba	**Calculus-based Physics**	15 PTS	**Tri 2**
Prerequisites:	PHYS 101 or ((MATH 141 or approved level of achievement in NCEA Level 3 Calculus 1) and (PHYS 131 or physics standard AS 91524 "mechanical systems" with excellence))		
Restrictions:	ENGR 142, PHYS 114, 115		

PHYS 142 covers topics in electrostatics and magnetostatics, electric circuits and electromagnetism. It will also cover mechanics (circular and harmonic motion) and required math concepts (differential equations and integration).

** Engineering students should generally take ENGR 142 rather than PHYS 142.*

PHYS 145 CRN tba	**Practical skills for Scientists: Applications in Physics**	15 PTS	**Tri 2**
Prerequisites:	16 AS credits of NCEA Level 3 Mathematics (or equiv) or MATH 132;		
Restrictions:	PHYS 114, 115		

PHYS 145 is designed to teach basic computing, data analysis, physics, and mathematics transferrable skills and their applications to practical physics problems. It will serve students majoring in physics and is also open to any (science or otherwise) student, interested in a hands-on experience of physics. The course will introduce skills required for experimental physics in laboratory environments and use them to explore physics phenomena in optics, mechanics, modern physics and thermodynamics.

STAT 193	**CRN** (SEE STREAMS)	**Statistics in Practice**	15 PTS

Streams:
Tri 1: Stream A (CRN 1791); Stream B (CRN 11333)
Tri 2: Stream A (CRN 4442); Stream B (CRN 6164)
Tri 3: CRN 17069

An applied statistics course for students who will be advancing in other disciplines as well as those majoring in Applied Statistics. It is particularly suitable for students majoring in Biological Science subjects, Geography, Linguistics, Psychology, social sciences such as Education, and is also suitable for students taking BCom subjects.

200-LEVEL COURSES

AIML 231 CRN tba	**Techniques in Machine Learning**	15 PTS	**Tri 1**
Prerequisites	AIML131 or 60 200-level points or at least a B in DATA 101; one of (COMP 103, 132)		
Restrictions	COMP103, COMP309, DATA302		

The course introduces core concepts and techniques in machine learning, as well as commonly used software libraries for implementing machine learning pipelines. It includes an overview of the machine learning field, including supervised and unsupervised learning; fundamental machine learning techniques including neural networks; tools to understand data such as exploratory data analysis, pre-processing, and visualisation; and the design machine learning pipelines. This course balances theoretical concepts of machine learning and the use of programming libraries for hands-on practice. This course is first offered in 2024.

AIML 232 CRN tba	**Techniques in Artifical Intelligence**	15 PTS	**Tri 2**
Prerequisites	AIML231, COMP103, and one of ENGR123, MATH177,STAT193, QUAN102, EEEN220		

The course introduces various concepts and techniques of broad applicability to artificial intelligence and machine learning. It includes an introduction to common machine learning paradigms such as neural networks and evolutionary learning; gradient-based and gradient-free optimisation techniques; dimensionality reduction; reasoning under uncertainty including Bayesian networks; and an introduction to AI planning. The course covers how these concepts can be used to solve important AI/ML tasks such as classification, regression, clustering and sequential decision making. This course is first offered in 2024

CGRA 252 CRN 35033	**Games and Graphics Engine Programming**	15 PTS	**Tri 2**
Prerequisites	CGRA 151, COMP 103		

(New course for 2023)
This course introduces students to a range of game and graphics engines and teaches students how to use the variety of tools in these engines to build games and graphics output. Students will learn how to program extensions to games and graphics engines and how to use graphics APIs such as OpenGL in their programming.

COMP 261 CRN18314	**Algorithms and Data Structures**	15 PTS	**Tri 1**
Prerequisites	COMP 103, ENGR 123 or MATH 161		

The course covers a range of algorithms and data structures building on the fundamental structure and algorithms from COMP 103. The major areas covered by this course are graph algorithms, graphics algorithms, and advanced data structures. This course takes a practical approach focusing on the implementation of a wide variety of algorithms.

CYBR 271 CRN30040 **Secure Programming** 15 PTS **Tri 2**

Prerequisites CYBR 171, NWEN 241

This course addresses the concepts, techniques, and tools required for developing software that reliably preserves the security properties of the information and systems they protect. The course covers common software vulnerabilities, specifying security requirements, secure design principles and techniques for evaluating software security. Practical work will involve developing and evaluating the security of C and Java programs.

EEEN 201 CRN 33053 **Mechatronic Design and Prototyping** 15 PTS **Tri 2**

Prerequisites COMP 102 or 112; ENGR 101, 110; ENGR 121 or MATH 141 or equivalent
Restrictions ECEN 201

This course will equip students with a basic understanding of mechanical theory and the skills of electronic and mechanical design and construction so that they can successfully design and complete a moderately complex project. A presentation of this project work forms an integral part of the course.

EEEN 202 CRN 33054 **Digital Electronics and Microprocessors** 15 PTS **Tri 1**

Prerequisites one of (COMP 102, 112, ENGR 101, 121, MATH 161)
Restrictions ECEN 202

An introduction to the design and construction of digital electronic instruments. Following a review of binary arithmetic and Boolean algebra, the course will focus on the design of digital circuits using both combinatorial and sequential logic. Further work will study microprocessor architectures, programming and interfacing and the conversions of digital and analogue signals.

EEEN 203 CRN 33055 **Circuit Analysis** 15 PTS **Tri 1**

Prerequisites: (ENGR 122 or MATH 142); (ENGR 142 or PHYS 115)
Restrictions: ECEN 203

This course covers the analysis of analogue electrical and electronic circuits. Topics covered include basic circuit theorems, operational amplifier circuits, the use of phasors for AC circuit analysis and the Laplace transform for switched systems. The use of computational and measurement tools for circuit characterisation is also covered.

EEEN 204 CRN 33055 **Electronic Devices** 15 PTS **Tri 2**

Prerequisites: (ENGR 122 or MATH 142); (ENGR 142 or PHYS 115)
Restrictions: ECEN 204

This course introduces fundamental electronic devices and their circuit applications. Topics include semiconductor fundamentals, diodes, transistors and operational amplifiers and the operation and application of special function diodes such as light emitting diodes and solar cells. Prototyping and testing of practical circuits using these electronic devices will be addressed in the laboratory sessions.

EEEN 220 CRN 33055 **Signals, Systems and Statistics I** 15 PTS **Tri 2**

Prerequisites (ENGR 121, 122) or (MATH 142, 151)
Restrictions ECEN 220

The course introduces analysis techniques for signals and linear time-invariant systems as well as fundamentals of engineering statistics. The first part of the course focuses on continuous time signals and systems and Fourier transform techniques, with applications to circuit analysis and communication systems. The second part of the course introduces probability mass and density functions, random variables and functions of random variables.

ENGR 201 CRN 29036 **Engineering in Context** 15 PTS **Tri 2**

Prerequisites ENGR 101, 110 and 45 further points from Part 1 of the BE(Hons) schedule

This course addresses the research, analysis, critical and creative thinking skills embodied in written and oral communication which professional engineers are expected to display in the workplace. While addressing these aspects, the course at the same time develops the personal and interpersonal skills required to work effectively as part of a team in an engineering context.

ENGR 222 CRN 33042 **Computational Algebra and Calculus 15 PTS Tri 1**

Prerequisites: (ENGR 121, 122) or (MATH 142, 151)

The course will cover fundamental concepts in linear algebra and multivariable calculus and their applications to physical and engineering problems. Mathematical software will be used extensively. Topics covered will include dimensionality, linear transformations, matrix decomposition, Taylor series, calculus of vector-valued functions and calculus of two-variable functions.

MATH 244 CRN 18324 **Modelling with Differential Equations** 15 PTS **Tri 1**

Prerequisites: (MATH 142, 151) or (ENGR 121, 122)

Types of ordinary differential equations and methods of solution (, , Fourier series, Laplace transforms, Numerical algorithms); boundary-value and initial-value problems; systems of equations; qualitative analysis of solutions; applications.

MATH 245 CRN 30099 **Computational Mathematics** 15 PTS **Tri 2**

Prerequisites ENGR 122 or ENGR 123 or (MATH 151 and (141 or 142))

Mathematical, numerical and computational techniques for practical problems involving optimization, simulation and approximation. The course emphasises the properties and implementation of numerical algorithms for solving linear, non-linear and differential equations, least squares, singular-value decomposition, splines and Monte Carlo methods. Some previous experience in programming is highly desirable.

MATH 261 CRN 18326 **Discrete Mathematics 2** 15 PTS **Tri 1**

Prerequisites MATH 161 or B+ or better in ENGR 123

Enumerative combinatorics (binomial coefficients, the inclusion-exclusion principle, generating functions, Burnside's Lemma) and algorithmic graph theory (shortest paths, matchings, flows).

NWEN 241 CRN 18315 **Systems Programming** 15 PTS **Tri 1**

Prerequisites COMP 103

This course considers the issues raised when programming at a low-level, for example in embedded systems, OS system level, or network protocol stacks. Topics include: an introduction to C language programming; and higher-level systems programming using Python scripting languages. It will include motivating examples related to a wide variety of applications of system programming.

NWEN 243 CRN 19863 **Clouds and Networking** 15 PTS **Tri 2**

Prerequisites COMP 103

The course provides a broad introduction to computer networks and a basic understanding of network application programming, with an emphasis on the working principles and application of computer networks. It covers a range of introductory topics including the essentials of data communication, computer network concepts, protocols, network applications and cloud computing. The course features an interactive laboratory component with projects starting from basic networking technologies leading into cloud application development.

SWEN 221 CRN 18318 **Software Development** 15 PTS **Tri 1**

Prerequisites COMP 103

This course develops a deeper understanding of object-oriented programming and associated practices. The focus is on programming techniques at the micro scale. Topics include inheritance, polymorphism, genericity, error handling, testing and debugging. A sequence of short assignments will develop the key ideas and practices; rigour in testing will be developed through (automated) assessment of program correctness.

SWEN 225 CRN 18319	**Software Design**	15 PTS	**Tri 2**
Prerequisites	SWEN 221		
Restrictions	SWEN 222		

This course develops a strong understanding of object-oriented design. Students will study modelling and programming techniques that support the analysis, design and development of large and maintainable programs. Students will work together in groups on an engineering problem and use a variety of best practices (e.g. Design Patterns) and notations (e.g. UML). Students will use specialized tools to apply these techniques in practical work.

300-LEVEL COURSES

CGRA 350 CRN 28400	**Real-time 3D Computer Graphics**	15 PTS	**Tri 2**
Prerequisites	CGRA 251, COMP 261, NWEN 241		

This course addresses graphics programming for real-time 3D graphics. It covers graphics APIs, in particular, OpenGL, and the graphics processing pipeline (including geometry processing, viewing, projection, transformation, illumination, texture mapping). It also addresses display hardware and graphics cards.

CGRA 352 CRN 30096	**Image-based Graphics**	15 PTS	**Tri 1**
Prerequisites	CGRA 251; COMP 261 or NWEN 241		

Image-based graphics brings together the power of image processing and computer graphics to use real-world visual media content to produce vivid, compelling, and meaningful computer graphics. This course studies ways of manipulating and combining images and videos, including image filtering, image manipulation, and video processing.

CGRA 354 CRN36029	**Computer Graphics Programming**	15 PTS	**Tri 1**
Prerequisites	CGRA 252, NWEN 241; ENGR121 or MATH151		

This course addresses algorithms, mathematical knowledge and programming tools for 3D Computer Graphics, including offline rendering. It covers programming with Modern low-level graphics APIs, shader programming and the graphics processing pipeline (including geometry processing, viewing, projection, transformation, illumination, texture mapping and shading algorithms).

CGRA 359 CRN36030	**Games and Graphics Project**	15 PTS	**Tri 2**
Prerequisites	CGRA 252,15 300-level CGRA pts X COMP 313; GAME 390 taken concurrently		

This course is a capstone for the Computer Graphics and Games major in which students learn to work in a multidisciplinary team to develop a game or graphics system up to release quality. The course will be taught in conjunction with GAME 390, and most teams will have students from both courses. The course brings together practical development and theoretical analysis to ensure students know both how to make games and how to assess them.

COMP 307 CRN 968	**Introduction to Artificial Intelligence**	15 PTS	**Tri 1**
Prerequisites	COMP 261 or NWEN 241 or SWEN 221; ENGR 123 or MATH 151 or 161; At least a B in both DATA 201 and 202 will be permitted		
Restrictions	COMP 420, AIML 420		

This course considers ideas and techniques from Artificial Intelligence. It first introduces a range of search algorithms that are used throughout AI. It then examines applications and techniques of AI, including rule-based systems for embodying human expertise, algorithms for planning and problem solving, natural language processing, methods for machine learning, and neural nets and other computation intelligence techniques.

COMP 309 CRN 30098	**Machine Learning Tools and Techniques**	15 PTS	**Tri 2**
Prerequisites	COMP 261 or (DATA 201 and DATA 202) or NWEN 241 or SWEN 221		

This course explores a range of machine learning tools and techniques for analysing data and automatically generating applications. The course will address tools for classification, regression, clustering, and text mining and techniques for preprocessing data and analysing the results of machine learning tools. Students will gain practical experience in applying a range of tools to a range of different data sets from different domains.

COMP 312 CRN 10444	**Simulation and Stochastic Models**	15 PTS	**Tri 1**
Prerequisites	one course from (COMP 102, 112, 132, DATA 202); one course from (ENGR 123, MATH 177, 277, STAT 292), 15 further 200-level COMP, DATA, MATH, NWEN, STAT or SWEN pts		
Restrictions	OPRE 354		

Simulation and modelling of stochastic systems, covering examples from Operations Research and Computer Science, including queues, networks, and computer systems. Design, analysis and validation of simulation experiment. Previous experience with computer programming is required before starting this course.

CYBR 371 CRN 32072 **System and Network Security** 15 PTS **Tri 1**

Prerequisites CYBR 171, NWEN 241, 243

This course addresses key concepts, techniques and tools needed to provide security in computer and communications systems. Topics include the need for security, system and network security threats such as malware or denial-of-service attacks, secure systems design, identity management, authentication, access control, and computer network defence. Practical work will involve developing operating system and network security tools such as keyloggers as well as choosing and implementing appropriate security controls to meet a small organisation's network security needs.

CYBR 372 CRN 32078 **Applications of Cryptography** 15 PTS **Tri 2**

Prerequisites CYBR 171, CYBR 271 or COMP 261, NWEN 243

Cryptographic mechanisms are widely deployed for communication and data protection. This course addresses how cryptographic mechanisms can be effectively used within larger security systems and how cryptographic mechanisms can be vulnerable in deployed systems. Topics covered include cryptographic primitives, cryptographic protocols, cryptanalytic techniques on primitives and protocols in deployed systems and attacks based upon common errors in use of libraries. Practical work will include best practice use of cryptographic libraries and attacks.

CYBR 373 CRN 32079 **Human and Organisational Security** 15 PTS **Tri 2**

Prerequisites CYBR 371

This course addresses how the behaviour and values of people as individuals or within an organisation affect cybersecurity threats and mitigation strategies. Topics include social engineering, cultural considerations (including mātauranga Māori), the insider threat, security usability, and risk management.

EEEN 301 CRN 34002 **Computer Architecture and Embedded Systems** 15 PT **Tri 1**

Prerequisites EEEN 202 (or ECEN 202), NWEN 241
Restrictions: ECEN 301, NWEN 342

The course develops an understanding of the structure of computers, how they execute programs and how they interface to the real world. The course first covers ARM assembly language programming, data representation, computer arithmetic, microprocessor architecture at the hardware level and a comparison with GPU, DSP and FPGA architectures. The course then explores the design flow and application of embedded computers in real-world engineering problems. Practical experience is gained through the use of microprocessors, techniques to interface them with the physical world, development tool chains, debugging and embedded Linux operating systems.

EEEN 313 CRN 33058	**Power Electronics and Electrical Machines**	15 PTS	**Tri 2**
Prerequisites	EEEN 203 (or ECEN 203), EEEN 204 (or ECEN 204)		

This course covers the theory, design and application of electrical machines, power electronic circuits, electric drives, and the transformation and control of electrical energy. The course introduces the fundamentals of electromagnetics and electrical machines, as well as power electronics, and discusses the design issues related to electrical drives and small-scale power generation. Practical work will involve the design, development, and implementation of solutions to drive motors, convert renewable power, and switch mode power amplifiers.

EEEN 315 CRN 34004	**Control and Instrumentation**	15 PTS	**Tri 1**
Prerequisites	EEEN 203 (or ECEN203)		

The course shows how models can be used to analyse, describe and predict the behaviour of mechanical and electrical systems. The use of feedback to alter the properties of these systems to meet desired specifications is presented. A variety of methods are developed for designing control systems, including the use of a PID controller.

EEEN 320 CRN 34005	**Signals, Systems and Statistics II**	15 PTS	**Tri 2**
Prerequisites	EEEN 220 (or ECEN220)		

The course introduces analysis techniques for discrete-time signals and linear time- invariant systems as well as topics in engineering statistics. The first part of the course focuses on discrete-time signals and systems and discrete Fourier transform techniques, with applications to circuit analysis and communication systems. The second part of the course covers topics in engineering statistics, including confidence intervals, statistical tests, and regression, as applied to engineering problems.

ENGR 301 CRN 17178	**Engineering Project Management 1**	15 PTS	**Tri 1**
Prerequisites	Admission to Part 2 of the BE(Hons), ENGR 201 and 60 200-level pts from (CYBR, COMP, ECEN, NWEN, RESE, SWEN)		

The course takes a practice-based approach to teaching engineering project management, including aspects of project life cycle, requirements analysis, principles of design, project tasks and deliverables, contracts, cost estimation, project scheduling, risk management, quality assurance, managing project resources, testing and delivery, interpersonal communication, teamwork and project leadership. Students will work on a technical group project which will provide opportunities to practice the project management techniques learned in class.

ENGR 302 CRN 17179 **Engineering Project Management 2** 15 PTS **Tri 2**

Prerequisites ENGR 301

The course takes a practice-based approach to teaching engineering project management, emphasising execution, monitoring, control communication, project closing, and delivery. Students will continue their work on a technical group project providing opportunities to practice the project management techniques learned in class.

RESE 321 CRN 34007 **Renewable Energy Generation Engineering** **15 PTS** **Tri 1**

Prerequisites EEEN 203, 204
Restrictions RESE 211

This course introduces a range of different energy generation systems, and especially those that utilise renewable resources: wind energy (pumping and power), geothermal, hydro (at different scales), solar photovoltaic, solar thermal, and bioenergy. For each technology, the theoretical underpinning is examined – for example, optical physics to harness solar radiation in concentrating solar systems – and the engineering approaches to identify and design efficiency improvements for such systems are established.

RESE 322 CRN 34008 **Renewable Energy Storage Engineering** **15 PTS** **Tri 2**

Prerequisites EEEN 203, 204

This course provides insights into technologies that convert renewable energy generation into useful fuels or power in the economy and society. It will include bioenergy conversion processes, such as gasification, pyrolysis and torrefaction; chemical storage (solid-state and liquid batteries); thermal storage; and pumped and mechanical storage. It examines the underlying physics and chemistry for each technology platform, with related practical experiments in the laboratory. The engineering approaches to identify and design efficiency improvements for such systems are established.

SWEN 301 CRN 17183 **Scalable Software Development** 15 PTS **Tri 2**

Prerequisites SWEN 225

(Note trimester change from the usual Tri 1).
This course introduces the processes, practices, and tools required to engineer medium to large software systems, and to address challenges arising from the emerging complexity of such systems. Topics include software craft, architecture, design, implementation, testing, maintenance, quality assurance, configuration management, build automation and principled use of components and libraries, and open-source development. Practical work will use integrated development environments, automation, and domain specific languages.

SWEN 303 CRN 17185 **User Experience Engineering** 15 PTS **Tri 1**

Prerequisites COMP 261 or SWEN 221

This course addresses the engineering of user experiences (UX). It presents principles and guidelines for design and covers a range of design and engineering processes. It presents techniques for user testing of applications, digital systems, and physical devices.

SWEN 304 CRN 17186 **Database System Engineering** 15 PTS **Tri 1**

Prerequisites COMP 261 or SWEN 221; ENGR 123 or MATH 161

This course addresses fundamental principles underlying databases and database management systems. It covers the structure and principles of the relational data model, including SQL, and the principled design of the relational database schema. It also addresses issues in database transaction processing, concurrency control, recovery, and the complexity of query processing.

SWEN 326 CRN 30042 **Safety Critical Systems** 15 PTS **Tri 1**

Prerequisites: NWEN 241, SWEN 225 (or 222)

This course addresses the concepts, techniques and tools required for developing computer systems that are applicable where safety and reliability is paramount. Topics include: the concepts and principles underlying safety-critical systems & standards (e.g. DO178C and IEC61508); techniques for design validation (e.g. model checking); and implementation techniques for ensuring software correctness (e.g. coding guidelines, testing, static analysis, etc). Practical work will involve the design, implementation, and analysis of simple safety critical applications (e.g. for industrial, embedded and healthcare systems).

400-LEVEL COURSES

AIML 420 CRN 33065 **Artificial Intelligence** 15 PTS **Tri 1**
Prerequisites 60 300-level COMP, DATA, SWEN or NWEN pts
Restrictions COMP 307, COMP 420

This course addresses concepts and techniques of artificial intelligence (AI). It provides a brief overview of AI history and search techniques, as well as covering important machine learning topics and algorithms with their applications, including neural networks and evolutionary algorithms. Other topics include probability and Bayesian networks, planning and scheduling. The course will also give a brief overview of a selection of other current topics in AI.

AIML 421 CRN 33066 **Machine Learning Tools and Techniques** 15 PTS **Tri 2**
Prerequisites 60 300-level COMP, DATA, NWEN, STAT or SWEN pts
Restrictions COMP 309

This course addresses the use of machine learning tools and techniques for analysing data and automatically generating applications. The course will explore a range of tools and techniques for classification, regression, image analysis, clustering, text mining, and preprocessing data. It examines the applicability and limitations of the techniques and methods for analysing and evaluating the outcome of using machine learning tools. Students will gain practical experience in applying a range of tools to a range of different problems from different domains.

AIML 425 CRN 33067 **Neural Networks and Deep Learning** 15 PTS **Tri 2**
Prerequisites AIML 420 or COMP 307
Restrictions the pair (COMP 421, 422)

This course addresses the fundamentals of neural network based deep learning. It covers the commonly used deep learning architectures such as fully connected networks, resnets, variational autoencoders, and generative adversarial networks. It discusses functional blocks such as convolutional nets, recurrent neural nets such as LSTMs, and the common objective functions and regularization procedures. Examples will discuss applications such as object classification, classification of sequential text, and the generation of realistic human faces.

AIML 426 CRN 33068 **Evolutionary Computation and Learning** 15 PTS **Tri 2**
Prerequisites AIML 420 or COMP 307

This course addresses evolutionary approaches in machine learning and optimisation. The course will cover both evolutionary algorithms and swarm intelligence as well as some other population-based techniques for problem solving. It will include a range of real-world application domains such as classification, regression, clustering, and optimisation.

AIML 427 CRN 33069 **Big Data** 15 PTS **Tri 1**

Prerequisites	one of (AIML 420, 421, COMP 307, 309, STAT 393, 394); one of (ENGR 123, STAT 193, MATH 177, QUAN 102) or comparable background in Statistics
Restrictions	COMP 424, COMP 473 (2016-2018)

Big Data refers to the large and often complex datasets generated in the modern world: data sources such as commercial customer records, internet transactions, environmental monitoring. This course introduces the theory and practice of working with Big Data. Students enrolling in this course should be familiar with the basics of machine learning, data mining, statistical modelling and with programming.

AIML 428 CRN 33070 **Text Mining and Natural Language Processing** 15 PTS **Tri 1**

Prerequisites	60 300-level pts
Corequisites	AIML 420 or COMP 307
Restrictions	COMP 423

This course focuses on text mining and natural language processing. It covers a variety of topics including text representation, document classification and clustering, opinion mining, information retrieval, recommender systems, query expansion, and information extraction.

AIML 429 CRN 33071 **Probabilistic Machine Learning** 15 PTS **Tri 1**

Prerequisites:	AIML 420 or COMP 307; one of (MATH 177, STAT 292, 293) or approved background in Maths or Statistics
Restrictions:	COMP 421

This course teaches the ideas, algorithms, and techniques of probabilistic machine learning. Topics include Bayesian inference, discriminative and generative classifiers, the EM algorithm, Gaussian processes, Markov Chain Monte Carlo, hidden Markov models, belief nets and other graphical models, and causal modelling.

AIML 430 CRN 33072 **Applications and Implications of Artificial Intelligence** 15 PTS **Tri 2**

Prerequisites	60 300-level pts

This course looks at the range of applications of artificial intelligence in the world of today and the future. It surveys the kinds of problem that can be solved with AI technology and techniques and considers the implications and consequences of using AI technology in these applications. It will discuss the positive and negative outcomes and the ethical issues and principles that need to be considered when creating technological solutions using AI.

AIML 431	CRN 33073	**Current Topics in Artificial Intelligence**	15 PTS	**Tri 2**
Prerequisites		AIML 420 or COMP 307		
Restrictions		COMP 421		

This course addresses several current topics in artificial intelligence. Possible topics include Reinforcement Learning, AI for robotics, AI in games, Intelligent image analysis, AI and optimisation, AI Planning.

AIML 440	CRN 33074	**Directed Individual Study**	15 PTS	**Tri 1**
	CRN 33233			**Tri 2**
	CRN 33234			**Tri 3**
Prerequisites		Permission of Head of School		

A supervised programme of study approved by the Head of School.

AIML 441	CRN 33075	**Directed Individual Study**	30 PTS	**Tri 1**
	CRN 33235			**Tri 2**
	CRN 33236			**Tri 3**
Prerequisites		Permission of Head of School		

A supervised programme of study approved by the Head of School.

CGRA 463	CRN 28330	**Computer Graphics Practicum**	30 PTS	**Tri 2**
	CRN 31190			**Tri 3**
Prerequisites		Permission of Head of School		

The practicum is an opportunity for students to engage with a supervised computer graphics project in the context of an external company or organisation.

CGRA 489	CRN 28333	**Research Project**	30 PTS	**Full Year**

All candidates for BSc(Hons) in Computer Graphics are required to take CGRA 489, which is a research project conducted under the supervision of a staff member. The purpose of the BSc(Hons) research project is to provide students with an opportunity to study a particular problem within this area. It is also intended to provide training and experience in individual study and research and communicating the results thereof. CGRA 489 is a two-trimester course. It can be done over any two consecutive trimesters.

COMP 489 CRN 1027 **Research Project** 30 PTS **Full Year**

A research project on a topic approved by the Head of School.

All candidates for BSc(Hons) in Computer Science are required to take COMP 489, which is a research project conducted under the supervision of a staff member. The purpose of the BSc(Hons) research project is to provide students with an opportunity to study a particular problem within this area. It is also intended to provide training and experience in individual study and research and communicating the results thereof. COMP 489 is a two-trimester course. It can be done over any two consecutive trimesters.

CYBR 471 CRN 32239 **Offensive and Defensive Security** 15 PTS **Tri 2**

Prerequisites: CYBR 271, 371, 373

This course focuses on offensive and defensive security techniques in the context of incident handling best practices and theories about attacker behaviour. The course will include lectures and demonstrations but is designed around a virtual lab environment and scenarios that provide robust and realistic hands-on experiences in dealing with a range of offensive and defensive topic areas such as cybersecurity intelligence and investigation, incident response, and proactive cybersecurity.

CYBR 472 CRN 32240 **Digital Forensics** 15 PTS **Tri 1**

Prerequisites: CYBR 271, 371, 30 further points of (CYBR, NWEN, SWEN 324, 326)

This course addresses the collection and analysis of the digital footprint left by humans and computers in a way that is reproducible by third parties and suitable for presentation to a non-specialist audience. Topics include the rules of evidence, preservation of data, file system forensics, network forensics, live forensics, anti-forensics as well as forensics for non-standard devices such as mobile/smart phones, cloud computing and vehicular systems. Practical work will include labs where evidence is collected using tools and presented as well as the use, development and enhancement of these tools.

CYBR 473 CRN 32241 **Malware and Reverse Engineering** 15 PTS **Tri 1**

Prerequisites: CYBR 271, 371, 30 further points of (CYBR, NWEN, SWEN 324, 326)

This course addresses the problem of using reverse-engineering techniques and related techniques such as fuzzing to both analyse malicious code and identify vulnerabilities in software. Topics will include methodology and techniques as well as the anatomy, behaviour and propagation of malware. Practical work will involve malware analysis in a controlled environment as well as the analysis of real-world vulnerabilities and creation of exploits.

EEEN 401 CRN 34003 **Applied Electromagnetics and Compliance** 15 PTS **Tri 2**

Prerequisites: EEEN 313, one of (ENGR 222, MATH 244)

This course will address the engineering applications of electromagnetism, including propagation of signals, low EM emissions circuit board design, radio waves and antennas, grounding, high voltage insulators, and electrical safety design and testing. An important focus of the course is to become familiar with the international framework of product compliance and sustainability.

EEEN 402 CRN 34014 **Programmable Digital Logic and High-Level Design Methods** 15 PTS **Tri 2**

Prerequisites: EEEN 301 (or ECEN 301)

The course develops an understanding of the structure of Field Programmable Gate Arrays, how to program them and how to interface them to the real world. The topics covered are VHDL programming, logic design, state machine design, I/O, design tools, simulation, timing analysis, debugging, IP block design methodology, softcore microprocessors and system on a chip implementation. Practical experience is gained through the use of professional design tools and hardware to interface FPGAs with the physical world.

EEEN 411 CRN 34003	**Coding and Cryptography for Communications**	15 PTS	**Tri 2**
Prerequisites:	EEEN 310 (or ECEN 310)		
Restrictions:	MATH 324		

The course covers key topics in modern coding theory (finite vector spaces, linear codes, coding bounds, perfect codes, cyclic codes) as applied to wireless communication systems. Further topics include cryptography (classical ciphers, the one-time pad, Shannon's Theorem, linear shift registers, public key cryptography, one-way functions, the RSA cryptosystem, key distribution and digital signatures).

EEEN 415 CRN 34029	**Advanced Control Systems Engineering**	15 PTS	**Tri 2**
Prerequisites:	EEEN 315 (or ECEN 315)		
Restrictions:	ECEN 415		

This course extends previous control studies to cover the use of modern control techniques in shaping the behaviour of complex systems having multiple inputs and outputs, in both discrete and continuous time. Optimal control (LQR) and estimation (the Kalman filter) are introduced. The course concentrates on linear and linearised systems, but some introductory nonlinear material is presented, including applications to robot control.

EEEN 427 CRN	Special Topic	15 PTS	**Tri 1**
Prerequisites:	EEEN 325 (or ECEN 301)		
Restrictions:	EEEN 425		

This course presents advanced principles of robotic and mechatronic design, prototyping, construction and control. It covers both the theoretical and practical aspects of integrating the mechanical, electronic and software components and applies relevant machine learning concepts. The course also covers to an advanced level, operational amplifier imperfections, noise, feedback and stability and operational amplifier applications such as active filters, differential amplifiers and oscillators.

ELCO 489 CRN 23071	**Research Project**	30 PTS	**Full Year**
Prerequisites:	A research project on a topic approved by the Head of School.		

All candidates for BSc(Hons) in Electronic and Computer Systems are required to take ELCO 489, which is a research project conducted under the supervision of a staff member. The purpose of the BSc(Hons) research project is to provide students with an opportunity to study a problem within this area. It is also intended to provide training and experience in individual study and research and communicating the results thereof. ELCO 489 is a two-trimester course.

ENGR 401 CRN 18690	**Professional Practice**	15 PTS	**Tri 1**
Prerequisites:	75 300-level pts from the BE(Hons) schedule including ENGR 301, 302		

This course will prepare students' expectations for many of the events and situations they are likely to meet in the professional working world. This includes: codes of conduct, as determined by professional bodies and company practices; ethical behaviour, as found in the workplace and dictated by company practices; critical thinking and people issues, as relevant in the workplace and in company practice.

ENGR 440 CRN 26008 CRN 27189	**Directed Individual Study**	15 PTS	**Tri 1** **Tri 2**
Prerequisites	Permission of Head of School		

A supervised programme of study approved by the Head of School.

ENGR 441 CRN 26239 CRN 26009	**Directed Individual Study**	15 PTS	**Tri 1** **Tri 2**
Prerequisites	Permission of Head of School		

A supervised programme of study approved by the Head of School.

ENGR 489 CRN 18688	**Engineering Project**	30 PTS	**Full Year**
Prerequisites	75 300-level pts from the BE(Hons) including ENGR 301, 302		

Students will work on an individual project of a complex nature in order to develop a solution to an engineering problem. In addition to the technical engineering development work, the project may require consideration of issues such as customer specifications, cost analysis, IP and product testing and delivery. Students will be required to give an oral and a poster presentation as well as a final report on their project.
Please note: ENGR 489 is a two-trimester course.

RESE 411 CRN 31173 **Power Systems Analysis** 15 PTS **Tri 2**
Prerequisites EEEN 313

This course introduces the electricity industry and its components along with techniques for modern electric power system modelling and analysis. Topics include transmission line models, transformers and per unit systems, generator models, network matrices, power flow analysis and computation, real and reactive power control, voltage control, and protection. The course incorporates lab and simulation-based exercises, an industrial tour, and an industrial project.

RESE 412 CRN 31165 **Advanced Development of Renewable Energy Systems** 15 PTS **Tri 1**
Prerequisites EEEN 315 (or ECEN 315)

This course presents techniques used to design advanced, integrated renewable energy solutions for given situations. The design of nano- and micro-grids will be analysed, with students applying this knowledge to designing, constructing and testing a fit-for-purpose renewable energy system. This course also presents the concept of systems engineering, introducing systems thinking principles.

RESE 421 CRN 35093 **Energy Economics Analysis** 15 PTS **Tri 1**
Corequisites RESE 423, 431, 412

This course introduces principles of economics, and how they relate to energy systems, specifically reflecting on the energy-economic nexus. It explores practical techniques to analyse the micro- and macro-economic implications of transitions in the energy system, along with relevant business and financial analysis techniques. It applies the principles and techniques to analyse a real-world topic to inform decision- or policymaking with appropriate conclusions and recommendations.

RESE 422 CRN 35094 **Sustainability Modelling Techniques** 15 PTS **Tri 2**
Corequisites RESE 423, 431, 412

This course introduces various approaches to analyse the sustainability of systems, such as cost-benefit analysis, and simulation modelling techniques. It then focuses more deeply on system dynamics modelling and life cycle analysis. Practical work explores simulations using industry-standard software packages and a project to model and investigate the sustainability implications of a renewable energy intervention in the economy – to develop a policy brief.

RESE 431 CRN 35096 **RE Systems Generation** 15 PTS **Tri 1**
Prerequisites
This course introduces a range of different energy generation systems, and especially those that utilise renewable resources: wind energy (pumping and power), geothermal, hydro (different scales), solar photovoltaic, solar thermal, and bioenergy. For each technology, the theoretical underpinning is examined with related practical experiments in the laboratory. Approaches to identify and conceptualise efficiency improvements for such systems are established. A practical project is undertaken to conceptualise and demonstrate an improved energy generation system for a real-world context.

RESE 432 CRN 35097 **RE Storage and Conversion** 15 PTS **Tri 2**
Prerequisites RSE 431 or 412

This course provides insights into technologies that convert renewable energy generation into useful fuels or power in the economy and society. It will include bioenergy conversion processes, chemical storage (solid-state and liquid batteries), thermal storage, and pumped and mechanical storage. It examines the underlying physics and chemistry for each technology platform with related practical experiments in the laboratory. Approaches to identify and conceptualise efficiency improvements for such systems are established. A practical project is undertaken to conceptualise and demonstrate an improved energy storage system for a real-world context.

RESE 451 CRN 35098 **Research Methods for RE Systems (Theory)** 15 PTS **Tri 1**
Corequisites RESE 421 or 431 or 412

This course covers the theory and practice of undertaking research. The nature and process of quantitative and qualitative research approaches are explored to enable students to formulate and conduct a research effort to find answers to specific problems related to renewable energy. Topics that will be covered include: the aims of research; the research topic, project title, and research problem; literature review types; population and sampling types; types of quantitative and qualitative research designs; data-collecting methods and measuring instruments in quantitative and qualitative research; data analysis and interpretation of results; and validity of conclusions.

RESE 452 CRN 35099 **Research Methods for RE Systems (Project)** 15 PTS **Tri 2**
Prerequisites RESE 451

This course applies the research theory – from RESE 451 – to a specific renewable energy related, real-world problem that is identified. It explores and applies practical methods to undertake in-depth, critical analyses of the literature to derive the research rationale, objectives/questions, and strategy, as well as grounding the theory and engineering or analytical methods, and the related gaps in knowledge, that are applicable to the identified research problem. Practical workshops are undertaken to instil academic writing techniques that are applied to authoring a research proposal and supporting research article.

RESE 487 CRN 35100 **Research Project** 15 PTS **Tri 2 + 3**
Prerequisites EEEN 315 (or ECEN 315)

RESE 423 CRN 35095 **Case Studies of RE Systems** 15 PTS **Tri 1**
Corequisites RESE 421, or 431

This course provides an overview of the role of energy systems in sustainability, and the development trends, past and future, of different technologies. The ways in which the technologies influence industry, government, and society are examined from a range of different perspectives, by focussing on specific, real-world case studies. Students will also gain practical skills in modelling renewable energy systems for different transmission/distribution contexts, by utilising standard industry software packages.

SWEN 422 CRN 18662 **Human Computer Interaction** 15 PTS **Tri 1**
Prerequisites: one of (COMP 313, SWEN 303, 325)

This course covers principles of human-computer interaction that underlie good design of software user interfaces. Advanced topics are introduced with a focus on current research areas.

SWEN 431 CRN 18669 **Advanced Programming Languages** 15 PTS **Tri 1**

Prerequisites: 30 300-level COMP or SWEN points

This course applies a range of advanced contemporary programming languages in current use, covering practical programming skills in the languages as well as their niches and design paradigms. The course will cover languages of present industrial interest, along with design trends of future languages.

SWEN 432 CRN 18670 **Advanced Database Design and Implementation** 15 PTS **Tri 2**

Prerequisites: SWEN 304, 15 further 300-level COMP, NWEN or SWEN pts
Restrictions: COMP 442

This course explores a selection of the following topics: XML Databases, Cloud Databases, Data Warehouse and Object-Relational Databases. It examines features of these advanced database systems and analyses the new applications they facilitate.

SWEN 433 CRN 18671 **Web Information Systems Engineering** 15 PTS **Tri 1**

Prerequisites: SWEN 304, 15 further 300-level COMP, NWEN or SWEN pts
Restrictions: COMP 443

This course gives a technology-centered introduction to web information systems and services. On successful completion of the course students are able to explain basic concepts used in building and managing web information systems. They know central technological standards underlying web information systems and web services, understand architectural principles, and are able to evaluate and critically discuss such systems.

SWEN 435 CRN 35116 **Database System Engineering** 15 PTS **Tri 1**

Prerequisites: 60 300-level pts of COMP, NWEN, SWEN

Restrictions: SWEN 304, SWEN 439 in 2021-2022

The course addresses fundamental principles underlying databases and database management systems. It covers the structure and principles of the relational data model, including SQL, and the principled design of the relational database schema. It also addresses issues in database transaction procession, concurrency control, recovery, and the complexity of query processing.

SWEN 438 CRN 18597 **Special Topic: DevOps** 15 PTS **Tri 2**

Prerequisites: ENGR 302

This course explores the principles of the DevOps transformation currently taking place in software engineering and information technology industries. The theory and practice of DevOps is examined alongside the modern software engineering tools and technologies which are used to create and maintain observable, scalable and reliable information technology infrastructures.

WHO TO CONTACT

Te Herenga Waka—Victoria University of Wellington offers a range of services that covers all student-related matters from applications/enrolment to graduation.

Student Success Team, Te Wāhanga Ahunui Pūkaha—Faculty of Engineering

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