INTRODUCTION

We hope that you will find this guide helpful. It contains information about the postgraduate degrees and diploma offered by the School. Note that it should be read in conjunction with the Faculty of Engineering & the Built Environment Rules and Syllabuses booklet, which contains the rules governing postgraduate study. If anything in this guide is in conflict with the Rules and Syllabuses, the Rules and Syllabuses take precedence.

The School of Electrical and Information Engineering offers the following postgraduate degrees and diplomas:

- Postgraduate Diploma in Electrical Engineering (EXA00)
- Master of Engineering (Professional) (ECA01)
- Master of Science in Engineering by coursework and Research Report (ECA00)
- Master of Science in Engineering by Dissertation (ERA00)
- Doctor of Philosophy (ED002)
Information about the degrees and diplomas

Postgraduate Diploma in Electrical Engineering.
The postgraduate diploma offers entry into the Masters programs of the School and is primarily intended for those who do not already have a four year BSc in Electrical Engineering (or equivalent).
Typically someone with a Bachelor of Technology or a Bachelor of Science in an Engineering related discipline.
It may also include those who might not meet the formal entry requirements but have many years of industrial experience. Depending on the applicant’s previous qualifications, applicants may be required to undertake an assessment as part of the application process to determine their foundational knowledge.

The Postgraduate Diploma is offered at the same level as the fourth year of the BSc in Electrical Engineering, and many of the courses are run together with these forth year courses.

- NQF Level of the qualification : 8
- Total number of credits for qualification : 120 Credits
- Number of courses required: six 20 Credit courses at NQF level 8

It is possible to select two of the courses from other Schools if that School agrees and it works in the timetable. One such School may be the School of Mechanical Industrial and Aeronautical Engineering and their courses and timetable are available on their website at: http://www.wits.ac.za/mecheng/postgraduate

The curriculum planner showing the courses on offer (on the next page of this guide) can be used to set up a proposed curriculum and this curriculum planner document should be attached to an application.

The Diploma can be completed in one year full time or two years part time. For part time study normally three courses are selected, but no more than five.

For this Diploma no more than three courses may be repeated.
# Postgraduate Diploma Curriculum planner

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEN5000A</td>
<td>Measurement Systems</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5001A</td>
<td>High Frequency Techniques</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5002A</td>
<td>High Voltage Engineering</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5003A</td>
<td>Software Engineering (Can not be taken together with ELEN5010A)</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5004A</td>
<td>Software Development III</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5005A</td>
<td>Electromechanical Conversion</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5006A</td>
<td>Network Fundamentals</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5007A</td>
<td>Control II</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5008A</td>
<td>Power Systems</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5009A</td>
<td>Database Systems</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5010A</td>
<td>Introduction to Software Engineering (Can not be taken together with ELEN5003A)</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5011A</td>
<td>Selected Topics in Software Engineering</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5012A</td>
<td>Software Development Methodologies Analysis and Design</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5013A</td>
<td>Software Project Management</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELEN5014A</td>
<td>Software Technologies and Techniques</td>
<td>20</td>
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<tr>
<td></td>
<td>Total</td>
<td><strong>120</strong></td>
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</table>

**Notes:**

No more than 60 credits can be obtained from repeating courses (This means you may not fail more than three 20 credit courses)
Master of Engineering (Professional)

This qualification is a coursework only degree that is focussed on delivering specialist knowledge for industry. It comes in one of two different specializations:

  - Power Engineering
  - Telecommunications Engineering

This degree is offered to those who already have a four year MSc in Electrical Engineering (or Equivalent), a Postgraduate Diploma in Electrical Engineering or an Electrical Engineering related BSc (Hons).

- **NQF Level of the qualification**: 9
- **Total number of credits for qualification**: 180 Credits
- **Number of courses required**: Six 20 Credit courses at NQF level 9
  - One 15 Credit Research methods course
  - One 45 Credit Industrial / Research project

The curriculum planner and the courses on offer are on the next page of this document. The degree can be completed in one year full time or two years part time.

For this Degree no more than two courses may be repeated.
# Master of Engineering (Professional) Curriculum planner

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEN7059A</td>
<td>Principles of Communications Systems</td>
<td>20</td>
</tr>
<tr>
<td>ELEN7015A</td>
<td>Teletraffic Engineering</td>
<td>20</td>
</tr>
<tr>
<td>ELEN7011A</td>
<td>Selected Topics in Telecommunications</td>
<td>20</td>
</tr>
<tr>
<td>ELEN7064A</td>
<td>Principles of Wireless Communications</td>
<td>20</td>
</tr>
<tr>
<td>ELEN7009A</td>
<td>Principles of Insulation Coordination in Electric Power Systems</td>
<td>20</td>
</tr>
<tr>
<td>ELEN7018A</td>
<td>Earthing and Lightning Protection</td>
<td>20</td>
</tr>
<tr>
<td>ELEN7043A</td>
<td>Advanced Electromechanical Conversion</td>
<td>20</td>
</tr>
<tr>
<td>ELEN7048A</td>
<td>Variable Speed Drives for AC Machines</td>
<td>20</td>
</tr>
<tr>
<td>ELEN7056A</td>
<td>Power Electronics</td>
<td>20</td>
</tr>
<tr>
<td>ELEN7013A</td>
<td>Selected Topics in Power Engineering</td>
<td>20</td>
</tr>
<tr>
<td>Pending</td>
<td>Research methodology (Compulsory)</td>
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</tr>
<tr>
<td>ELEN7068A</td>
<td>Research/Industrial Project (Compulsory)</td>
<td>45</td>
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</table>

Total 180

Notes:
- No more than 40 credits can be obtained from repeating courses (This means you may not fail more than two 20 credit courses).
- If a course has been failed twice, it cannot be taken a third time.
- If an elective from another School is chosen, please ensure you meet the requirements of that elective.
Master of Science in Engineering by coursework and Research Report

This degree consists of half coursework and half research.

The degree comes in one of two different specializations:
- Power Engineering
- Telecommunications Engineering

This degree is offered to those who already have a four year MSc in Electrical Engineering (or Equivalent), a Postgraduate Diploma in Electrical Engineering or an Electrical Engineering related BSc (Hons).

- NQF Level of the qualification : 9
- Total number of credits for qualification : 180 Credits
- Number of courses required: Four 20 Credit courses at NQF level 9
  - One 10 (min) Credit research methods course
  - One 90 Credit Research Report

The curriculum planner and the courses on offer are attached to this document.

The degree can be completed in one year full time or two years part time.

For this Degree all courses and the Research Report need to be successfully completed on the first attempt.

In addition to the courses a Research Report is also required. The Research Report is the equivalent of six months of full time work. (For more information on the research component please see the MSc by research degree)

NB: Applicants are required to secure a supervisor to supervise the Research Report part of the degree before an application is made.
## MSc 50/50 Curriculum planner

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<thead>
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<th>2020</th>
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<tbody>
<tr>
<td>ELEN7059A</td>
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<td>ELEN7015A</td>
<td>Teletraffic Engineering</td>
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<tr>
<td>ELEN7064A</td>
<td>Principles of Wireless Communications</td>
<td>20</td>
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<td>ELEN7011A</td>
<td>Selected Topics in Telecommunications</td>
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<tr>
<td>ELEN7009A</td>
<td>Principles of Insulation Coordination in Electric Power Systems</td>
<td>20</td>
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<tr>
<td>ELEN7018A</td>
<td>Earthing and Lightning Protection</td>
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<td>ELEN7043A</td>
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<td>ELEN7048A</td>
<td>Variable Speed Drives for AC Machines</td>
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<td>Power Electronics</td>
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<tr>
<td>ELEN7013A</td>
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<tr>
<td>ELEN7067A</td>
<td>Research methodology (Compulsory)</td>
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**Coursework Total 95**

<table>
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<th>2019</th>
<th>2020</th>
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<td>ELEN7000A</td>
<td>Research Report (Compulsory)</td>
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</table>

**Total 185**

### Notes:

- The Research Report is compulsory.
- Every course including the Research Report must be passed on the first attempt.
- If an elective from another School is chosen, please ensure you meet the requirements of that elective.
- The Research methodology should be completed before or in conjunction with the Research Report.
**Master of Science in Engineering by Dissertation**

The Masters of Science in Engineering by Dissertation is aimed at developing research competencies. It is carried out under the guidance of a supervisor appointed by the School. After consultation with the supervisor a Dissertation is submitted for examination. This Dissertation must constitute both an application of the methods of research and a contribution to the advancement of knowledge in the subject chosen.

This degree is offered to those who already have a four year MSc in Electrical Engineering (or Equivalent), a Postgraduate Diploma in Electrical Engineering or an Electrical Engineering related BSc (Hons).

- **NQF Level of the qualification:** 9
- **Total number of credits for qualification:** 180 Credits

For this Degree (and the Research Report component of the MSc by coursework and Research Report) a supervisor in the School is required. The supervisor is normally selected during the application phase of the degree. The applicant is advised to consult broadly within the School to find a supervisor whose research interests align with those of the candidate. It may not always be possible to find such an alignment and in these cases the application will not be successful. A short research proposal of the envisaged research may be required with the application.

The degree can be completed in one year full time or two years part time.

**NB:** Applicants are required to secure a supervisor to supervise the Dissertation before an application is made.

**Doctor of Philosophy**

At the close of the period for research and after consultation with the appointed supervisor, a candidate will be expected to submit, with the supervisor’s approval, a thesis for examination. The thesis must constitute a substantial contribution to the advancement of knowledge in the subject chosen and must be satisfactory as regards literary style and presentation.

- **NQF Level of the qualification:** 10
- **Total number of credits for qualification:** 360 Credits

The minimum period of registration for the degree of PhD is two years of full-time study or four years of part time study.
Addition and cancellation of courses

If you wish to change any of the courses for which you are registered you may only do so with prior approval of the Assistant Dean (Postgraduate Affairs).

Amendment forms are available on the Faculty web site or the Postgraduate Officer (and also attached to this guide). The signed, completed forms must be returned to the Postgraduate Officer’s email or in person.

You may not add a course later than 10 days prior to the commencement of that course.

You may not drop a course later than ten working days prior to the date of examination of that course; if you do so a result of FAIL/ABSENT will be recorded for that course.

If you cancel a course after it has commenced you will be charged the full cost of the course, irrespective of whether you have attended any lectures.

Fees will be charged if a course has started and a student does not attend but has not cancelled.

If you do not register for a course but attend it and write the examination you will not be given a result or credit for that course.

Application Process

1. Applicants can follow the links below to make an online application.
   
   To apply online please visit www.wits.ac.za/applications  
   To upload documents or view your application status please visit https://self-service.wits.ac.za  
   For application information and closing dates please visit http://www.wits.ac.za/study-at-wits/

2. Applicants who apply for the Degrees listed below are requested to secure a supervisor before making an application. Please visit the Schools web page for more information.
   
   http://www.wits.ac.za/ebe/schools/electrical-and-information-engineering/research-groups/
   
   a. Master of Science In Engineering by Coursework and Research Report
   b. Master of Science In Engineering by Dissertation
   c. Doctor of Philosophy

Contact details for the School of Electrical and Information Engineering

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postgraduate Officer</td>
<td>Ms M Adam</td>
<td>011 717-7232</td>
<td><a href="mailto:Muntaz.adam@wits.ac.za">Muntaz.adam@wits.ac.za</a></td>
</tr>
<tr>
<td>Faculty officer assigned to the School</td>
<td>Ms C Mosimane</td>
<td>011 717-7008</td>
<td><a href="mailto:Charlotte.Mosimane@wits.ac.za">Charlotte.Mosimane@wits.ac.za</a></td>
</tr>
<tr>
<td>Postgraduate Co-ordinator</td>
<td>Prof I Hofsajer</td>
<td>011 717-7210</td>
<td><a href="mailto:Ivan.hofsajer@wits.ac.za">Ivan.hofsajer@wits.ac.za</a></td>
</tr>
<tr>
<td>Head of School</td>
<td>Prof E Trengove</td>
<td>011 717 7230</td>
<td><a href="mailto:Estelle.Trengove@wits.ac.za">Estelle.Trengove@wits.ac.za</a></td>
</tr>
</tbody>
</table>

NB! Please be sure to monitor your student Email account. All official correspondence will be sent to this account.
SYLLABUSES

Postgraduate Diploma courses

ELEN5000A Measurement Systems (20 Credits, NQF Level 8)

ELEN5001A High Frequency Techniques (20 Credits, NQF Level 8)

ELEN5002A High Voltage Engineering (20 Credits, NQF Level 8)
Revision of Electromagnetic Engineering fundamentals and principles, as well as applicable principles of power engineering Conduction and breakdown processes in gases, liquids and solids. Generation of HV testing voltages (and high testing currents), HV measurement technique. Insulation assessment and design considerations for HV equipment

ELEN5003A Software Engineering (20 Credits, NQF Level 8)
Revision of applicable material from software development. What is Software Engineering and why is it needed? Managing the software development process; the software lifecycle; configuration management; people management and team organisation; software quality; cost estimation; project planning and control. The software development process; requirements engineering; software architecture; software design; software testing; software maintenance. Software reusability. Software reliability. Software performance.

ELEN5004A Software Development III (20 Credits, NQF Level 8)
This course is part of the postgraduate diploma in electrical engineering. It is modelled on an existing fourth year course. The credits for this course are greater than the existing
course and additional foundational material is included to enable a non-mainstream electrical engineer to engage with the content. Additionally there is a larger scoped project which adds to the credits.

ELEN5005A Electromechanical Conversion (20 Credits, NQF Level 8)
Revision of Electromagnetic Engineering fundamentals and principles, as well as applicable principles of power engineering AC and DC Machines; Mechanical Loads; Development of the d-q Model; Principles of Vector Control; Unconventional Motors; Computer Analysis and Simulation of Electrical Drives.

ELEN5006A Network Fundamentals (20 Credits, NQF Level 8)
Revision of basic communication fundamentals. The ISO reference model will be used to discuss each of the layers and the functionality it provides. Application layer discussions will focus on standardised protocols that support many application types. Transport layer discussions will focus on achieving reliable transfer over an unreliable channel, flow and congestion control. Network layer discussions will cover global hierarchical addressing and the operation of routing. The data link layer will cover local area networks and their operation.

ELEN5007A Control II (20 Credits, NQF Level 8)
Revision of basic control theory and signals and systems Robust control and performance analysis for Multi-input Multi-output (MIMO) systems: Digital control; Design, simulation and implementation of digital controllers; Advanced control techniques and identification: A selection of control strategies such as, but not limited to, genetic algorithms for control, Neuro-Fuzzy control, Optimal control and optimisation techniques, Nonlinear control techniques, Real-time controllers and systems. These control strategies are used as tools for system modelling, analysis and control of classes of nonlinear and multi-variable systems.

ELEN5008A Power systems (20 Credits, NQF Level 8)
Revision of applicable concepts from Electromagnetic Engineering and Power Engineering Power transmission: Constants of transmission lines; design of overhead lines and cables; voltage and current relations and performance of transmission links under steady state and transient conditions; power system stability. Protection: Current and voltage transformers; symmetrical components, fault calculations, characteristics of protective relays; protection of transformers, generators, motors and transmission lines.

ELEN5009A Database Systems (20 Credits NQF Level8)
Large information models are an important component in many modern engineering applications. The course covers the principles underlying information modeling and database design and implementation. The application of these principles to important engineering tasks is then presented. In particular the course covers, geospatial information as an important engineering application, and Knowledge Management as an important information management application. Content: Database theory: relational databases; normalisation; SQL; object oriented Database design. Spatial databases: location based Systems (GIS);Information and Knowledge Management applications.

ELEN5010A Introduction to Software Engineering (20 Credits NQF Levels 8)
What is Software Engineering (SE)? Introduction to SE Management. The Software Development Lifecycle. Requirements Engineering: Software Design; OO Analysis and Design; Software testing; User Interface Design.

**ELEN5011A Selected Topics In Software Engineering (20 Credits NQF Level 8)**

There is no syllabus for this course - the topic varies from year to year.

**ELEN5012A Software Development Methodologies, Analysis and Design (20 Credits NQF Level 8)**

This course has two major objectives. The first is to set the task of software design within the context of the wider development process. The second objective is to introduce the student to a variety of software development methodologies. A number of examples and case studies are presented and students gain experience in developing designs of their own and in groups. Important topics such as problem frames, and analysis and design patterns are covered.

**ELEN5013A Software Project Management (20 Credits NQF Level 8)**

The course introduces students to key issues in the field of software project management. Topics covered in this course are: Introduction to software engineering concepts and problems: complexity; the software lifecycle; reuse; maintainability. Introduction to Software project management (SPM): problems and objectives; survey of important management approaches; planning; costing. People management and team working. Quality management systems and quality standards. Examples and case studies are given.

**ELEN5014A Software Technologies and Techniques (20 Credits NQF Level 8)**

The primary objective of this course is to extend basic material and concepts introduced at undergraduate level and develop a richer insight into the rapidly changing technical area of software development. Students are required to deliver a presentation that focuses on software development issues relevant to the course content. A major component of this course involves effective teamwork where students work in groups on a substantial software development project.

Content: Software development languages, paradigms and philosophies; Pragmatic programming; Team working and software project management; Operating systems and system architectures; Client server/multi-tier application standards; Distributed and parallel processing; Information models and systems, databases and data modelling; Software in business and e-business.
Masters Courses

ELEN7009A Principles of Insulation Coordination in Electrical Power Systems (20 Credits NQF Level 9)
Introduction; lightning parameters; lightning performance of transmission lines; switching
performance of transmission lines; AC performance of transmission lines; modelling
breakdown behaviour; insulation co-ordination of substations and distribution networks.

ELEN7011A Selected Topics in Telecommunications (20 Credits NQF Level 9)
There is no syllabus for this course – the topic varies from year to year.

ELEN7013A Selected Topics in Power Engineering (20 Credits NQF Level 9)
There is no syllabus for this course – the topic varies from year to year.

ELEN7015A Teletraffic Engineering (20 Credits NQF Level 9)
Review of essential probability theory: negative exponential, Poisson and Binomial
distributions.
Traffic measures: call attempts, holding times, the Erlang.
Analysis of circuit switches: blocking, blocking probability, grade of service, multistage
switches and switches with alternative routing.
Queueing systems: queue and server models, applications to packet switching and ATM.

ELEN7018A Earthing and Lightning Protection (20 Credits NQF Level 9)
Lightning physics and the point of strike. Theory and practice of external lightning
protection. Theory and practice of internal lightning protection. Earth electrode systems
and characteristics. Philosophy of site-wide earthing. Evaluation of direct and indirect
strikes. Project planning for existing and new systems. SPD’s – choice and characteristics,
installation practice.

ELEN7043A Advanced Electromechanical Conversion (20 Credits NQF Level 9)
Introduction to electromechanical concepts, including state-space modelling of the
systems. Investigating various popular structures, e.g. asynchronous machines. Also
introducing the concepts of linear motors as well as other mechanical force or torque
producing structures. Aspects of the electronic control of such devices.

ELEN7048A Variable Speed Drives for AC Machines (20 Credits NQF Level 9)
Concepts of mechanics; space vector theory of AC motors; control of AC motors; scalar
and vector; AC-AC converters – cycloconverters; DC-AC converters; slip energy recovery.

ELEN7056A Power Electronics (20 Credits NQF Level 9)
This course introduces students to the application of the two most important
semiconductor devices for the control of power – the silicon controlled rectifier (SCR) and
the insulated gate bipolar transistor (IGBT). The course then proceeds to examine the
circuits, and analyse the performance of the various types of variable speed drives for both
AC motors (synchronous and induction) and DC motors.
The problems associated with variable speed drives, such as the injection of current
harmonics back into the supply are also examined. Characteristics, ratings and protection
of SCR’s, GTO’s, BJT’s, MOSFET’s and IGBT’s.
AC-DC converters. Harmonics in power systems. DC-DC converters. DC-AC inverters.
AC-AC converters.

ELEN7059A Principles of Communication Systems (20 Credits NQF Level 9)
This course covers the basics of digital and analogue information transfer over wired and wireless links. Topics include baseband and bandpass (M-FSK, M-PSK, M-QAM) modulation formats and associated pulse shaping, symbol timing and carrier recovery techniques, together with bandpass analogue modulation techniques. The course covers mobile radio propagation, modulation theory, diversity combining, cellular radio architectures and capacity calculation. The aim is to provide an insight into the choice of access techniques in future generation wireless networks. Analytical tools for describing information transfer and uncertainty are discussed and applied to practical data and communication systems. The key parameters that govern power and bandwidth of a communication system are introduced. The course examines both analogue and digital modulation schemes and coherent and non-coherent detection techniques.

ELEN7061A Telecommunications Business Environment (20 Credits NQF Level 9)
This module deals with strategic management issues related to running a telecommunications operating company [Telco], enabling course participants to appreciate the business perspectives of telecommunications both in South Africa and globally. Emphasis is on providing an understanding of the interactive nature of the forces impacting on the performance of Telecoms.

ELEN7064A Principles of Wireless Communications (20 Credits NQF Level 9)
The main focus of this course is on the design, analysis, and fundamental limits of wireless transmission systems. In particular, we look at the wireless channel and system models, fading and diversity, resource management and power control, multiple-antenna and MIMO systems, space-time codes and decoding algorithms, multiple-access techniques and multiuser detection, cellular and ad-hoc network topologies, OFDM and ultra-wide band systems, and architectural issue

ELEN7065A Telecoms Network Architectures (20 Credits NQF Level 9)
This module introduces fundamental principles in the design and operation of modern telecommunication networks, with specific focus on the core network. Topics included are control signalling (ISUP), principles of mobile wireless networks (mobility management/roaming/handover) using GSM as a case study, peripheral and value-added services using Intelligent Networks as a case study. The aim is to provide the student with a clear understanding of the overall architecture of a telecommunications network and thus enable the student to deal with the complexity of evolving technologies such as 3G and 4G.

ELEN7067A Research Methodology (15 Credits NQF Level 9)
Research is considered to be the process of making new knowledge. This process will be approached from the point of view of what constitutes knowledge in different domains and what is a good research question. When is new knowledge a contribution to existing knowledge and how can we be certain it is a contribution. New knowledge can only be accepted within the context of existing knowledge and the construction of a sound
foundation is of the utmost importance. The research tools of creative problem solving, argument and planning will be discussed in detail. The course will lead to the development of a research proposal.

ELEN 7068A  Research/Industrial Project  (45 Credits NQF Level 9)