ELECTRICAL ENGINEERING

The Department of Electrical Engineering is located on the 4th floor of the Menzies Building, Library Road, Upper Campus, Rondebosch.

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G de Jager, MSc *Rhodes* PhD *Manchester* MBL *SA* MIEEE
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Emeritus Associate Professors
ME Dlodlo, BSEE Geneva MSEE *Kansas State* PhD *Delft* MIEEE F'ZweIE Pr.Eng.(ECZ)
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J Pead, BSc(Eng) MSc(Eng) *Cape Town*
M Soltanian, BSc(Eng) MSc(Eng) *Iran*

Senior Technical Officers
P Bizimana
P Titus

Technical Officer
B Daniels

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J Buxey

Finance Officer
C Koonin

Administrative Officer (Undergraduate)
M van der Westhuizen BA PGDip(LIS) *Cape Town*

Administrative Assistants
R Harris (General)
N Moodley (Postgraduate)
S Sabodien (AMES Research Group)
D Singh (Space and Radar Masters)

Receptionist
L Johannes

The Department offers the following postgraduate specialisations:

Control Engineering
Computational Electronics
Engineering Education
High Performance Computing

Image Processing and Vision Systems
Instrumentation
Mechatronics
Machines and Power Electronics
Nuclear Power
Power Systems
Radar, Antennas and Remote Sensing Robotics
Renewable Energy
Robotics
Telecommunications
Space Technology

Postgraduate Programmes

Honours Programmes

Bachelor of Science Honours specialising in Nuclear Power [EH007EEE08]

Emeritus Professor and Programme Convener::
C.T. Gaunt, PrEng BSc(Eng) *Natal* MBL *SA* PhD *Cape Town* FIET FSAIEE

Nuclear power stations operating in over 30 countries provide approximately 13% of the world's electricity. Nuclear energy is a part of the existing and planned energy and electricity policy of South Africa.
This Bachelor of Science Honours programme provides an interdisciplinary postgraduate qualification in the key aspects of nuclear power for societal benefit. The programme provides a balance of the scientific, engineering and applications aspects of nuclear power, including the policy, operating, safety and regulatory aspects.
The degree comprises coursework to the minimum of 108 credits and a 40-credit final year project.

The programme can be completed as a one-year full-time programme, or over an extended period for students who are employed. It is designed to accommodate students who cannot be resident in Cape Town for the full duration of the degree. The courses will be offered in intensive one-week blocks, with pre-contact reading and post-contact assignments and various distance learning activities. Students will be required to be in Cape Town for the intensive course periods.

Core Courses

Code	Course	NQF Credits	HEQSF Level
EEE4106Z	Introductory nuclear physics and radiation for power supply	16	8
EEE4107Z	Thermodynamics for nuclear power stations	16	8
EEE4108Z	Electrical and mechanical equipment in nuclear power stations	16	8
EEE4109Z	Theory and design of nuclear reactors	16	8
EEE4110Z	Operation and safety of nuclear reactors	16	8
EEE4111Z	Regulatory standards for nuclear power	16	8
MEC4111Z	Nuclear manufacturing & construction engineering management	12	8
EEE4112Z	Honours Nuclear Project	40	8
	Total credits	**148**	

Please note that courses will only be offered if there are sufficient students registered for the course.

Master's Programmes

Master of Engineering specialising in Nuclear Power [EM017EEE08]

Emeritus Professor and Programme Convener:
CT Gaunt, PrEng BSc(Eng) *Natal* MBL *SA* PhD *Cape Town* FIET FSAIEE

Nuclear power stations operating in over 30 countries provide approximately 13% of the world's electricity. Nuclear energy is a part of the existing and planned energy and electricity policy of South Africa.
This Master of Engineering (MEng) programme provides a postgraduate qualification in the key aspects of nuclear power for societal benefit. The programme provides a balance of the scientific, engineering and applications aspects of nuclear power, including the policy, operating, safety and regulatory aspects.
The degree comprises coursework to the minimum of 120 credits and a 60-credit dissertation.
The programme can be completed as a one-year full-time programme, or over an extended period for students who are employed. It is designed to accommodate students who cannot be resident in Cape Town for the full duration of the degree. The courses will be offered in intensive one-week or two-week blocks, with pre-contact reading and post-contact assignments and various distance learning activities. Students will be required to be in Cape Town for the intensive course periods.

Core Courses

Code	Course	NQF Credits	HEQSF Level
EEE5004Z	Minor Dissertation: M(Eng)	60	9
EEE4106Z	Introductory nuclear physics and radiation for power supply	16	8
EEE4107Z	Thermodynamics for nuclear power stations	16	8
EEE4108Z	Electrical and mechanical equipment in nuclear power stations	16	8
EEE5128Z	Nuclear reactor theory and design	20	9
EEE5129Z	Nuclear reactor operations and safety	20	9
EEE5130Z	Regulatory requirements for nuclear power	20	9
MEC4111Z	Nuclear manufacturing & construction engineering management	12	8
	Total credits	**180**	

Please note that courses will only be offered if there are a sufficient number of students registered for the course.

Master of Philosophy specialising in Nuclear Power [EM027EEE08]

Emeritus Professor and Convener:
CT Gaunt, PrEng BSc(Eng) *Natal* MBL *SA* PhD *Cape Town* FIET FSAIEE

Nuclear power stations operating in over 30 countries provide approximately 13% of the world's electricity. Nuclear energy is a part of the existing and planned energy and electricity policy of South Africa.
This Master of Philosophy (MPhil) programme provides an interdisciplinary postgraduate qualification in the key aspects of nuclear power for societal benefit. The programme provides a balance of the scientific, engineering and applications aspects of nuclear power, including the policy, operating, safety and regulatory aspects.
The degree comprises coursework to the minimum of 120 credits and a 60-credit dissertation.

Candidates deemed to have completed equivalent coursework, or deemed to have equivalent work experience in nuclear science, power or regulation may exceptionally be permitted to register for this degree by only 60 credits of coursework, in which case the dissertation must be to the value of 120 credits.
The programme can be completed as a one-year full-time programme, or over an extended period for students who are employed. It is designed to accommodate students who cannot be resident in Cape Town for the full duration of the degree. The courses will be offered in intensive one-week or two-week blocks, with pre-contact reading and post-contact assignments and various distance learning activities. Students will be required to be in Cape Town for the intensive course periods.

Core courses

Code	Course	NQF Credits	HEQSF Level
EEE5145W	Minor Dissertation: MPhil	60	9
EEE4106Z	Introductory nuclear physics and radiation for power supply	16	8
EEE4107Z	Thermodynamics for nuclear power stations	16	8
EEE4108Z	Electrical and mechanical equipment in nuclear power stations	16	8
EEE5128Z	Nuclear reactor theory and design	20	9
EEE5129Z	Nuclear reactor operations and safety	20	9
EEE5130Z	Regulatory requirements for nuclear power	20	9
MEC4111Z	Nuclear manufacturing & construction engineering management	12	8
	Total credits	**180**	

Please note that courses will only be offered if there are a sufficient number of students registered for the course.

Master of Engineering specialising in Radar [EM017EEE06]

Associate Professor and Programme Convener::
D O'Hagan, BEng(Hons) MSc *Ulster* PhD *UCL* MIEEE MIET

A candidate for the MEng in Radar is required to complete core courses totalling 120 credits and a 60 credit minor dissertation.
Each course will typically contain a lecture component of five full days, followed by weekly seminars, tasks and a written examination, over a five week period after the first, intensive lecture session. The programme is designed to support students that cannot be resident in Cape Town for the full duration to complete all courses, by using distance learning techniques during the follow up period after each course (after the one week intensive lecture period). All students will, however, have to be present in Cape Town for the one week lecture period for each course. Elements of continuous assessment (problem sets, short projects) and a written examination are utilised to assess the course.

Core Course

Code	Course	NQF Credits	HEQSF Level
EEE5004Z	Minor Dissertation: M(Eng)	60	9

Elective courses: select courses to the value of 120 credits

Code	Course	NQF Credits	HEQSF Level
EEE5105Z	Fundamentals of Radar Signal and Data Processing	20	9
EEE5108Z	Advanced Engineering Mathematics	20	9
EEE5109Z	Multitarget Multisensor Tracking and Data Fusion	20	9
EEE5110Z	Clutter and Detection in Clutter	20	9
EEE5111Z	High Resolution & Imaging Radar	20	9
EEE5112Z	Radar System Modelling	20	9

Code	Course	NQF Credits	HEQSF Level
EEE5114Z	Special Topics in Radar A	5	9
EEE5115Z	Special Topics in Radar B	5	9
EEE5116Z	Special Topics in Radar C	5	9
EEE5117Z	Special Topics in Radar D	10	9
EEE5118Z	Special Topics in Radar E	10	9
EEE5119Z	Introduction to Radar Systems	20	9
EEE5120Z	Introduction to Electronic Defence	20	9
EEE5121Z	Microwave Components & Antennas	20	9
EEE5131Z	Microwave Filters	20	9
EEE5132Z	Special Topics in Radar F	20	9
	Total credits	**180**	

Please note that certain courses run every alternate year and courses will only run if there are sufficient students registered for the course

Master of Engineering specialising in Telecommunications [EM017EEE09]

Associate Professor and Programme Convener:
ME Dlodlo, Reg Eng, BSEE BS *Geneva* MSc *Kansas State* PhD *Delft* FZweIE MIEEE

A candidate for the MEng in specializing Telecommunications is required to complete core courses of 120 credits and a 60 credit minor dissertation.

This programme aims to provide knowledge, skills and aptitudes for practising engineers to adapt to the rapidly changing technological landscape, turning products of research into practical solutions of developing world problems within international standards. The programme offers a selection of courses that span broad fundamental concepts that find applications in a wide range of disciplines. The approach enables students to be agile in response to new knowledge and novel developments. Core courses include Information Theory, Statistical Signal Theory and Advanced Engineering Mathematics.

Core Courses

Code	Course	NQF Credits	HEQSF Level
EEE5004Z	Minor Dissertation: M(Eng)	60	9

Elective courses: select courses to the value of 120 credits

Code	Course	NQF Credits	HEQSF Level
EEE5032Z	Digital Communication Systems	20	9
EEE5121Z	Microwave Components and Antennas	20	9
EEE5138Z	Broadband Communication Networks	20	9
EEE5108Z	Advanced Engineering Mathematics	20	9
EEE5135Z	Information Theory and Error-Control Coding	20	9
EEE5136Z	Statistical Signal Theory	20	9
EEE5139Z	Wireless Data Network Convergence	20	9
EEE5140Z	Software Defined Radio	20	9
	Total credits	**180**	

Please note that certain courses run every alternate year and courses will only run if there are sufficient students registered for the course

Master of Philosophy specialising in Space Studies [EM026EEE07]

Programme Convener:
P Martinez, BSc, BScHons(Mat Eng), MSc, PhD, *Cape Town* IAA, IISL, FRAS, MSAIP

Space technology and space applications are used to such an extent that they are now part of the critical infrastructure of the modern information society. Space applications are also a key contributor to sustainable development in areas such as food and water security, weather prediction, climate change monitoring, environmental resource management, disaster management, search-and-rescue, financial transactions, telemedicine and tele-education. This Master of Philosophy (MPhil) programme is aimed at providing an interdisciplinary postgraduate qualification in the key aspects of space science and technology and space applications for societal benefit. The programme provides a balance of the scientific, engineering and applications aspects of space technology, as well as the policy, financial, commercial and regulatory aspects. The degree comprises coursework to the minimum of 60 credits and a 120-credit dissertation. The coursework comprises 45 credits of compulsory core courses in: Space mission analysis and design; Space applications for sustainable development; and Space and society. The candidate is required to complete a further minimum of 15 credits of approved elective courses to make up a minimum of 60 credits of coursework. Candidates deemed to have completed equivalent coursework, or deemed to have equivalent work experience in the space arena, may exceptionally be permitted to register for this degree by dissertation only, in which case the dissertation must be to the value of 180 credits [EM025EEE07].
The programme is designed to accommodate students who cannot be resident in Cape Town for the full duration of the degree. The courses will be offered in intensive course periods with pre-contact reading and post-contact assignments and various distance learning activities. Students will be required to be in Cape Town for the intensive course periods.

Core Courses

Code	Course	NQF Credits	HEQSF Level
EEE5146W	Partial Dissertation: MPhil	120	9
EEE5103Z	Dissertation Preparation	0	9
END5050X	Master's journal paper	0	9
EEE5124Z	Space and Society	15	9
EEE5125Z	Space Applications for Sustainable Development	15	9
EEE5126Z	Space Mission Analysis and Design	15	9
	Elective courses	15	9
	Total credits	**180**	

Elective Courses: select courses to value of at least 15 credits

Code	Course	NQF Credits	HEQSF Level
EEE5127Z	Special Topics in Space Technology A	5	9
EEE5133Z	Special Topics in Space Technology B	5	9
EEE5134Z	Special Topics in Space Technology C	5	9
EEE5141Z	Special Topics in Space Technology D	5	9
EEE5142Z	Special Topics in Space Technology E	5	9

Please note that certain courses run every alternate year and will only be offered if there are sufficient students registered for the course.

Master of Philosophy specialising in Engineering Education [EM026EEE04]

Programme Convener:
CB Shaw, BSc HDE MPhil(EngMan) PhD *Cape Town*

The Faculty of Engineering and the Built environment offers a structured MPhil programme in Engineering Education. Students are required to complete a minimum of 60 credits of coursework, 45 credits of which are core to the programme. The additional credits will include an elective course approved by the supervisor. To qualify for the MPhil degree specialising in Engineering Education candidates are required to complete a supervised dissertation equivalent to a further 120 credits. The dissertation should incorporate any or all of the following: design of an engineering education research project involving advanced concepts and theoretical principles located in the engineering education research field; a research project of a theoretical or practical nature; a critical review of a specified topic based upon a comprehensive search of the literature or available data, a rigourous analysis of empirical data, and the development of a coherent discussion of the analysis, or any other study acceptable to the Faculty. Students will register for the dissertation in the home department of their supervisor.

Core Course

Code	Course	NQF Credits	HEQSF Level
MEC5102Z	Knowledge and Practices in Engineering Education	15	9
EEE5148Z	Theoretical Foundations in Engineering Education Research	15	9
EEE5103Z	Dissertation Preparation	0	9
CIV5147Z	Methodologies in Engineering Education Research	15	9
Elective	Subject to approval by supervisor	15	9
EEE5149W	Dissertation Engineering Education	120	9
	Total credits	**180**	

Master of Science in Engineering specialising in Electrical Engineering [EM023/EM024]

The Department prepares candidates for the Master of Science in Engineering in Electrical Engineering and for the Doctor of Philosophy. The Department offers a number of special postgraduate courses each year some of which are scheduled to facilitate attendance by practising engineers from industry. The majority of courses are full-time and cover a variety of topics.

The Master of Science in Engineering can be either by dissertation only [EM023] or by coursework (approved by your supervisor) and dissertation [EM024].

Research Master's by dissertation [EM023EEE01]

EM023 Research Master's by dissertation

Core Course

Code	Course	NQF Credits	HEQSF Level
EEE5000W	Full Dissertation: MSc(Eng)	180	9
END5050X	Master's journal paper	0	9
	Total credits	**180**	

Research Master's by coursework and dissertation
[EM024EEE01]
EM024 Research Master's by coursework and dissertation

Core Courses

Code	Course	NQF Credits	HEQSF Level
EEE5002W	Partial Dissertation: MSc(Eng)	120	9
EEE5103Z	Dissertation Preparation	0	9
END5050X	Master's journal paper	0	9
	Elective courses approved by supervisor	60	9
	Total credits	**180**	

Doctoral Programmes

Doctor of Philosophy
[ED001EEE01]
ED001 Doctor of Philosophy is a Research Degree

Core Course

Code	Course	NQF Credits	HEQSF Level
EEE6000W	Thesis	360	10

It is advisable before making an online application (http://www.ebe.uct.ac.za/ebe/apply/postgradstudies/apply) for Masters or PhD, that you make contact via email with one of the Academic staff members listed below to discuss your research interest.

RESEARCH AREAS	
Bio-Inspired Robotics and Biomechanics	A.Patel@uct.ac.za
Commensal Radar Research	Daniel.OHagan@uct.ac.za
Control Systems and Mechatronics	Edward.Boje@uct.ac.za
Electronic & Accelerated Computational Engineering	Alireza.Baghai-Wadji@uct.ac.za
Electronics	Andrew.Wilkinson@uct.ac.za
Engineering Education	Renee.Smit@uct.ac.za
Future Internet Technologies	Joyce.Mwangama@uct.ac.za
Image Processing & Vision Systems	Fred.Nicolls@uct.ac.za
Control & Instrumentation Engineering	Mohohlo.Tsoeu@uct.ac.za
Machines & Power Electronics	Azeem.Khan@uct.ac.za
Microwave and Millimeter Wave Engineering	Riana.Geschke@uct.ac.za
Power Systems & Renewable Energy	David.Oyedokun@uct.ac.za
Mobile Robotics	Robyn.Verrinder@uct.ac.za
Power Systems Protection, Renewable Distributed Generation & Microgrids	Sunetra.Chowdhury@uct.ac.za
Power Electronics, Drives & Machines	Paul.Barendse@uct.ac.za
Power System Network Studies	Kehinde.Awodele@uct.ac.za
Power Network Optimization, Control and Stability	Komla.Folly@uct.ac.za
Radar Signal Processing and Digital Signal Processing	Yunus.Abdulgaffar@uct.ac.za
Space Technology	Peter.Martinez@uct.ac.za
Signal Processing	Amit.Mishra@uct.ac.za
Software Defined Radio	Simon.Winberg@uct.ac.za
Telecommunications Network Management	Alexandru.Murgu@uct.ac.za

Telecommunications Networks	Olabisi.Falowo@uct.ac.za
Telecommunications Systems	Mqhele.Dlodlo@uct.ac.za

Course descriptions are set out in the section on Courses Offered. The course code abbreviation for Electrical Engineering is EEE.

Course Outlines

EEE4106Z INTRODUCTORY NUCLEAR PHYSICS AND RADIATION FOR POWER SUPPLY
16 NQF credits at HEQSF level 8
Convener: Emeritus Professor D Aschman
Course outline:
This advanced course aims to develop strong concepts of nuclear physics and radiation in the context of nuclear power reactors. Topics include: nuclear physics and radiation in the context of nuclear power reactors: atomic nature of matter; binding energy; radioactive decay; nuclear fission; neutron efficiency; ionising radiation; radiation detection and measurement; and effects of radiation on matter and biological systems.
DP requirements: None
Assessment: Coursework 30%, examination 70%.

EEE4107Z THERMODYNAMICS FOR NUCLEAR POWER STATIONS
16 NQF credits at HEQSF level 8
Convener: Dr R Smit
Course outline:
This advanced course aims to develop strong concepts of thermodynamics as approached by different disciplines and applied in the context of nuclear power. Topics include: concepts and application of thermodynamics for power stations: ; basic energy concepts, units and properties; thermodynamic cycles; fluid dynamics; thermo-hydraulics and core thermal units
DP requirements: None
Assessment: Coursework 30%, examination 70%.

EEE4108Z ELECTRICAL & MECHANICAL EQUIPMENT IN NUCLEAR POWER STATIONS
16 NQF credits at HEQSF level 8
Convener: Professor MA Khan
Course outline:
This course aims to develop an advanced understanding of the role of electrical and mechanical equipment in nuclear power stations, including a working knowledge of the different types, applications and operating mechanisms where applicable. Topics include: electrical and mechanical equipment used in nuclear power stations: pumps and valves; heat exchangers; compressors; transformers, motors, generators; sensors, detectors and protection systems; battery chargers, inverters and back-up supplies.
DP requirements: None
Assessment: Coursework 30%, examination 70%.

EEE4109Z THEORY AND DESIGN OF NUCLEAR REACTORS
16 NQF credits at HEQSF level 8
Convener: Emeritus Professor CT Gaunt
Course outline:
This course aims to develop strong concepts of engineering theory and design as applied in the context of nuclear power reactors. Topics include: nuclear reactor engineering theory and design,

with an emphasis on pressurised water reactors: types and generations of power reactors; neutron life cycle; reactor operation theory; reactor core design; thermal-hydraulic analysis; core power density and effect on reactor size, control and shielding; corrosion and materials properties.
DP requirements: None
Assessment: Coursework 30%, examination 70%.

EEE4110Z OPERATION AND SAFETY OF NUCLEAR REACTORS
16 NQF credits at HEQSF level 8
Convener: Emeritus Professor CT Gaunt
Course outline:
This advanced course aims to develop strong concepts in the operation and safety of complex systems and the application in the context of nuclear power stations. Topics include: functional description and design of main components of primary, secondary, auxiliary and safety systems: physical phenomena determining order of magnitude of key parameters of reactor operation; system modelling, normal operating transients, accident scenarios and extreme event identification; shutdown and restart; reactor coolant system; reactor protection; electricity supplies needed for production and safety; and simulators.
DP requirements: None
Assessment: Coursework 30%, examination 70%.

EEE4111Z REGULATORY STANDARDS FOR NUCLEAR POWER
16 NQF credits at HEQSF level 8
Convener: Emeritus Professor CT Gaunt
Course outline:
This course aims to understand the principles of regulatory processes, including safety, environmental and operating regulations, and their application in the context of nuclear power. Topics will include the safety requirements and licencing processes for nuclear plants: nuclear regulation; design philosophy; radiation protection management; emergency preparedness; verification and assurance; learning from incidents; international peer review. Energy regulation: energy regulator, integrated energy planning. Environmental regulation: environmental impact analysis; environmental management plans; and monitoring.
DP requirements: None
Assessment: Coursework 30%, examination 70%.

EEE4112Z HONOURS NUCLEAR PROJECT
40 NQF credits at HEQSF level 8
Convener: Emeritus Professor CT Gaunt
Course outline:
An engineering project involves the creative application of scientific principles to the solution of a technical problem. It involves a problem description or research hypothesis developed in consultation with a supervisor, reviewing the topic in detail and defining the boundaries (scope) carefully, confirming an understanding of the requirements of the supervisor, searching for, selecting and justifying the most appropriate approaches to solving the problem or testing the hypothesis. It also requires a student to be able to analyse, design, build, integrate and test as is appropriate for the specific project. This could include the use of hardware, software and simulation. A student is required also to evaluate the project against the success criteria and design objectives, and to write a report about the project, the findings, and any recommendations. The report shall not exceed 18000 words. In addition a student must make an oral presentation and prepare a poster.
DP requirements: None
Assessment: Report 95%, Poster 5%

EEE5000W FULL DISSERTATION: MSC(ENG)
180 NQF credits at HEQSF level 9
Convener: Professor E Boje
Course outline:
The dissertation should incorporate any or all of the following: design of all or part of an engineering project to a specification involving advanced concepts and theoretical principles: a research project of a theoretical or practical nature in engineering science or design; a critical review of a specified topic based upon a comprehensive search of the literature or available data; development of an item of equipment or a technique involving novel features or advanced design; or any other study acceptable to the Faculty. The written report shall demonstrate the candidate's understanding and application of the scientific method or engineering method as appropriate. The report shall not exceed 40 000 words without the Head of Department's approval of the candidate's written application and justification.
DP requirements: None
Assessment: Written work counts 100%.

EEE5002W PARTIAL DISSERTATION:MSC(ENG)
120 NQF credits at HEQSF level 9
Convener: Professor E Boje
Course entry requirements: EEE5103Z
Course outline:
The dissertation should incorporate any or all of the following: design of all or part of an engineering project to a specification involving advanced concepts and theoretical principles: a research project of a theoretical or practical nature in engineering science or design; a critical review of a specified topic based upon a comprehensive search of the literature or available data; development of an item of equipment or a technique involving novel features or advanced design; or any other study acceptable to the Faculty. The written report shall demonstrate the candidate's understanding and application of the scientific method or engineering method as appropriate. The report shall not exceed 30 000 words without the Head of Department's approval of the candidate's written application and justification.
DP requirements: None
Assessment: Written work counts 100%.

EEE5004Z MINOR DISSERTATION: M(ENG)
60 NQF credits at HEQSF level 9
Convener: Professor E Boje
Course outline:
The minor dissertation shall be on an engineering science or design topic consistent with the specialisation of the degree. The project should incorporate any or all of the following: design of all or part of an engineering project to a specification involving advanced concepts and theoretical principles: research of a theoretical or practical nature; a critical review of a specified topic based upon a comprehensive search of the literature or available data; development of an item of equipment or a technique involving novel features or advanced design; or any other study acceptable to the Faculty. The written report shall demonstrate the candidate's understanding and application of the scientific method or engineering method as appropriate. The report shall not exceed 20 000 words without the Head of Department's approval of the candidate's written application and justification.
DP requirements: None
Assessment: Written work counts 100%.

EEE5018Z MULTIVARIABLE CONTROL SYSTEM DESIGN
16 NQF credits at HEQSF level 9
Convener: Professor E Boje
Course entry requirements: EEE3069W or equivalent.
Course outline:
This course in multivariable control system design will cover selected topics in: Structure of large-scale systems, system decomposition. Frequency domain design methods: inverse nyquist arrays, characteristic loci, direct nyquist arrays. State Space design methods: pole placement control, state observers. Adaptive control methods: parameter estimators, minimum variance, pole placement designs in self-tuning regulators, and model reference adaptive controllers.
DP requirements: Satisfactory completion of coursework.
Assessment: Examination 3 hours.

EEE5022Z IMAGING RADAR APPLICATIONS
Offered on Demand
20 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan
Course entry requirements: BSc(Eng) in Electrical Engineering or BSc(Hons) in Physics
Course outline:
This advanced course covers the underlying principles of all common imaging radar applications. Topics include: fundamentals of electromagnetic surface scattering; basics of synthetic aperture radar; interferometry; subsidence monitoring; polarimetry; scatterometers; altimeters; lidar and ground penetrating radar applications.
Assessment: Examination 3 hours.

EEE5032Z DIGITAL COMMUNICATIONS
Offered on Demand
20 NQF credits at HEQSF level 9; tutorials and 8 practical exercises as required and a project..
Convener: Associate Professor M Dlodlo
Course entry requirements: EEE3084W, EEE3086F or equivalent .and Postgraduates standing in Telecommunications or Radar
Course outline:
This advanced course in digital communications includes: Digital Communication Systems Theory: probability, random variables and random signal principles, modelling of digital communication signals and systems; modelling of information sources; optimum receivers, channel and system performance in the presence of Gaussian noise, synchronisation; channel models, channel capacity, and equalisation, resource allocation, multichannel and multicarrier systems, spread-spectrum signalling, optical communication signalling principles, and software-defined radios. Practical Applications: selected topics from baseband and bandpass signalling; technical standards for wireless / optical / satellite-based communication systems; multiplexing and multiple access standards; next generation communication systems
DP requirements: 80% attendance and satisfactory completion of coursework.
Assessment: June Examination 50%, year mark 50%.

EEE5103Z DISSERTATION PREPARATION
0 NQF credits at HEQSF level 9
Course outline:
The aim of this course is to allow a student to undertake preparatory work for the master's dissertation. Work required includes literature searches and reviews; identification of the research problem, objectives and hypothesis; consideration of research methodology; planning for the active research phase; and ensuring that research infrastructure (e.g. apparatus etc.) is or will be in place. The student should maintain regular contact with his/her supervisor in order to show evidence of

suitable progress towards these aims. The supervisor must indicate satisfactory fulfilment of the course aims prior to the student proceeding to the dissertation.
DP requirements: None

EEE5105Z FUNDAMENTALS RADAR SIGNAL & DP
20 NQF credits at HEQSF level 9
Convener: Associate Professor A Mishra
Course entry requirements: BSc in Electrical Engineering, Honours in Science, including final year students
Course outline:
This course in the fundamentals of radar signal and data processing includes selected topics in:signal processing in radar systems (history of radar; basic radar functions; elements of pulsed radar; signal processing concepts in radar e.g. spatial resolution, sampling theory, correlation, interference suppression, phenomenology, imaging, detection). Signal models and processing in radar (radar cross section; radar equation; swerling models; clutter modelling; noise modelling and signal-to-noise ratio; jamming; doppler shift; cross-range; multipath; sampling in doppler and angle domains; quantization; I/Q modulation; radar; matched filtering; compression filtering; ambiguity function; pulse burst waveforms; frequency-modulated waveforms; phase modulated waveforms; doppler spectrum; moving target indication; pulse doppler processing; pulse pair processing) data processing; topics in radar (radar detection and hypothesis testing; threshold detection; binary integration; constant false alarm rate; cell-averaging CFAR; order statistic CFAR; spatial filtering; beam forming; space-time adaptive processing; and cognitive radar).
DP requirements: 80% attendance of lectures and completion of tutorials/projects.
Assessment: Project 25%, tutorials 20% and examination 55%

EEE5108Z ADVANCED ENGINEERING MATHEMATICS
20 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan
Course entry requirements: All undergraduate calculus, algebra and numerical methods required by a typical BSc Engineering (Electronics) degree.
Course outline:
This course aims to develop an advanced understanding of radar, electronic protection and telecommunications mathematics. Selected topics include: statistics and random processes: probability and induction; causality versus randomness; distribution and density functions; mean and variance; moments; characteristic functions; probability space; conditional distributions and probability; Bernoulli's theorem and games of chance; bivariate distributions; joint moments; joint characteristic functions; conditional expected values; ergodicity detection and estimation: systems with stochastic inputs; the power spectrum; parameter estimation; hypothesis testing; mean square estimation; Cramer-Rao bounds; stochastic convergence and limit theorems; finite-order systems and state variables; spectral representation of random processes; spectrum estimation; bandlimited processes and sampling theory; deterministic signals in noise; bispectra and system identification; filtering and prediction; Kalman filters. linear algebra: system of linear equations; Cramer's rule; Gaussian elimination; Gauss-Jordan elimination; vectors and vector spaces; least squares; Gram-Schmidt process; vector differential calculus; vector integral calculus. Matrix algebra: matrix addition, multiplication, dot product, transpose; eigenvalue, eigenvector and eigenspace; Jordan normal form; matrix rank, determinants and inversion; matrix congruence and congruence relation; conjugate transpose and hermitian matrices; matrix orthogonality; matrix decomposition methods; specific types of matrices e.g. Toeplitz matrices. Numerical methods: numerical linear algebra, e.g. solving systems of linear equations and eigenvalue algorithms; Interpolation, e.g. polynomial interpolation, spline interpolation and trigonometric interpolation; finding roots of nonlinear equations; optimization, e.g. linear programming and nonlinear programming; numerical quadrature (i.e. integration); numerical differential equation solutions; and the Monte Carlo analysis.
DP requirements: 80% attendance of lectures and completion of tutorials/projects.
Assessment: Coursework 20%, examination 55% and project 25%.

EEE5109Z MULTI-TARGET MULTISENSOR TRACKING AND DATA FUSION

Offered on Demand

20 NQF credits at HEQSF level 9

Convener: Associate Professor D O'Hagan

Course entry requirements: BSc in Electrical Engineering, Honours in Science, including final year students.

Course outline:

Part 1: Multi-Target Tracking (selected topics from) The Basics of Target Tracking. Sensor and Source Characteristics. Kinematic State Estimation: Filtering and Prediction basics (Kalman filtering, Bayesian filtering, others). Information-theoretic models (parametric templates, artificial neural networks, cluster algorithms, voting methods, figures of merit, pattern recognition, others) Modelling and Tracking Dynamic Targets. Passive Sensor Tracking. Basic Methods for Data Association. Advanced Methods for MTT Data Association. Attribute Data Fusion. Multiple Sensor Tracking - Issues and Methods. Multiple Sensor Tracking - System Implementation and Applications. Reasoning Schemes for Situation Assessment and Sensor Management. Situation Assessment; Tracking System Performance Prediction, and Evaluation. Multi Target Tracking with an Agile Beam Radar. Sensor Management. Multiple Hypothesis Tracking System Design and Application. Detection and Tracking of Dim Targets in Clutter.

Part 2 : Kinematic Data Fusion (selected topics from)Data/Information Fusion Models — JDL Data Fusion Model. Unified Data Fusion Model. Visual Situation Assessment Model. Strategies and Algorithms for Target Tracking and Data Fusion; Multiple Radar Tracking (Architectures; Centralized or distributed? Tracks or measurements? Sensor registration and alignment; Track fusion) Performance Evaluation of Data Fusion Systems, Software, and Tracking; Evaluation of tracking system; Covariance analyses; Correlation probabilities; Markov chains Simulation and Monte Carlo techniques Applications of Multisensor Systems and Data Fusion; Sensor Management in Data Fusion Systems (Sensor management functions Establishing target priorities; Sensor tasking).

DP requirements: 80% attendance of lectures and completion of tutorials/projects.

Assessment: Projects 25%, tutorials 20% and examination 55%.

EEE5110Z CLUTTER & DETECTION IN CLUTTER

Offered on Demand

20 NQF credits at HEQSF level 9

Convener: Associate Professor D O'Hagan

Course outline:

Selected topics from:Part 1: Ground and Sea Radar Clutter Modelling.

Statistical modelling of radar clutter. General sea and ground clutter features; Modelling for radar cross section (RCS); Empirically observed models (Rayleigh, Weibull, K, generalized K, log-normal, etc.); Extension of the Central Limit Theorem (CLT): the compound-Gaussian model; Multidimensional models of random clutter vectors; Radar clutter power spectral density models (Gaussian, power-law, exp., AR, etc.); - Experimental Validation: Sea Clutter Data. Amplitude analysis of HH, VV, HV, and VH data; Validation of the compound-Gaussian model by means of speckle and texture analyses; Cumulant domain analysis; Coherent analysis: empirical correlation and PSD; Incoherent analysis: empirical correlation; Non-stationarity and cyclostationarity of sea clutter data;Validation of the compound-Gaussian model by means of speckle and texture analyses; Cumulant domain analysis; Coherent analysis: empirical correlation and PSD; Incoherent analysis: empirical correlation; Non-stationarity and cyclostationarity of sea clutter data; Experimental Validation: Ground Clutter Data. Measurement instrumentation; Analysis of I and Q clutter components; Azimuth and range correlation/spectral analyses; Cumulant based Gaussianity test; Amplitude PDF analysis; Impact of clutter statistics and spectral models on radar performance prediction. Clutter simulation for radar performance evaluation.

Part 2: Coherent Radar Target Detection in Heavy-Tailed Clutter**.**

- Coherent Detection of Radar Targets in non-Gaussian Disturbance. Radar detection problem; Optimum coherent detection in Gaussian clutter; Optimum coherent detection in compound-

Gaussian clutter (the likelihood ratio test; the estimator-correlator; the whitening matched filter and data-dependent threshold;) Suboptimum detection in Gaussian clutter and in compound-Gaussian clutter (based on the three interpretations of the optimum detector); Performance analysis - design trade-offs; Optimum and suboptimum detection in compound-Gaussian clutter when the target signal is r-D unknown (modelled as a rank-deficient Gaussian random vector);
- Adaptive Implementation of Detectors in non-Gaussian Disturbance. Gaussian clutter when the clutter covariance matrix is unknown; Compound-Gaussian clutter when the clutter covariance matrix is unknown; compound-Gaussian clutter when the target signal is 1-D unknown (unknown steering vector); Adaptive implementation in compound-Gaussian clutter when the target signal is r-D unknown (modelled as a rank-deficient Gaussian random vector); Advanced radar detection under mismatched signal models (Mismatched signals; Robust receivers; Selective receivers; Tunable receivers).
DP requirements: 80% attendance of lectures and completion of tutorials/projects.
Assessment: Project 25%, tutorials 20% and examination 55%.

EEE5111Z HIGH RESOLUTION AND IMAGING RADAR
Offered on Demand
20 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan
Course entry requirements: BSc in Electrical Engineering, Honours in Science, including final year students.
Course outline:
Part 1: High Resolution Radar (selection of) Application of the Radar Range Equation to High-Resolution Radar, High-Resolution Radar Design; High-Range-Resolution Waveforms and Processing; Synthetic High-Range-Resolution Radar.
Part 2: Synthetic Aperture Radar (selection of) Synthetic Aperture Concepts; SAR Signal Properties; SAR Processing Algorithms (Range Doppler Algorithm; Chirp Scaling Algorithm; Omega-K Algorithm; SPECAN Algorithm) Comparison of Algorithms; Doppler Centroid Estimation; Automatic Focusing; Advanced concepts (Polarimetric SAR; Interferometric SAR; GMTI); Applications of SAR (Military, Earth Observation, Digital Terrain Elevation Models).
Part 3: Inverse Synthetic Aperture Radar (selection of) Inverse Synthetic Aperture Radar Concepts; ISAR Geometry and Signal Modeling; ISAR image formation (RF Front-End and Signal demodulation; Radial motion compensation (Autofocusing); Image formation (Range-Doppler (RD), Joint Time-Frequency Analysis (JTFA), Back-projection); Interpretation of ISAR Images Image Autofocusing techniques (Parametric and non-parametric techniques; Hot Spot Processing (Prominent Point Processing); Phase Gradient Autofocus (PGA); Image Contrast Based Autofocus (ICBA); Image Entropy Based Autofocus (IEBA); Comparison of methods Time-window selection; Cross range scaling; ISAR imaging using CLEAN techniques; Polarimetric ISAR; Recent advances (Bistatic and multi-static ISAR, 3D ISAR).
DP requirements: 80% attendance of lectures and completion of tutorials/projects.
Assessment: Projects 25%, tutorials 20% and examinations 55%.

EEE5112Z RADAR SYSTEM MODELLING
Offered on Demand
20 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan
Course entry requirements: BSc in Electrical Engineering, Honours in Science, including final year students
Course outline:
This course aims to develop an advanced understanding of radar system modelling. Topics include: modelling & simulation to assess radar systems; the complexities of radar cross section of a target; propagation and clutter and application of techniques to integrate propagation, radar cross section and clutter models into the radar model.
DP requirements: 80% attendance of lectures and completion of tutorials/projects.

Assessment: Projects 25%, tutorials 20% and examinations 55%.

EEE5114Z SPECIAL TOPICS IN RADAR A
Offered on Demand
5 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan
Course outline:
This short course is a presentation and study of a specialist topic in the field of radar and electronic defence. A student will participate in 16 hours of lectures and a post cost seminar, which will discuss a problem, set by the course convener. Assessment is by means of a written examination.
DP requirements: None
Assessment: 3 hour Examination 100%.

EEE5115Z SPECIAL TOPICS IN RADAR B
Offered on Demand
5 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan
Course outline:
This short course is a presentation and study of a specialist topic in the field of radar and electronic defence. A student will participate in 16 hours of lectures, and a post cost seminar, which will discuss a problem, set by the course convener. Assessment is by means of a written examination.
DP requirements: None
Assessment: 2 hour examination 100%.

EEE5116Z SPECIAL TOPICS IN RADAR C
Offered on Demand
5 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan
Course outline:
This short course is a presentation and study of a specialist topic in the field of radar and electronic defence. A student will participate in 16 hours of lectures, and a post course seminar, which will discuss a problem, set by the course convener. Assessment is by means of a written examination.
DP requirements: None
Assessment: 3 hour examination 100%

EEE5117Z SPECIAL TOPICS IN RADAR D
Offered on Demand
10 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan
Course outline:
This short course is a presentation and study of a specialist topic in the field of radar and electronic defence. A student will participate in 16 hours of lectures, and a post course seminar, which will discuss a problem, set by the course convener. Assessment is by means of a written examination.
DP requirements: None
Assessment: 3 hour examination 100%

EEE5118Z SPECIAL TOPICS IN RADAR E
Offered on Demand
10 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan

Course outline:
This short course is a presentation and study of a specialist topic in the field of radar and electronic defence. A student will participate in 16 hours of lectures, and a post course seminar, which will discuss a problem, set by the course convener. Assessment is by means of a written examination.
DP requirements: None
Assessment: 3 hour examination 100%

EEE5119Z INTRODUCTION TO RADAR SYSTEMS
20 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan
Course entry requirements: BSc in Electrical Engineering, Honours in Science, including final year students
Course outline:
This advanced course in radar systems includes: Introduction to Signal Processing in Radar Systems (basic radar functions; elements of pulsed radar; signal processing concepts in radar e.g. spatial resolution, sampling theory, correlation, interference suppression, phenomenology, imaging, detection). Signal Models and Processing in Radar (radar cross section; radar equation; swerling models; clutter modelling; noise modelling and signal-to-noise ratio; jamming; doppler shift; cross-range; multipath; sampling in doppler and angle domains; quantization; I/Q modulation; radar; matched filtering; compression filtering; ambiguity function; pulse burst waveforms; frequency-modulated waveforms; phase modulated waveforms; Doppler spectrum; moving target indication; pulse doppler processing; pulse pair processing). Data Processing Topics in Radar (radar detection and hypothesis testing; threshold detection; binary integration; constant false alarm rate; CFAR forms, {Cell-averaging CFAR; Order statistic CFAR}; spatial filtering; temporal filtering, beam forming; space-time adaptive processing; concepts of cognitive radar). Introduction to Radar Target Recognition Information available in radar signals; extracting features from radar signals, signal processing for target recognition, pattern recognition techniques, secondary radar, over the horizon radar, and subsurface radar.
DP requirements: 80% attendance of lectures and completion of tutorials/projects.
Assessment: Coursework 40% and examination 60%

EEE5120Z INTRODUCTION TO ELECTRONIC DEFENCE
Offered on Demand
20 NQF credits at HEQSF level 9
Convener: Associate Professor D O' Hagan
Course entry requirements: BSc in Electrical Engineering, Honours in Science, including final year students.
Course outline:
This course is an advanced introduction to electronic defence. Selected topics include: Electronic Warfare: threats, requirements and principles (information warfare, intelligence, electronic attack against radar & communication systems). Advanced Radar Threat (low-intensity threat, air defence radar, phased array radars, airborne radar, EP techniques for surveillance and tracking radar). Modern EA Systems: architecture, types, and technology (onboard/offboard architectures, operational EA systems architecture, EA radar jamming waveforms, transponder jamming, support jamming). EA Against Modern Radar Systems (pulse compression, pulsed doppler radar, monopulse, coherent sidelobe cancelers). Digital Radio Frequency Memory (DRFM architectures, DRFM fundamentals, DRFM sampling techniques, direct digital synthesizer, advanced DRFM architecture, voltage controlled oscillators). Electronic Warfare Support (signal and threat environment, parameters measured by the ES system, advanced ES systems, direction finding, probability of intercept). Expendables and Decoy Systems (design of expendable EA systems, chaff, infrared missile attack). Directed Energy Weapons and Stealth Technology (directed energy weapons, stealth). Applications of EW-Surveillance (search for, intercept, identify, and locate or localize sources of intentional and un-intentional radiated electromagnetic energy for immediate threat recognition, targeting, planning). Jamming (use of electromagnetic energy, directed energy, or

anti-radiation weapons to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability). Protection (passive and active means to protect personnel, facilities, and equipment from any effects of friendly or enemy use of the electromagnetic spectrum that could degrade, neutralize, or destroy friendly combat capability).
DP requirements: 80% attendance of lectures and completion of tutorials/projects.
Assessment: Coursework 40% and examination 60%

EEE5121Z MICROWAVE COMPONENTS& ANTENNAS
Offered on Demand
20 NQF credits at HEQSF level 9; block release.
Convener: Associate Professor D O'Hagan
Course outline:
This advanced course will focus on microwave components and antennas used in radar systems. The design of components and antennas is a core part of the curriculum and includes an understanding of: filters and multiplexing: microwave filters, diplexers, duplexers, ferrites in circulators and isolators, isolator, gyrator, circulator, power tubes, klystron, travelling wave tube, backward wave oscillator antenna theory: antenna characteristics including gain, directivity, reciprocity far field, reflector antennas, antenna arrays, and radar antennas.
DP requirements: None
Assessment: Coursework 30% and examination 70%

EEE5122F COMPUTATIONAL ELECTRONICS I
20 NQF credits at HEQSF level 9; block release.
Convener: Professor A Baghai-Wadji
Course outline:
This course introduces students to classical, modern and cutting-edge computational techniques for modelling and simulation of micro-electronic, micro-acoustic, and photonic devices. The course provides instruction in: finite difference method, finite element method, boundary element method, classical statistical methods, standard integral transform techniques, variational analysis techniques, method of functional analysis, iterative techniques, asymptotic analysis methods and micro-acoustic devices, electromagnetic and acoustic near-fields, photonic devices, meso-scopic electronic devices.
DP requirements: None
Assessment: Coursework 30% and examination 70%.

EEE5123S COMPUTATIONAL ELECTRONICS II
20 NQF credits at HEQSF level 9; block release.
Convener: Professor A Baghai-Wadji
Course outline:
This course introduces students to modern computational techniques for modelling and simulation of nano-electronic, plasmonic, quantum electronic, and molecular-electronic devices and provides instruction in: path integral method, quantum statistical methods, wavelets and frames, modern integral transform techniques, theory of distributions, various differentiation techniques, various integration techniques, method of functional analysis, lie algebras, coherent states, dressed states, squeezed states, Wannier functions, nano-acoustic devices, plasmonic devices, meta-materials, and quantum devices, quantum dots, quantum wires.
DP requirements: None
Assessment: Coursework 30% and examination 70%.

EEE5124Z SPACE AND SOCIETY
15 NQF credits at HEQSF level 9; block release.
Convener: Professor P Martinez
Course outline:
This advanced course will focus on the societal dimensions of space science and technology. The course will cover the scientific, military, economic and political rationales for space activities. The various international and national regulatory frameworks for space activities will be covered as well as the rationales for and salient aspects of international space cooperation. Space activities are often thought of in terms of their scientific and technological attributes. Yet, the successful implementation of both public and private sector space programmes relies on a wide variety of non-space factors. This course will cover: the historical and current economic, political, military and regulatory drivers for space activities. The drivers for international cooperation in space activities and the changing geopolitics of space cooperation. An overview of regulation of space activities at national and international level and the financing of space projects. A further important aim will be to train students in the communication of space activities to the media and to non-specialist audiences.
DP requirements: None
Assessment: Coursework 45% and examination 55%

EEE5125Z SPACE APPLICATIONS FOR SUSTAINABLE DEVELOPMENT
15 NQF credits at HEQSF level 9; block release.
Convener: Professor P Martinez
Course outline:
Space systems play a critical role in the modern information society. The course will focus on the applications of space technology to address sustainable development challenges from a local and global perspective. The three main pillars of space applications are: Earth observation, communications and satellite-aided positioning, timing and navigation. These technologies may be applied to a wide variety of problems in food, water and human security, climate change, environmental management, disaster management and telemedicine and tele-education. The course will provide an overview of the main applications of space systems to support sustainable development. The course content will be supplemented by hands-on workshops in which students will have the opportunity to work with satellite data to solve real-world problems.
DP requirements: None
Assessment: Coursework 45% and examination 55%

EEE5126Z SPACE MISSION ANALYSIS AND DESIGN
15 NQF credits at HEQSF level 9; block release.
Convener: Professor P Martinez
Course outline:
Spacecraft are considered to be part of a space system that comprises both a space segment and a ground segment. This requires an understanding of the space environment and its effects on spacecraft, as well as the basic principles of astronautics to describe satellite orbits and spacecraft trajectories. This course aims to provide a systematic introduction to all the aspects and processes involved in the definition, design, development, testing and operation of space systems. Students are introduced to analysis tools that can be used to explore different mission architectures from the point of view of the space environment, Earth coverage, orbit selection, mission operations and data/information flow and analysis. The course will also address access to space and space transportation from a mission design perspective.
DP requirements: None
Assessment: Coursework 45% and examination 55%

EEE5127Z SPECIAL TOPICS IN SPACE STUDIES
5 NQF credits at HEQSF level 9
Convener: Professor P Martinez
Course outline:
This course provides an introduction to a highly specialized or cutting-edge topic in space studies. The course will cover an important topic in space studies that is not covered by other courses. The topic will be presented by a leading practitioner in the field. The course will be delivered through lectures and supplemented by the use of online resources. The course convener and/or presenter will set goals for structured self-learning to complement the classroom learning and deepen the students' knowledge of the special topic.
DP requirements: None
Assessment: Coursework 45% and examination 55%

EEE5128Z NUCLEAR REACTOR THEORY AND DESIGN
20 NQF credits at HEQSF level 9
Convener: Emeritus Professor CT Gaunt
Course outline:
This advanced course aims to develop strong concepts of engineering theory and design as applied in the context of nuclear power reactors. Topics include: nuclear reactor engineering theory and design, with an emphasis on pressurised water reactors: types and generations of power reactors; neutron life cycle; reactor operation theory; reactor core design; thermal-hydraulic analysis; core power density and effect on reactor size, control and shielding; corrosion and materials properties.
DP requirements: None
Assessment: Coursework 30%, examination 70%.

EEE5129Z NUCLEAR REACTOR OPERATIONS AND SAFETY
20 NQF credits at HEQSF level 9
Convener: Emeritus Professor CT Gaunt
Course outline:
This advanced course aims to establish strong concepts of the operation and safety of complex systems and the application in the context of nuclear power stations. Topics include: functional description and design of main components of primary, secondary, auxiliary and safety systems: physical phenomena determining order of magnitude of key parameters of reactor operation; system modelling, normal operating transients, accident scenarios and extreme event identification; shutdown and restart; reactor coolant system; reactor protection; electricity supplies needed for production and safety; and simulators.
DP requirements: None
Assessment: Coursework 30%, examination 70%.

EEE5130Z REGULATORY REQUIREMENTS FOR NUCLEAR POWER
20 NQF credits at HEQSF level 9
Convener: Emeritus Professor CT Gaunt
Course outline:
This course aims to develop an advanced understanding of nuclear facility licencing, assess the integration of nuclear energy into large power systems, and understand environmental impact assessment and management. Topics include: safety requirements and licencing processes for nuclear plants: nuclear regulation; design philosophy; radiation protection management; emergency preparedness; verification and assurance; learning from incidents; international peer review. Energy regulation: energy regulator, integrated energy planning; independent system operators; market systems. Environmental regulation: environmental impact analysis; environmental management plans; and monitoring.
DP requirements: None
Assessment: Coursework 30%, examination 70%.

EEE5131Z MICROWAVE FILTERS
Offered on Demand
20 NQF credits at HEQSF level 9
Convener: Associate Professor R Geschke
Course outline:
The course is presented over five days and presents a systematic progression of topics from specification and theoretical synthesis, CAD-assisted design and practical manufacturing techniques for microwave filters operating in the frequency ranges of typical radar systems.
DP requirements: 80% attendance and submission of seminars and tutorial assignments
Assessment: Coursework 50%, Examination 50%

EEE5132Z SPECIAL TOPIC IN RADAR F
20 NQF credits at HEQSF level 9
Convener: Associate Professor D O'Hagan
Course entry requirements: An Engineering Honours Degree or equivalent.
Course outline:
This course is a presentation and study of a specialist topic in the field of Radar and Electronic Defence. A student will attend 35 hours of lectures in block release format in 1 week. This will be followed by about 5 weeks of tutorials and projects. Assessment is by means of coursework 30% and a final examination 30%.
DP requirements: 80% attendance and submission of seminars and tutorial assignments
Assessment: Coursework 30%, Examination 70%

EEE5133Z SPECIAL TOPICS IN SPACE TECHNOLOGY B
5 NQF credits at HEQSF level 9
Convener: Professor P Martinez
Course outline:
This course provides an introduction to a highly specialised or cutting-edge topic in space studies. The topic will be presented by a leading practitioner in the field. The course will be delivered through lectures, supplemented by the use of online resources and distance-learning methods. The course convener and/or presenter will set goals for structured self-learning to complement the classroom learning and hence deepen the course participant's knowledge of the special topic in question.
DP requirements: 80% attendance at all lectures and learning events and submission of all assignments.
Assessment: Coursework 45%, Examination 55%

EEE5134Z SPECIAL TOPICS IN SPACE TECHNOLOGY C
5 NQF credits at HEQSF level 9
Convener: Professor P Martinez
Course entry requirements: An Engineering degree or equivalent four-year degree.
Course outline:
This course provides an introduction to a highly specialized or cutting-edge topic in space studies. The topic will be presented by a leading practitioner in the field. The course will be delivered through lectures, supplemented by the use of online resources and distance-learning methods. The course convener and/or presenter will set goals for structured self-learning to complement the classroom learning and hence deepen the course participant's knowledge of the special topic in question.
DP requirements: 80% attendance at all lectures and learning events and submission of all assignments.
Assessment: Coursework 45%, Examination 55%

EEE5135Z INFORMATION THEORY & ERROR-CONTROL CODING
20 NQF credits at HEQSF level 9
Convener: Associate Professor M Dlodlo
Co-requisites: Postgraduate standing in Electrical Engineering and exposure to undergraduate telecommunications content
Course outline:
This course explains the basic ideas of information theory and the correspondences between the elements of this theory and certain natural concepts of importance in a wide number of fields, such as transmission, storage, authoring and protection of data. On the basis of simple concepts from probability calculus, models are developed for a discrete information source and a discrete communication channel. Further, the theoretical basics for developing source coding algorithms is provided, as well as the basics of optimal data transmission through a discrete communication channel. Introduction to error-correcting codes; mathematical basics; block codes fundamentals; cyclic codes; co-operating codes; soft-decision decoding; convolutional codes; iterative decoding (turbo codes, LDPC codes); applications.
DP requirements: None
Assessment: Coursework 50%, Examination 50%

EEE5136Z STATISTICAL SIGNAL THEORY
20 NQF credits at HEQSF level 9
Convener: Dr A Murgu
Course entry requirements: MAM2083F/S, EEE2036S, EEE3086F, or equivalents.
Co-requisites: None
Course outline:
This course originates in the realm of causal uncertainty over observed phenomena due to incomplete information from the real world. The theory of probability seeks to mathematically verify whether or not predictions about these phenomena are justifiable and pragmatic. The course challenges the participants to assume the probabilistic model of events where some of the possible determining factors may be unavailable. Mathematical statistical theory then enables us to examine the concepts and measure the likelihood of the relevance of those predictions to the physical world and our engineering applications within it. The development will include topics such as: probability theory, random variables, functions of a random variable, two or more random variables, sequences of a random variable, introduction to stochastic processes, second-order processes, and applications of random processes in communication systems. elements of DSP; estimation filtering and detection of random signals; information pattern retrieval.
DP requirements: Assignment mark of at least 40%
Assessment: Coursework 40%, Examination 60%

EEE5138Z BROADBAND COMMUNICATION NETWORKS
20 NQF credits at HEQSF level 9
Convener: Mr N Ventura
Course entry requirements: Postgraduate standing in Electrical Engineering or background in undergraduate communication engineering course work.
Co-requisites: None
Course outline:
Enterprises are faced with demands that focus their attention on the need to design, evaluate, manage and maintain networks infrastructures to process large quantity of data, move portions of the information technology operation to a cloud computing infrastructure, have large number of objects providing services to end users and have mobile devices as an indispensable part of an enterprise generating unique demands on network planning and management.

The course aims to develop an understanding of key innovation areas in Modern Networking, which are closely related but nevertheless represent different research domains, namely:

1. Network of the Future (NoF) driven by Mobile Broadband evolution towards high bandwidth heterogenous access networks, single core network architectures, and the notion of Software Defined Networks (SDN) and the Openflow protocol;
2. Traditional concepts of virtual networks and the modern approach to network virtualization; the concept of software defined infrastructure;
3. Cloud-based Networks and Service Delivery Platforms (SDP), enabling much more scalable and cost efficient realizations and role outs of networks and innovative applications;
4. Internet of Things (IoT) and unified Machine to Machine (M2M) communications enabling the convergence of a broad spectrum of monitoring and control applications;
5. The 5G infrastructure which is expected to become the core of the digital society and economy. Anything as a service (XaaS) everywhere is envisioned as among the primary drivers for global adoption. 5G will support mission-critical machine communications and massive machine type of traffic.

DP requirements: 80% attendance and handing in of tutorials
Assessment: Coursework 20%, Project 30% and Examination 50%

EEE5139Z WIRELESS DATA NETWORK CONVERGENCE
20 NQF credits at HEQSF level 9
Convener: Associate Professor OE Falowo
Course entry requirements: Postgraduate standing in Electrical Engineering or EEE3084W or EEE3083F and EEE3085S or equivalent.
Co-requisites: Postgraduate standing in Electrical Engineering and prior exposure to undergraduate telecommunications content.
Course outline:
This course aims to introduce students to advanced wireless networks with an emphasis on architecture, components, and protocols, as well as the latest developments in 4G towards 5G wireless standards. New concepts of mobility management, software defined network and new developments will be covered together with 3GPP standards and Internet Engineering Task Force (IETF) standard protocols. These examples will enable student engagement with the theoretical material and the related practical issues. Students will be able to understand the challenges associated with the latest generation of wireless networks and gain insight into new techniques under development.
DP requirements: None
Assessment: Coursework 40%, Examination 60%

EEE5140Z SOFTWARE DEFINED RADIO
Offered on Demand
20 NQF credits at HEQSF level 9
Convener: Dr S Winberg
Course outline:
This course aims to provide advanced students with an overview of a software-defined radio systems and the technologies necessary for successful implementation, as well as exposure to significant computer and hands-on project work necessary to implement working SDR systems. Students will be able to: understand the fundamentals of the communication link, modulation and demodulation, digital filters, dealing with uncertainty and errors in the channel, error detection and correction mechanisms, characteristics of wireless network protocols, and be able to discuss the allocation of radio resources and technologies. Understand the systems required by a software-defined radio to function and the trade-offs, benefits and limitations encountered in choosing a software-defined radio system design. Understand elementary antenna design to accommodate the needs of a particular software-radio system. Calculate an accurate link budget for a software-defined radio system or other wireless communications link. Understand how analogue and digital technologies are used for software-defined radios and the topologies and applications of those networks.
DP requirements: Minimum 45% for project
Assessment: Coursework 50%, Examination 50%

EEE5141Z SPECIAL TOPICS IN SPACE TECHNOLOGY D

Offered on Demand

5 NQF credits at HEQSF level 9

Convener: Professor P Martinez

Course outline:

This course provides an introduction to a highly specialized or cutting-edge topic in space studies. The course will cover an important topic in space studies that is not yet covered by other courses. The topic will be presented by a leading practitioner in the field. The course will be delivered through lectures, supplemented by the use of online resources and methods. The course will set goals for structured self-learning to complement the classroom learning and deepen knowledge of the special topic.

DP requirements: None

Assessment: Coursework (45%), Examination (55%)

EEE5142Z SPECIAL TOPICS IN SPACE TECHNOLOGY E

Offered on Demand

5 NQF credits at HEQSF level 9

Convener: Professor P Martinez

Course outline:

This course provides an introduction to a highly specialized or cutting-edge topic In space studies. The course will cover an important topic in space studies that is not yet covered by other courses. The topic will be presented by a leading practitioner in the field. The course will be delivered through lectures, supplemented by online resources and methods. The course will set goals for structured self-learning to complement the classroom learning and deepen knowledge of the special topic.

DP requirements: None

Assessment: Coursework (45%) Examination (55%)

EEE5143Z COMPUTATIONAL LINGUISTICS

16 NQF credits at HEQSF level 9

Convener: Dr M Tsoeu

Course outline:

This course aims to introduce advanced students to aspects of linguistics: phonetics, phonology, morphology, syntax, semantics, speech production and perception, which are relevant to machine processing of languages and speech. A review of measurement systems, and signal processing: sampling, Fourier transforms, modulation, will be covered with applications to acoustics. An introduction to probability theory and its applications in parameter estimation will be covered, leading to advanced concepts in machine learning: neural networks, support vector machines, hidden Markof models, deep learning and auto-encoders, with applications to language signal processing, acoustic modeling, language modeling, language recognition and translation. This course will be taught using a selected programming language between: C++, C#, Java and Python, and applied to a selected set of South African Languages: English, Afrikaans, Sesotho, Sepedi, Setswana, isiXhosa, isiZulu, isiSwati, isiNdebele, Tshvenda, Xhitsonga and South African Sign Language.

DP requirements: Completion of practicals and class project.

Assessment: 10% test, 20% project, 10% tutorial, 10% practicals, 50% exam

EEE5144Z MATHEMATICAL METHODS IN NETWORK OPERATIONS AND MANAGEMENT

20 NQF credits at HEQSF level 9

Convener: Dr A Murgu

Course outline:
This course aims to develop an advanced understanding of networks services management and governance approaches in modern communication and data networks. Topics include: linear and nonlinear programming, planning and schedluing models for fixed-mobile convergence of the next-generation networks and services; network topology modeling, minimum spanning trees for network interoperability, hierarchical and rconfigurable networks; max-flow and min-cost flow probem models for network operations: routing, multicasting, flow control, data parsing, information retrieval, signaling; parametric flow optimization problem: time lags modeling, dynamic networks models for Multi-Protovol Label Switching(MPLS), Virtual Private LAN Systems (VPLS), network virtualization, multiservice platforms, data servers, cluster servers; digraphic sequencing models for network reconfiguration, evolution and self-optimization; network economics: utility theory, competition, arbitrage, convergence; applications to service clouds, resource sharing, pooling and splitting; models of service governance.
DP requirements: Assignment mark of at least 40%
Assessment: Coursework 40%, examination 60%

EEE5145W MINOR DISSERTATION: MPHIL
60 NQF credits at HEQSF level 9
Convener: Professor E Boje
Course outline:
The minor dissertation shall be on a multi- or inter-disciplinary topic associated with electrical engineering and on an topic consistent with the taught courses and/or the specialisation of the degree. The project should incorporate any or all of the following: design of all or part of an engineering project to a specification involving advanced concepts and theoretical principles: research of a theoretical or practical nature; a critical review of a specified topic based upon a comprehensive search of the literature or available data; development of an item of equipment or a technique involving novel features or advanced design; or any other study acceptable to the Faculty. The written report shall demonstrate the candidate's understanding and application of the scientific method or engineering method or rigorous investigation by deductive or inductive reasoning or rhetoric, as appropriate. The report shall not exceed 20 000 words without the Head of Department's approval of the candidate's written application and justification.
DP requirements: None
Assessment: Written work counts 100%.

EEE5146W PARTIAL DISSERTATION: MPHIL
120 NQF credits at HEQSF level 9
Convener: Professor E Boje
Course entry requirements: EEE5103Z
Course outline:
The research dissertation in partial fulfilment of a degree shall be on a multi- or inter-disciplinary topic associated with electrical engineering and on an topic consistent with the taught courses and/or the specialisation of the degree. The project should incorporate any or all of the following: design of all or part of an engineering project to a specification involving advanced concepts and theoretical principles: research of a theoretical or practical nature; a critical review of a specified topic based upon a comprehensive search of the literature or available data; development of an item of equipment or a technique involving novel features or advanced design; or any other study acceptable to the Faculty. The written report shall demonstrate the candidate's understanding and application of the scientific method or engineering method or rigorous investigation by deductive or inductive reasoning or rhetoric, as appropriate. The report shall not exceed 30 000 words without the Head of Department's approval of the candidate's written application and justification.
DP requirements: None
Assessment: Written work counts 100%.

EEE5147W FULL DISSERTATION: MPHIL
180 NQF credits at HEQSF level 9
Convener: Professor E Boje
Course outline:
The dissertation shall be on a multi- or inter-disciplinary topic associated with electrical engineering and should incorporate any or all of the following: design of all or part of an engineering project to a specification involving advanced concepts and theoretical principles: research of a theoretical or practical nature; a critical review of a specified topic based upon a comprehensive search of the literature or available data; development of an item of equipment or a technique involving novel features or advanced design; or any other study acceptable to the Faculty. The written report shall demonstrate the candidate's understanding and application of the scientific method or engineering method or rigorous investigation by deductive or inductive reasoning or rhetoric, as appropriate. The report shall not exceed 40 000 words without the Head of Department's approval of the candidate's written application and justification.

EEE5148Z THEORETICAL FOUNDATIONS IN ENGINEERING EDUCATION RESEARCH
15 NQF credits at HEQSF level 9
Course outline:
This course aims to provide an introduction to substantive theories that address key educational concepts. These broad concepts revolve around the notions of identity, discourse, knowledge, student experience, and social structure. Students should be able to: demonstrate understanding of key theoretical concepts for framing engineering education in the higher education context; evaluate the utility of theories introduced to describe and explain engineering education phenomena; critically evaluate engineering education research literature (from a theoretical perspective);and construct a theoretical argument.

EEE5149W DISSERTATION ENGINEERING EDUCATION
120 NQF credits at HEQSF level 9
Course outline:
The dissertation should incorporate any or all of the following: design of an engineering education research project involving advanced concepts and theoretical principles located in the engineering education research field; a research project of a theoretical or practical nature; a critical review of a specified topic based upon a comprehensive search of the literature or available data, a rigourous analysis of empirical data, and the development of a coherent discussion of the analysis, or any other study acceptable to the Faculty.

END5050X MASTERS JOURNAL PAPER REQUIREMENT
0 NQF credits at HEQSF level 9
Course outline:
The aim of submitting a research paper for the masters' degree is to develop an understanding of what is required for the publication of research findings. To this end a candidate shall submit a summary of the key aspects of the dissertation, presented in the form of a paper which is, potentially, of publishable standard, approved by a Panel of Assessors. This is a requirement for candidates submitting either a 180 or 120 credit dissertation for the following degrees: MSc in Construction Economics and Management, MSc(Eng), MSc(ProjMan), MPhil, MSc in Property Studies. Refer to the appropriate degree rules.
DP requirements: None

EEE6000W PHD IN ELECTRICAL ENGINEERING
360 NQF credits at HEQSF level 10
Course outline:
A PhD thesis is required to be an original, coherent and consistent body of work which reflects the candidate's own efforts. The thesis may not be more than 80 000 words. A candidate will undertake

research, and such advanced coursework as may be required, under the guidance of a supervisor or supervisors appointed by Senate.
DP requirements: None
Assessment: Written work counts 100%.