ELEC60004
Artificial Intelligence

use and evaluate different algorithms for finding a graph as a basis for planning and problem-solving	use and evaluate algorithms for automated reasoning in propositional, predicate and modal logics	apply formal languages for knowledge representation and reasoning through symbolic computation	implement algorithms for planning and reasoning in Prolog (logic programming language)

ELEC70048
Probability and Stochastic Processes

evaluate the performance of a system using key probability and random variables	derive the probability density function of a function of a random variable or random variables	model an engineering problem using random signals (or processes) and Markov chains	analyse random phenomena (signals and noise) in electrical engineering

ELEC70015
Human-Centered Robotics

learn the theory underlying robotic systems that perceive human states using multimodal interfaces (e.g. computer vision, wearable systems, haptic systems, brain-machine, augmented reality systems), computationally model and recognise human behaviour, and adaptive shared control methods to assist humans in their task; use learning algorithms to improve their performance through interaction with humans	learn to incorporate human factors in the design of their interactive robotic systems	learn to design and implement control and planning algorithms for interactive robotic systems	learn to work in groups to investigate interactive human-system (hardware/software) challenges

ELEC70003
Advanced Electronic Devices

critically analyse transport processes in nanoscale FETs, including quantum phenomena and self-heating/cooling	derive device characteristics given the geometry and material parameters using drift-diffusion estimations as well as numerical simulations using Sentaurus TCAD	extract the performance parameters of FETs and critically appraise their relevance in applications	read and write technical papers in the field of semiconductor device design and their impact on future CMOS developments	design/optimise current and novel devices using TCAD software (Sentaurus from Synopsis)

ELEC50006
Discrete Mathematics

Apply graph algorithms to efficiently explore data-structures	Prove algorithms are correct using inductive logic	Describe computability in terms of turing machines	Use complexity notation to analyse runtime and storage requirements of a computer program	Use the divide and conquer strategy for designing algorithms, and analyse their efficiency in terms of complexity notation using the Master Theorem

ELEC60020
Managing Engineering Projects

lead and manage innovative technological projects within an engineering context	manage teams within an organisational context	anticipate and accommodate risk and change during the life of a project	apply a range of skills to the planning, implementation, management and budgeting of engineering projects

ELEC70039
Wavelets

analyse natural signals and images like for example biomedical signals, speech, audio, medical images, video sequences	analyse the efficacity of a signal representation and develop new signal representation	design perfect reconstruction filter banks	design filter banks and construction of discrete and continuous-time bases for efficient signal analysis	apply basic image and video compression principles

ELEC70037
Topics in Large Dimensional Data Processing

design algorithms for large dimensional data processing, with the focus on finding sparse structures in the data for dimension reduction	use linear algebra tools to model problems involving large dimensional data	develop optimization and statistics tools to solve problems involving large dimensional data	evaluate advantages and disadvantages of different approaches for analysis of large dimensional data in real-world applications, including for example imaging inverse problems, online recommendation, machine learning

ELEC50012
Power Electronics and Power Systems

describe operation of a switch-mode power supply (SMPS) and appreciate why it is capable of high efficiency and how step-down and step-up of voltage is possible	calculate suitable component values for a given SMPS specification	calculate current and power flow for star- and delta-connected, three-phase loads	describe the construction and operating principles of a transformer	justify elements of the equivalent circuit of a transformer	calculate the current flow, efficiency and voltage regulation in transformer	describe qualitatively how a rotating magnetic field is produced by a three-phase winding and how torque is developed by interaction of two fields	justify elements of a per-phase induction machine equivalent circuit	calculate slip, power and torque of an induction machine based on the equivalent circuit	calculate power flow between nodes of a network and the voltages at the nodes	describe how voltage is controlled in a network

ELEC70047
HVDC Technology and Control

appraise the pros and cons of using HVDC with respect to AC for overhead and cable transmission	describe the operation and control of HVDC converters and HVDC systems	recognise the benefits and limitations of two broad HVDC technologies and their suitability in a specific context	design the control system for HVDC converters and systems	analyse the interaction between HVDC and host AC systems	appreciate the role of HVDC in renewable integration and decarbonisation of the electric power sector

ELEC70051
Radio Frequency Subsystems

apply the main architectures employed in RF systems	interpret subsystem specifications	calculate power link budgets	analyse circuits and subsystems using S-parameters	calculate gain, stability and noise issues in small-signal amplifiers	design impedance matching networks and filters

ELEC50010
Instruction Architectures and Compilers

Describe how high-level programs are executed through the sequencing of instructions	Create a compiler from a high-level language to an instruction-based language	Program a functional model of a CPU	Optimise high-level data structures to exploit the low-level memory hierarchy	Design data-structures which can represent programs	Determine the worst-case propagation delay of a combinational circuit	Design arithmetic circuits to meet a specification and determine the propagation delay	Evaluate possible architectural solutions against a set of performance objectives	Discuss the relationship between throughput, latency, and pipelining

ELEC60031
Classical and Modern Radar

use the radar equations	apply the radar theory to classify the various radar architectures and rate their performance	analyse and design the transmitter and receiver of any type of radar system	design radar waveforms and system architectures aiming at improving the solutions of the detection, estimation, tracking and classification of various types of targets/objects/signals in the presence of noise, clutter and interference

ELEC70001
Adaptive Signal Processing and Machine Intelligence

extract adaptively latent component from real-world data	apply algorithms of adaptive signal processing to real-time streaming data	effectively use adaptive machine intelligence techniques such as deep learning, recurrent neural networks, and deep neural networks	implement the corresponding dimensionality reduction techniques, and develop and find structure in data and handle Big Data through tensor decompositions	produce MATLAB code for adaptive noise cancellation, high-resolution spectrum/parameter estimation from your own physiological recordings (ECG), universal function approximation through recurrent and deep neural architectures, and their connection with tensor decompositions for big data applications.

ELEC60014
Group Consultancy Project

Develop an engineering specification from a given open-ended brief	Generate number of viable solutions to the brief	Select the optimum solution through technical and critical analysis	Develop a prototype to demonstrate the principles of the proposed solution	Provide financial and commercial information to support their decision	Manage the project from a resource and workload point of view	Communicate in a way to suit the intended target audience (written and oral)

ELEC60025
Real-Time Digital Signal Processing

put the concepts of signal processing into practice	learn the differences between real-time and batch processing applications	learn the differences between SP and general-purpose computing hardware	learn how to use Matlab and Matlab Simulink to design and analyse SP algorithms	learn how to use simulink Embedded Coder to program microcontrollers	program as embedded platform	revise basic concepts of DSP

ELEC60009
Information Processing

Classify real-world data into different types of signals	Describe Linear Time-Invariant systems mathematically and in a way suitable for impementation in processing systems	Explain and apply convolution for linear time-variant and time-invariant under functions for continuous and discrete time systems	Use the sampling theorem with the discrete Fourier Transform and the z-transform	Model a data filtering problem as a transfer function and understand how to apply filters to signals	Implement discrete filters using software	Create information systems which use software and hardware to process information

ELEC70012
Full-Custom Integrated Circuit Design

consider key features, limitations and technologies of CMOS technology	appraise the full custom integrated circuit design methodology and issues/constraints involved in analogue/digital/mixed signal circuit design	design and assess full custom integrated circuit layouts	develop full custom design of CMOS integrated circuits using a complete tool suite (schematic capture, simulation, layout design, physical verification)

ELEC60028
Predictive Control

construct a range of finite horizon optimal control problems with constraints	solve constrained finite horizon optimal control problems by formulating them as linear dimensional optimization problems	compare the advantages and disadvantages of optimization as a solution to finite horizon optimal control problems in a receding , decreasing- or variable-horizon fashion	transfer a real-world control problem into a mathematically well-defined optimal control problem	devise predictive controllers with guarantees of stability and feasibility	write Matlab programs that implement a predictive controller	appraise relatively simple papers on predictive control and be able to extract information from them in order to design a predictive controller

ELEC60002
Statistical Signal Processing and Inference

model, analyse and predict real world random processes using stochastic models	identify time varying parameters of non-stationary signals using adaptive estimation and inference	derive theoretical and practical performance bounds for statistical estimation and learning algorithms in practical settings	perform denoising and prediction of signals corrupted by noise, using advanced statistical learning and filtering	estimate relevant physiological parameters from real life recordings acquired recordings and understand how to critically analyse and improve signal quality

ELEC50009
Computer Engineering Design Project I and II

Capture and analyse a set of high-level requirements to produce a set of design specifications	Apply theoretical principles and laboratory skills to design, build and test a system to an engineering design problem, within practical constraints	Integrate analogue, digital and software theory and design techniques into a functioning system	Organise workload and manage time by functioning as an engineering team and decomposing the design challenge into subsystems	Formulate and implement a test plan to evaluate a design against its specifications	Communicate process and results to stakeholders using various forms of communication (reports, presentations, reviews, etc.)

ELEC60006
Communication Networks

Describe different communication networks and technologies including Industry standards	Analyse and control the main features and requirements of different communication networks and quality of service (QoS) related aspects	Discuss the validity of different performance modelling/assessment techniques	Identify different communication network QoS related requirements, and the appropriate techniques for these problems	Formulate the underlying assumptions of the studied modelling/assessment techniques and critically analyse their impact	Determine the conditions in which a communication system is operating	State and solve communication system and network performance related problems (e.g. optimal routing problem and system utilisation)	Derive and evaluate related performance analytical expressions.

ELEC60008
Control Engineering

Model dynamic system using differential and difference equations	Given a transfer function find suitable state representation and vice versa, and quantify difference between the two representations	Access stability properties of dynamical systems and structural properties	Design feedback controller in a systematic way to modify behavior of dynamical systems	Assess a prior what behaviour can and cannot be achieved in a dynamic system

ELEC50013
Signals and Systems

classify real-world data into different types of signals	describe Linear Time-Invariant systems mathematically and in a way suitable for impementation in processing systems	explain and apply convolution for linear time-variant and time-invariant under transfer functions for continuous and discrete time systems	use the sampling theorem with the discrete Fourier Transform and the z-transform	model a data filtering problem as a transfer function and understand how to apply filters to signals	

ELEC70009
Discrete-Event Systems

assess the the suitability of a system for modeling in a discrete-event set-up	create a discrete-event model and assess its structural properties	design algorithms for the qualitative and quantitative analysis of Discrete Event Systems	design a supervisory controller and an observer automaton	simulate a discrete event system	assess the performance of the system in a deterministic and stochastic set-up

ELEC60026
Semiconductor Devices

explain basic quantum mechanical principles of charged carrier conduction	apply energy band diagrams to analyse carrier transport processes	classify devices into majority and minority carrier devices and appreciate their advantages and disadvantages in different applications	derive device characteristics given the geometry and material parameters	calculate performance parameters by employing the correct equations and approximations	explain delays in small and large signal operation of devices

ELEC60005
Biomedical Electronics

Interpret biomedical signals and define their requirements for detection and processing	Identify the required building blocks for a given biomedical system	Design circuits and systems for a given biomedical system specification

ELEC60023
Optoelectronics

solve wave and waveguide problems using Maxwell's equations	design and evaluate optical fibre-based communication systems	design and evaluate optical fibre-based sensing systems

ELEC60012
Electrical Energy Systems

Explain the operating principle and describe the static models of synchronous machines, transformers and transmission lines	Use per-unit system for analysis of electric power systems	Perform power flow analysis using the Gauss-Seidel technique	Conduct short circuit analysis for balanced and unbalanced faults	Analyse steady-state and transient stability of simple electric power systems	Appraise the challenges associated with low system inertia and short-circuit levels driven by high penetration of renewables	

ELEC60019
Machine Learning

develop solutions to machine learning problems using modelling and pre-processing data, and designing, selecting and develop appropriate learning algorithms	consider and contrast the problems of learning and overfitting in an ML system	justify the use of linear regression, polynomial regression, logistic regression, support vector machines, neural networks, nearest neighbour and clustering	recommend and construct the use of a machine learning algorithm in unseen situations

ELEC60011
Digital Systems Design

design complex, high performance digital systems	use a modern CAD tool to help with the design	implement such designs using programmable logic (e.g. FPGAs)

ELEC60018
Instrumentation

state the operation principles and characteristics of various electronic sensors and transducers for mechanical and electromagnetic stimuli	specify the use of recently invented sensors (SQUID, GMR, QHE, etc) in applications with severe performance requirements	design interface circuits to optimise transducer performance	write embedded code to implement data acquisition (including subsampling and irregular sampling) and signal conditioning	assemble a PCB level prototype of a specified measurement instrument

ELEC50001
Circuits and Systems

Design, analyse and explain sensors: analogue circuit interfaces between the input and digital signal processing stage	Explain the common type of DAC and ADC architectures currently used in industry	Design low-pass, high-pass and band-pass filters for preconditioning signals	Choose suitable low-noise pre-amplifier and analyse its impact on signal-to-noise performance of the system	Choose suitable output circuit architecture for high current drive and design a circuit to meet specification	Design reasonably complex circuits involving digital building blocks such as shift register, multiplexer, memory, interface them to a processor	Write good quality Verilog code to specify digital hardware	Implement digital hardware on an FPGA	Design a basic testbench circuit

ELEC60003
Analogue Integrated Circuits and Systems

Analyse different analogue circuits and architectures	Design different analogue circuits taking into account the trade-offs and creating solutions to circumvent or resolve these	Derive and apply the concept of current feedback OPAMPs	Analyse and calculate integrated switched capacitor filters and continuous-time filters	Explain and simulate the operation of A/D and D/A Converters and contrast different approaches

ELEC60016
Individual Industrial Placement

critically analyse the requirements of an employer in a certain engineering related industry	operate in a professional manner in an industrial setting	summarise your work and critically analyse its impact on the business	criticise current practices and suggest alternative solutions that are ethically and economically responsible	make informed decisions on the direction of your future career

ELEC60041
Year Abroad

learning outcomes supported by the host university	experience of engineering practice, technology, and working methods outside the UK

ELEC60033
Electric Vehicle Technologies

describe the key subsystems of an EV and an EV including the motor model and a FOC	design and model a battery pack for an EV including the Charger, DC-DC Converter, Battery and Battery Management System	model and analyse other key blocks in an EV including the	assemble and adapt an EV model for the analysis and evaluation of its subsystems and performance assessment of the system as a whole	discuss the broader range of EV design issues not covered in depth in this module including safety implications, communication devices and the communications networks of a modern vehicle	discuss the impacts of EVs on the smart grid and environment including the potential future of adaptive and responsive charging (Demand-side response and Vehicle-to-grid)

ELEC60022
Microwave Technology

interpret electromagnetic wave propagation in various media; how guided-wave structures can be used as practical components, bridging the gap between Radio and optical frequencies	analyse the fundamental physical limitations of components. For example, why turbe mounted devices are not used at proper microwave frequencies	present aspects of commercial technologies in the design and manufacture of components and circuits	describe the application of commercial microwave technologies in the mobile phones and microwave ovens to radar and radiometric imaging

ELEC60010
Digital Signal Processing

use the sampling theory to design discrete data systems and analyse these systems in terms of system functions and z-transform	analyse and design digital filters using FIR and IIR filter design techniques	perform and interpret correctly the results of simple short-time spectral estimation	learn about the FFT, the fast computation of the DFT	develop basic multirate signal processing systems, exploiting appropriate measurements and identities, and design typical application examples including sample-rate-changing systems	

ELEC70041
Year Abroad

learning outcomes supported by the host university	experience of engineering practice, technology, and working methods outside the UK

ELEC50003_ELEC50008
Computer Engineering Design Project I and II

Capture and analyse a set of high-level requirements to produce a set of design specifications	Apply theoretical principles and laboratory skills to design, build and test a system to an engineering design problem, within practical constraints	Integrate analogue, digital and software theory and design techniques into a functioning system	Organise workload and manage time by functioning as an engineering team and decomposing the design challenge into subsystems	Formulate and implement a test plan to evaluate a design against its specifications	Communicate process and results to stakeholders using various forms of communication (reports, presentations, reviews, etc.)

ELEC40006
Electronics Design Project

Capture and analyse a set of high-level requirements to produce a set of design specifications	Apply theoretical principles and laboratory skills to design, build and test a system to an engineering design problem, within practical constraints	Integrate analogue, digital and software theory and design techniques into a functioning system	Organise workload and manage time by functioning as an engineering team and decomposing the design challenge into subsystems	Formulate and implement a test plan to evaluate a design against its specifications	Communicate process and results to stakeholders using various forms of communication (reports, presentations, reviews, etc.)

ELEC40005
Digital Electronics and Computer Architecture

designs significant synchronous sequential digital circuits using registers and combinational logic	design simple two's complement addition and subtraction digital circuits, with correct use of carry and overflow	use digital blocks: RAMS, ROMs, PLDs, registers, multiplexers and state machines to design and analyse the operation of simple pipelined RISC computer systems	model the operation of machine code instructions on a CPU at register-transfer level, and manipulate data using different numeric representations	write programs for low-level operations, manipulating bit fields within words, accessing memory, and calling subroutines	implement I/O in embedded computer systems using polling

ELEC70017
Individual Project (MEng)

plan and manage a project over an extended period	take personal responsibility of your work	tackle open-ended work and apply prior theoretical knowledge to practical situations	critically review information from a wide range of sources	adopt appropriate analytical, computational and/or experimental methods to meet your project objectives	communicate the outcomes of the project work, effectively and professionally in such a written and oral format

ELEC70044
Role and Value of Smart Grid Technologies

assess the role of the smart grid concept in facilitating a cost effective transition to a low carbon energy system	perform a cost-benefit analysis involving supply risks and operational or investment costs	model and assess the difference between preventive and corrective control	apply advanced approaches in scheduling of flexible demand	perform big data analytics in the application of smart grids	construct and evaluate basic reliability models and metrics	implement Monte Carlo risk computations	model a basic cyber attack and defence mechanism

ELEC50004
Control Systems

Construct linear dynamic models of engineering systems in relevance to the frequency and in the state-space domain	Recognise the basic principles governing the behaviour of a closed-loop control system including the modes of behaviour of its components	Evaluate, among several options, how to configure and structure the architecture and the controller of an engineering control system starting from functional requirements and considering performance constraints	Analyse the static and dynamic performance of basic linear feedback control systems and design controllers such that the overall control system behaves according to pre-specified requirements	Analyse and quantify the impact of digital implementation of the control system on the closed-loop performance	Validate experimentally the dynamic models and the satisfaction of performance requirements on a selected hardware test benchmark in the laboratory

ELEC60016
Individual Industrial Placement

critically analyse the requirements of an employer in a certain engineering related industry	operate in a professional manner in an industrial setting	summarise your work and critically analyse its impact on the business	criticise current practices and suggest alternative solutions that are ethically and economically responsible	make informed decisions on the direction of your future career

ELEC70004
Analogue Signal Processing

recommend voltage and current mode architectures used in analog signal processing	design circuits capable of performing low power analog computation and signal processing in CMOS	recommend circuit techniques which allow efficient computation and signal processing in CMOS such as log-domain filters and capacitor correlated double sampling and spike domain	design mix-mode systems utilising analogue signal processing techniques

ELEC60017
Individual Project

plan and execute an individual work	create and update a flexible project plan with specified tasks and fallbacks	learn and use information from one or more new technical areas	solve technical problems as necessary to achieve a deliverable	produce a major high quality written report to fixed deadlines	carry our independent work that can cover different aspects of engineering such as design and build topics and software implementation topics	

ELEC70045
Advanced Communication Theory

design and analyse optimum receivers based on 'decision theory'	evaluate the performance of M-ary matched filter receivers	model, design and analyse diversity systems using optimum diversity theory	solve the following three generic problems: 'detection', 'estimation' and 'receptors' problems and design suitable processors to implement these solutions	utilise array signal processing theory to model and analyse multi-antenna SIMO, MISO, MIMO and massive systems	model, design and analyse time- and space-time communications.

ELEC70030
Professional Portfolio and Group Consultancy Project

evidence the claims made in your CV	speak with confidence and eloquently on your achievement	reflect on what you have learned and how that can be applied in research/development/industrial practice.

ELEC60013
Embedded Systems

identify the particular requirements of computer systems which interact directly with the physical world	analyse the constraints imposed by time-critical applications and prove that they are met	set up low-level communication between software, hardware and between the wider world	use interrupts and threading to guarantee that time constraints are met	write complex, low-level software that is reliable	configure and use a variety of hardware platforms and development toolchains

ELEC60021
Mathematics for Signals and Systems

compute the trace, determinant, eigenvalues and eigenvectors of a matrix	compute the SVD of a matrix	critically analyse a linear mapping using the properties of the SVD	identify and find the least-square solution for overdetermined problems and minimum norm solution for under-determined problem	find the Total Least Square solution to an approximation problem	compute the rank and the null space of a matrix	

ELEC60009
Deep Learning

formalise a deep learning problem	choose and fit models to data	critically appraise the merits and shortcomings of model architectures on specific problems	apply existing deep learning models to real datasets	discriminate between different practical machine learning problems	implement and evaluate common neural network models for various types of data	apply a variety of learning algorithms to data	combine modular components to build deep learning systems for a wide range of real-world applications	perform a critical appraisal of recent scientific literature in deep learning	choose appropriate performance evaluation metrics	present and analyse the results as well as draw appropriate conclusions

ELEC60015
High Level Programming

write programs in the hybrid object-oriented and functional programming language F#	express simple algorithms in a transformational style using immutable operations	write recursive and tail recursive implementations of iteration	use list, map, array collection types and associated library functions	analyse and debug type errors in F#	analyse problems and design appropriate functional code	define appropriate data structures to represent problem domains	write immutable code and encapsulate mutable operations	split large problems into independent modules with controlled dependencies	work within a group to design, implement and test significant application in F#

ELEC60008
Control Engineering

Model dynamic system using differential and difference equations	Given a transfer function find suitable state representation and vice versa, and quantify difference between the two representations	Access stability properties of dynamical systems and structural properties	Design feedback controller in a systematic way to modify behavior of dynamical systems	Assess a prior what behaviour can and cannot be achieved in a dynamic system

ELEC60013
Embedded Systems

identify the particular requirements of computer systems which interact directly with the physical world	analyse the constraints imposed by time-critical applications and prove that they are met	set up low-level communication between software, hardware and between the wider world	use interrupts and threading to guarantee that time constraints are met	write complex, low-level software that is reliable	configure and use a variety of hardware platforms and development toolchains

ELEC70030
Professional Portfolio and Group Consultancy Project

evidence the claims made in your CV	speak with confidence and eloquently on your achievement	reflect on what you have learned and how that can be applied in research/development/industrial practice.

ELEC60009
Topics in Electrical Engineering

Describe waves as information carriers	Describe how waves propagate in free space and transmission lines	Apply mathematical tools to investigate signals in the frequency domain	Explain the need for modulation techniques to transmit a signal and identify the key functional components to achieve modulation and demodulation	Describe the transverse pn-junction in a pn diode and extrapolate this knowledge to its use as a solar cell	Employ laboratory skills to characterise solar cells	Illustrate how solar polar is transported from the source to the household	Relate the different engineering topics to demonstrate how they are interconnected

ELEC50002
Communications

Model noise in wireless communication systems	Understand the performance measures for analog and digital communication systems, and compare the performance of different modulation techniques	Explain the fundamental limits information theory sets on the performance of communication systems	Calculate the entropy of a random variable, and design the Huffman code for a given information source	Design, implement and characterise analog/digital systems implementation using the NI USRP software defined radio platform	Understand the role physical layer plays within larger communication networks

ELEC60021
Mathematics for Signals and Systems

compute the trace, determinant, eigenvalues and eigenvectors of a matrix	compute the SVD of a matrix	critically analyse a linear mapping using the properties of the SVD	identify and find the least-square solution for overdetermined problems and minimum norm solution for under-determined problem	find the Total Least Square solution to an approximation problem	compute the rank and the null space of a matrix	

ELEC60030
Robotic Manipulation

represent the position and orientation of objects in space	determine the kinematic model of a robot arm based on its number and types of articulation	compute the position of pose of a robot's body and gripper based on its joint angles (Forward Kinematics) and also compute the joint angles necessary to position the body or gripper at a target (Inverse Kinematics)	implement robotic motion trajectories using different control techniques, including joint vs. task space and position vs. velocity control	understand the principles of operation, including dynamics, of torque control (this may not be implemented on the physical robot due to hardware limitations)	understand the different robotic approaches to grasping / object picking (e.g. parallel jaw gripper, suction, fingers, undersactuation, grasp planning and vacuum grippers)	use CAD software to design a simple robot gripper for manipulation of specific objects (e.g. a screwdriver, a ball, a soda can, a toy car, a 6-sided dice)	program low-level motion controllers to execute and test all of the above on a commercially available desktop-size robot arms and grippers	appreciate some of the ways that machine learning is being used in contemporary robotic manipulator research and practical implementation

ELEC70017
Individual Project (MEng)

plan and manage a project over an extended period	take personal responsibility of your work	tackle open-ended work and apply prior theoretical knowledge to practical situations	critically review information from a wide range of sources	adopt appropriate analytical, computational and/or experimental methods to meet your project objectives	communicate the outcomes of the project work, effectively and professionally in such a written and oral format

ELEC60010
Digital Signal Processing

use the sampling theory to design discrete data systems and analyse these systems in terms of system functions and z-transform	analyse and design digital filters using FIR and IIR filter design techniques	perform and interpret correctly the results of simple short-time spectral estimation	learn about the FFT, the fast computation of the DFT	develop basic multirate signal processing systems, exploiting appropriate measurements and identities, and design typical application examples including sample-rate-changing systems	

ELEC70013
High Performance Analogue Electronics

formulate an integrated circuit design problem	consider different technologies and play a role in the process of design, and put those within the context of both, the circuit and the application	argue the need of following different paths in the design process as a function of the chosen design trade-offs	evaluate trade-offs as a function of a number of typical design specification	judge visually the basic behaviour of circuits and systems topologies, including a number of current mirrors, transconductors and filters; without the need of formal calculations	hypothesise, explain, in the context of transconductors, mirrors and filters, of when certain simplifying assumptions could aid the design depending on the required design specifications, with a main focus on linearity and noise

ELEC60022
Microwave Technology

interpret electromagnetic wave propagation in various media; how guided-wave structures can be used as practical components, bridging the gap between Radio and optical frequencies	analyse the fundamental physical limitations of components. For example, why turbe mounted devices are not used at proper microwave frequencies	present aspects of commercial technologies in the design and manufacture of components and circuits	describe the application of commercial microwave technologies in the mobile phones and microwave ovens to radar and radiometric imaging

ELEC60033
Electric Vehicle Technologies

describe the key subsystems of an EV and an EV including the motor model and a FOC	design and model a battery pack for an EV including the Charger, DC-DC Converter, Battery and Battery Management System	model and analyse other key blocks in an EV including the	assemble and adapt an EV model for the analysis and evaluation of its subsystems and performance assessment of the system as a whole	discuss the broader range of EV design issues not covered in depth in this module including safety implications, communication devices and the communications networks of a modern vehicle	discuss the impacts of EVs on the smart grid and environment including the potential future of adaptive and responsive charging (Demand-side response and Vehicle-to-grid)

ELEC50003_ELEC50008
Computer Engineering Design Project I and II

Capture and analyse a set of high-level requirements to produce a set of design specifications	Apply theoretical principles and laboratory skills to design, build and test a system to an engineering design problem, within practical constraints	Integrate analogue, digital and software theory and design techniques into a functioning system	Organise workload and manage time by functioning as an engineering team and decomposing the design challenge into subsystems	Formulate and implement a test plan to evaluate a design against its specifications	Communicate process and results to stakeholders using various forms of communication (reports, presentations, reviews, etc.)

ELEC40006
Electronics Design Project

Capture and analyse a set of high-level requirements to produce a set of design specifications	Apply theoretical principles and laboratory skills to design, build and test a system to an engineering design problem, within practical constraints	Integrate analogue, digital and software theory and design techniques into a functioning system	Organise workload and manage time by functioning as an engineering team and decomposing the design challenge into subsystems	Formulate and implement a test plan to evaluate a design against its specifications	Communicate process and results to stakeholders using various forms of communication (reports, presentations, reviews, etc.)

ELEC40005
Digital Electronics and Computer Architecture

designs significant synchronous sequential digital circuits using registers and combinational logic	design simple two's complement addition and subtraction digital circuits, with correct use of carry and overflow	use digital blocks: RAMS, ROMs, PLDs, registers, multiplexers and state machines to design and analyse the operation of simple pipelined RISC computer systems	model the operation of machine code instructions on a CPU at register-transfer level, and manipulate data using different numeric representations	write programs for low-level operations, manipulating bit fields within words, accessing memory, and calling subroutines	implement I/O in embedded computer systems using polling

ELEC70017
Individual Project (MEng)

plan and manage a project over an extended period	take personal responsibility of your work	tackle open-ended work and apply prior theoretical knowledge to practical situations	critically review information from a wide range of sources	adopt appropriate analytical, computational and/or experimental methods to meet your project objectives	communicate the outcomes of the project work, effectively and professionally in such a written and oral format

ELEC70044
Role and Value of Smart Grid Technologies

assess the role of the smart grid concept in facilitating a cost effective transition to a low carbon energy system	perform a cost-benefit analysis involving supply risks and operational or investment costs	model and assess the difference between preventive and corrective control	apply advanced approaches in scheduling of flexible demand	perform big data analytics in the application of smart grids	construct and evaluate basic reliability models and metrics	implement Monte Carlo risk computations	model a basic cyber attack and defence mechanism

ELEC50004
Control Systems

Construct linear dynamic models of engineering systems in relevance to the frequency and in the state-space domain	Recognise the basic principles governing the behaviour of a closed-loop control system including the modes of behaviour of its components	Evaluate, among several options, how to configure and structure the architecture and the controller of an engineering control system starting from functional requirements and considering performance constraints	Analyse the static and dynamic performance of basic linear feedback control systems and design controllers such that the overall control system behaves according to pre-specified requirements	Analyse and quantify the impact of digital implementation of the control system on the closed-loop performance	Validate experimentally the dynamic models and the satisfaction of performance requirements on a selected hardware test benchmark in the laboratory

ELEC60016
Individual Industrial Placement

critically analyse the requirements of an employer in a certain engineering related industry	operate in a professional manner in an industrial setting	summarise your work and critically analyse its impact on the business	criticise current practices and suggest alternative solutions that are ethically and economically responsible	make informed decisions on the direction of your future career

ELEC70004
Analogue Signal Processing

recommend voltage and current mode architectures used in analog signal processing	design circuits capable of performing low power analog computation and signal processing in CMOS	recommend circuit techniques which allow efficient computation and signal processing in CMOS such as log-domain filters and capacitor correlated double sampling and spike domain	design mix-mode systems utilising analogue signal processing techniques

ELEC60017
Individual Project

plan and execute an individual work	create and update a flexible project plan with specified tasks and fallbacks	learn and use information from one or more new technical areas	solve technical problems as necessary to achieve a deliverable	produce a major high quality written report to fixed deadlines	carry our independent work that can cover different aspects of engineering such as design and build topics and software implementation topics	

ELEC70045
Advanced Communication Theory

design and analyse optimum receivers based on 'decision theory'	evaluate the performance of M-ary matched filter receivers	model, design and analyse diversity systems using optimum diversity theory	solve the following three generic problems: 'detection', 'estimation' and 'receptors' problems and design suitable processors to implement these solutions	utilise array signal processing theory to model and analyse multi-antenna SIMO, MISO, MIMO and massive systems	model, design and analyse time- and space-time communications.

ELEC70030
Professional Portfolio and Group Consultancy Project

evidence the claims made in your CV	speak with confidence and eloquently on your achievement	reflect on what you have learned and how that can be applied in research/development/industrial practice.

ELEC60009
Topics in Electrical Engineering

Describe waves as information carriers	Describe how waves propagate in free space and transmission lines	Apply mathematical tools to investigate signals in the frequency domain	Explain the need for modulation techniques to transmit a signal and identify the key functional components to achieve modulation and demodulation	Describe the transverse pn-junction in a pn diode and extrapolate this knowledge to its use as a solar cell	Employ laboratory skills to characterise solar cells	Illustrate how solar polar is transported from the source to the household	Relate the different engineering topics to demonstrate how they are interconnected

ELEC50002
Communications

Model noise in wireless communication systems	Understand the performance measures for analog and digital communication systems, and compare the performance of different modulation techniques	Explain the fundamental limits information theory sets on the performance of communication systems	Calculate the entropy of a random variable, and design the Huffman code for a given information source	Design, implement and characterise analog/digital systems implementation using the NI USRP software defined radio platform	Understand the role physical layer plays within larger communication networks

ELEC60021
Mathematics for Signals and Systems

compute the trace, determinant, eigenvalues and eigenvectors of a matrix	compute the SVD of a matrix	critically analyse a linear mapping using the properties of the SVD	identify and find the least-square solution for overdetermined problems and minimum norm solution for under-determined problem	find the Total Least Square solution to an approximation problem	compute the rank and the null space of a matrix	

ELEC60030
Robotic Manipulation

represent the position and orientation of objects in space	determine the kinematic model of a robot arm based on its number and types of articulation	compute the position of pose of a robot's body and gripper based on its joint angles (Forward Kinematics) and also compute the joint angles necessary to position the body or gripper at a target (Inverse Kinematics)	implement robotic motion trajectories using different control techniques, including joint vs. task space and position vs. velocity control	understand the principles of operation, including dynamics, of torque control (this may not be implemented on the physical robot due to hardware limitations)	understand the different robotic approaches to grasping / object picking (e.g. parallel jaw gripper, suction, fingers, undersactuation, grasp planning and vacuum grippers)	use CAD software to design a simple robot gripper for manipulation of specific objects (e.g. a screwdriver, a ball, a soda can, a toy car, a 6-sided dice)	program low-level motion controllers to execute and test all of the above on a commercially available desktop-size robot arms and grippers	appreciate some of the ways that machine learning is being used in contemporary robotic manipulator research and practical implementation

ELEC70017
Individual Project (MEng)

plan and man