

The University of Auckland
Faculty of Engineering

Computer Systems Engineering Programme 2009

Part I	Pnts	Semester	
		1 st	2 nd
ENGGEN 121 Engineering Mechanics	15		
ENGGEN 140 Engineering Biology and Chemistry	15		
ENGSCI 111 Mathematical Modelling 1	15		
CHEMMAT 121 Materials Science	15		
ELECTENG 101 Electrical & Digital Systems	15		
ENGGEN 131 Intro. to Eng. Computation & Software development	15		
ENGGEN 115 Introduction to Engineering Design	15		
General Education Requirement	15		
ENGGEN 199 English Language Competency	0		
Total Points – Part I	120		

Part II	Pnts	Semester	
		1 st	2 nd
COMPSYS 201 Fundamentals of Computer Engineering	15		
ELECTENG 202 Circuits & Systems	15		
ELECTENG 210 Electronics 1	15		
ENGSCI 211 Mathematical Modelling 2	15		
COMPSYS 202 Object Oriented Design & Programming	15		
ELECTENG 204 Engineering Electromagnetics	15		
ELECTENG 209 Analog & Digital Design	15		
ENGGEN 204 Technical Communication for Engineers	15		
ENGGEN 299 Workshop Practice	0		
Total Points – Part II	120		

Part III	Pnts	Semester	
		1 st	2 nd
COMPSYS 302 Design: Software Practice	15		
COMPSYS 305 Digital Systems Design 1	15		
ENGGEN 303 Management for Engineers	15		
ENGSCI 313 Mathematical Modelling 3ECE	15		
COMPSYS 301 Design: Hardware Software Systems	15		
ELECTENG 303 Systems and Control	15		
<i>30 points selected from:</i>			
COMPSYS 303 Microcomputers & Embedded Systems	15		
COMPSYS 304 Computer Architecture 1	15		
SOFTENG 325 Software Architecture	15		
Other approved course	15		
Total Points – Part III	120		

Part IV	Pnts	Semester	
		1 st	2 nd
COMPSYS 401 Research Project	15+15		
ENGGEN 403 Professional & Sustainability Issues	15		
<i>At least 45 and not more than 60 points selected from:</i>			
COMPSYS 403 Embedded Systems Design	15		
COMPSYS 404 Real-time Systems	15		
COMPSYS 405 Comp. Networks & Distributed Applications	15		
COMPSYS 406 Robotics & Intelligent Systems	15		
COMPSYS 420 Special Topics 1	15		
COMPSYS 707 Advanced Microcomputer Architecture	15		
ELECTENG 413 Signal Processing	15		
COMPSYS 421 Special Topics 2	15		
COMPSYS 701 Advanced Digital Systems Design	15		
COMPSYS 703 Advanced Intelligent Systems	15		
COMPSYS 704 Advanced Embedded Systems	15		
COMPSYS 705 Formal Methods for Engineers	15		
COMPSYS 706 Speech & Language Processing	15		
ELECTENG 706 Digital Signal Processing	15		
<i>At least 15 and not more than 30 points selected from:</i>			
ELECTENG 412 Communication Systems	15		
ELECTENG 422 Control Systems	15		
Other approved course	15		
Total Points – Part IV		120	

*Part I***CHEMMAT 121 (15 Points)****Materials Science**

Atomic structure and bonding. Structure of solids. Microstructure. Mechanical properties. Alloying and phase diagrams. Engineering alloys and their heat treatment. Engineering ceramics and glasses. Engineering polymers. Engineering composites. Biomaterials. Electronic, optical, superconducting and magnetic materials. Corrosion and degradation of metals.

ELECTENG 101 (15 Points)**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.

ENGGEN 115 (15 Points)**Introduction to Engineering Design**

The aim of the course is to develop an appreciation of design as a key aspect of professional engineering. Course elements: sketching and interpretation of engineering drawings; preparation of drawings using Computer Aided Design (CAD) software; design projects, some of which will require teamwork and cover design-build-test activities; an introduction to the engineering design process.

ENGGEN 121 (15 Points)**Engineering Mechanics**

An introduction to mechanics including: planar forces, free body diagrams, planar equilibrium of rigid bodies, friction, distributed forces, internal forces, shear force and bending moment diagrams, simple stress and strain and associated material properties, kinematics and kinetics of particles, work and energy, motion of rigid bodies in a plane.

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 high level programming language C.

Restriction: ENGSCI 131

ENGGEN 140 (15 Points)**Engineering Biology and Chemistry**

Introduction to chemical and biological systems. The application of engineering analysis and design techniques to facilitate understanding the multiscale structure, function, and interactions of such systems. The use of research case studies to illustrate systems approaches to chemistry and biology.

ENGSCI 111 (15 Points)**Mathematical Modelling 1**

Introduction to mathematical modelling. Differentiation and integration (polynomials, trigonometric, exponential, logarithmic, hyperbolic and rational functions). Integration by parts, substitution and numerical integration. Differential equations and their solutions (including Euler's method). Complex numbers and roots of functions. Vector and matrix algebra, geometry, transformations, sets of linear equations, curve fittings. Introduction to statistics and 'R'.

*Part II***COMPSYS 201 (15 Points)****Fundamentals of Computer Engineering**

The hardware/software interface: processors, registers, memory, basic I/O. Representation of data, number systems, and computer arithmetic; assembly language programming and debugging; support for high-level languages; exceptions and multithreading; combinational and sequential circuits (traditional design and standard circuits); instruction sets; communication principles.

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

ELECTENG 202 (15 Points)**Circuits and Systems**

This course 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**

Electrical conduction theories, conducting materials and insulators, magnetic and dielectric properties and materials, electrostatics and magnetostatics, steady electric currents, the magnetic field of steady electric currents, Ampere's law and its applications, electromagnetic induction, Faraday's law and its applications, electromagnetism, simple transmission lines, magnetic circuits, permanent magnets, inductors, transformers, introduction to electrical machines.

Prerequisite: ELECTENG 101

ELECTENG 209 (15 Points)**Analogue and Digital Design**

This project-based course provides an introduction to real-world design of analogue and digital circuits. Practical skills will be gained in electronic circuit analysis, use of CAD tools, PCB design and construction, circuit testing and calibration using laboratory equipment. Appropriate design methodology will be developed in a practical framework.

Prerequisite: ELECTENG 101, 202, 210, COMPSYS 201

ELECTENG 210 (15 Points)**Electronics 1**

An introduction to semiconductor devices (diodes, bipolar junction transistors, field-effect transistors, operational amplifiers) and their applications. Device operation, device models and terminal characteristics. Biasing, coupling and bypass techniques. Small-signal analysis. Signal amplifiers, oscillators and power amplifiers. Switches and sensors.

Prerequisite: ELECTENG 101

ENGGEN 204 (15 Points)**Technical Communication for Engineers**

The communication of complex engineering material will be emphasised in the following ways: the use of appropriate engineering graphical software at an advanced level; the use of appropriate multi-media; visual and spoken presentation, in styles appropriate to seminars, conferences, and presentations to technological industries; the construction of industrial displays; and the preparation of engineering reports.

ENGSCI 211 (15 Points)**Mathematical Modelling 2**

First and second order ordinary differential equations and solutions. Laplace transforms. Taylor series and series in general. Multivariate and vector calculus including div grad and curl. Further linear algebra with partial pivoting. Fourier series and transforms. Application of the techniques through appropriate modelling examples.

Restriction: ENGSCI 212, 213

*Part 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 design, computer software design, system design and control, sensing, actuation and interfacing.

Prerequisite: COMPSYS 302, 305; ELECTENG 209

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

A project-based course with extensive hands-on programming experience emphasising problem-solving techniques and applications in computer systems engineering. Topics include: algorithms and data structures, parsing and translation, concurrent programming, scripting languages, systems programming.

Prerequisite: COMPSYS 202

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 202, 305

COMPSYS 304 (15 Points)**Computer Architecture 1**

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

COMPSYS 305 (15 Points)**Digital Systems Design 1**

Digital Systems implementation technologies; abstraction levels; hardware description languages; structural, architectural and behavioural modelling; register-transfer level design; datapath and control units; fixed and microprogrammed control units; ASM charts; synthesis from ASM charts, digital computation; verification; design flow. Design of a simple processor. FPGAs as prototyping technology.

Prerequisite: COMPSYS 201

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

ENGGEN 303 (15 points)**Management for Engineers**

An introduction to modern theory and practice of management, including project, quality and financial management appropriate to the engineering profession.

Prerequisite: ENGGEN, 199

Restriction: ENGGEN 302

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 optimization.

Restriction: ENGSCI 311, 312

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: SOFTENG 350 or COMPSYS 302

Part IV**COMPSYS 401A (15 Points)****COMPSYS 401B (15 Points)****Research Project**

A student is 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.

To complete this course students must enrol in COMPSYS 401 A and B

Prerequisite: COMPSYS 301, and 45 points from COMPSYS 303-306, SOFTENG 325

COMPSYS 403 (15 Points)**Embedded Systems Design**

Principles of embedded systems modeling. Models of computation. Languages for embedded systems design. Hardware/Software partitioning and co-design. Technologies. Energy-aware systems. Rapid prototyping. Distributed embedded systems. Case studies.

Prerequisite: COMPSYS 303

Restriction: COMPSYS 402

COMPSYS 404 (15 Points)**Real-time Systems**

Real-time concepts. Data- versus control-dominated systems. Hardware versus software tradeoffs. DSP algorithms. Architectures. Real-time operating systems. Reliability. Fault-tolerant computing systems. Internet-based and mobile systems.

Prerequisite: COMPSYS 303

Restriction: COMPSYS 402

COMPSYS 405 (15 Points)**Computer Networks and Distributed Applications**

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, 202

COMPSYS 406 (15 Points)**Robotics and Intelligent Systems**

Introduction to robotics and intelligent systems, including: robot manipulators and mobile robots, navigation techniques, planning and programming of robot actions, sensors and actuators, artificial intelligence, artificial neural nets, fuzzy systems, genetic algorithms.

Prerequisite: COMPSYS 302 or SOFTENG 306

COMPSYS 420 (15 Points)**Special Topics 1**

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

COMPSYS 421 (15 Points)**Special Topics 2**

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

*Honours and Masters Courses***COMPSYS 701 (15 Points)****Advanced Digital Systems Design**

Register-transfer, behavioural and system-level design and synthesis; resource sharing; scheduling; the use of hardware-description languages; algorithms to logic; hardware/software partitioning; systems-on-chip; component re-usability; reconfigurable systems, low-power systems; case studies (DSP, speech, image and video algorithms implementation).

Prerequisite: COMPSYS 305

COMPSYS 703 (15 Points)**Advanced Intelligent Systems**

Selected topics from current research in robotics and intelligent systems, such as: navigation, human-robot interaction, control, programming, path planning, problem solving, pattern recognition, artificial neural networks, fuzzy systems, genetic algorithms.

Prerequisite: COMPSYS 406

COMPSYS 704 (15 Points)**Advanced Embedded Systems**

Selected topics from current research in embedded systems, such as: models of computation, architectures, distributed embedded systems, systems-on-chip, real-time operating systems, heterogeneous models of computation, architectures and technologies, formal verification, model-checking.

Prerequisite: COMPSYS 403 or 404 or 701

COMPSYS 705 (15 Points)**Formal Methods for Engineers**

Validation versus Verification, Formal models, Formal Specification: Process Algebraic, Logic Based, Temporal Logic, Methods of Verification: Bisimulation, Model Checking, Theorem Proving. State Space explosion problem and solutions: BDDs, Symbolic Model Checking, Modular Verification. Verification of HDL designs, Tools: STeP, VIS, NuSMV.

Prerequisite: COMPSYS 302, 305

COMPSYS 706 (15 Points)**Speech and Language Processing**

Introduction to the fundamentals of speech and language processing. Concepts, methods and applications of speech signal processing. Principles of speech analysis, coding, modelling, recognition, synthesis, and language processing.

Prerequisite: ELECTENG 413

COMPSYS 707 (15 Points)**Advanced Microcomputer Architecture**

Hardware and software approaches for instruction-level parallel processing, multiprocessors and multithreading, embedded multiprocessing and memory systems, architectures for embedded multiple processors and networks on chip, dynamic reconfigurable architectures

Prerequisite: COMPSYS 304 or SOFTENG 363

ELECTENG 412 (15 Points)**Communication Systems**

Broadband systems: FDM, TDM, PCM. Noise. Information theory, error control coding, data networks, waveform coding and data compression, baseband data transmission. Introduction to digital systems: Digital modulation.

Prerequisite: ELECTENG 303

ELECTENG 413 (15 Points)**Signal Processing**

Analog signals and systems: Signal processing concepts and tools for analysing deterministic and random continuous-time signals and systems. Digital signals and systems: Discrete-time deterministic signal analysis, digital filters and transforms, including the FFT. Digital Signal Processor (DSP) architectures and DSP applications.

Prerequisite: ELECTENG 303

ELECTENG 422 (15 Points)

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, Liapunov's method of stability analysis, design of controllers for non-linear systems. Variable structure systems.

Prerequisite: ELECTENG 303

ELECTENG 706 (15 Points)

Digital Signal Processing

Advanced digital signal processing concepts and techniques for analysing discrete-time deterministic and random signals and systems. Stochastic signal description and analysis, system response to stochastic signals. Adaptive systems and applications. Multi-rate techniques. Digital Signal Processor (DSP) implementation strategies and real-world issues.

Prerequisite: ELECTENG 413

ENGGEN 403 (15 points)

Professional and Sustainability Issues

Issues of particular relevance to the engineering profession including those relating to the law, ethics, culture and sustainability.

Restriction: ENGGEN 203, 402