

# University of Pretoria Yearbook 2016

## BEngHons Electronic Engineering (12240091)

**Duration of study** 1 year

**Total credits** 128

### Programme information

The curriculum is determined in consultation with the relevant heads of departments. A student is required to pass modules to the value of at least 128 credits.

The degree is awarded on the basis of examinations only.

### Admission requirements

Subject to the stipulations of the General Regulations, Reg. G.1.3 and G.54, a BEng degree or equivalent qualification is required for admission.

### Other programme-specific information

Students may take modules to the value of 32 credits from other fields of specialisation or from other departments, with approval of the Coordinator: Postgraduate Studies.

### Examinations and pass requirements

- The examination in each module for which a student is registered, takes place during the normal examination period after the conclusion of lectures (i.e. November/January or June/July).
- A student registered for the honours degree must complete his or her studies within two years (full-time), or within three years (part-time) after first registration for the degree: Provided that the Dean, on recommendation of the relevant head of department, may approve a stipulated limited extension of this period.
- A student must obtain at least 50% in an examination for each module where no semester or year mark is required. A module may only be repeated once.
- In modules where semester or year marks are awarded, a minimum examination mark of 40% and a final mark of 50% is required.
- No supplementary or special examinations are granted at postgraduate level.

### Pass with distinction

A student passes with distinction if he or she obtains a weighted average of at least 75% in the first 128 credits for which he or she has registered (excluding modules which were discontinued timeously). The degree is not awarded with distinction if a student fails any one module (excluding modules which were discontinued timeously).

## Curriculum: Final year

**Minimum credits: 128**

### Elective modules

#### Optimal control 780 (EBO 780)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	Introductory control course such as EBB 320
<b>Contact time</b>	32 contact hours per semester
<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 1

##### Module content

Optimal control of dynamic systems: continuous time systems, the Euler Lagrange equations, minimum time problems, the Pontryagin maximum principle; feasible control: computation of control input strategies for nonlinear systems such that the given control specifications are satisfied; feedback control of dynamic systems: dynamic programming for continuous time and discrete time nonlinear systems; applications in manufacturing systems; parametrisations of nonlinear/intelligent controller structures and applications of feasible control; linear systems: linear optimal control, linear optimal observers; application of feasible control in the computation of linear optimal output feedback controllers such that the design specifications are satisfied including: robustness against parameter variations, disturbance rejection, command following, frequency domain specifications.

#### Introduction to research 732 (EIN 732)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	16 contact hours per semester
<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 1 or Semester 2

##### Module content

The aim of this module is to teach students to critically evaluate research literature, including conference papers and journal articles, in order to determine the current state of knowledge in a particular specialist area. It will also provide students with the principles of research to enable them to conduct research and prepare an original project in their particular specialist area.

#### Antenna theory 780 (EMA 780)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	Microwaves and antennas EMZ 320 or equivalent
<b>Contact time</b>	32 contact hours per semester

<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 2

#### Module content

Types of antennas and radiation mechanisms, parameters of antennas, radiation integrals, near and far field radiation, duality theorem, wire antennas, antenna arrays, mutual coupling and mutual impedance, surface equivalence theorem, reaction theorem, moment methods in antenna analysis, travelling wave antennas, microstrip antennas, horn antennas, physical optics, reflector antennas, antenna synthesis.

### Multivariable control systems 732 (EMB 732)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	Introductory control course such as EBB320
<b>Contact time</b>	32 contact hours per semester
<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 2

#### Module content

Introduction to linear dynamic systems: Modes, stability, controllability, observability, multivariable poles and zeros, state-space and transfer function descriptions. Singular values and singular value decomposition. Feedback performance specifications in the frequency domain. Synthesis via state space methods. Optimal control techniques, model predictive control.

### Microwave theory 780 (EMM 780)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	Microwaves and antennas EMZ 320 or equivalent
<b>Contact time</b>	32 contact hours per semester
<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 1

#### Module content

Review of EM theory and transmission lines, analysis of transmission lines and waveguides, microwave network analysis, impedance matching, power dividers, couplers and hybrids, microwave filters.

### Digital communications 732 (ETD 732)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	32 contact hours per semester

<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 1

#### Module content

Digital Communications ETD 732 is a first semester graduate course in Electronic Engineering, presented by the Signal Processing and Telecommunications Group, in collaboration with the Centre for Radio and Digital Communication (CRDC). The content of the course is as follows: Introduction to digital communications, digital communications applications and services. Review of: probability and stochastic processes, source coding, characterisation of communication signals and systems and optimum receivers for the AWGN channel. Advanced synchronisation systems: Carrier and symbol recovery. Shannon's channel capacity theorem and introduction to coding. Signal design for band-limited channels. Digital modulation techniques. Communication through band-limited linear filter channels. Introduction to adaptive equalisation. Spread spectrum signals for digital communications. Simulation of digital communication systems. Digital realisation of digital communication subsystems. Digital communication laboratory.

### Telecommunication systems engineering 732 (ETT 732)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	32 contact hours per semester
<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 1 or Semester 2

#### Module content

Telecommunication systems engineering ETT 732 is a first semester graduate course in Electronic Engineering, presented by the Signals and Telecommunications Group. This module provides an Introduction to telecommunication concepts, telecommunication systems, virtual private networks (VPN), advanced intelligent networks (AIN), local number portability (LNP), computer-to-telephony integration (CTI), signalling system 7 (SS7), CTI technologies and application, ISDN, frame relay, ATM, ATM and frame relay internetworking, data over power lines, xDSL, microwave and radio-based systems, local multipoint distribution services (LMDS), specialized mobile radio (SMR), cellular communication, GSM, personal communication services (PCS), wireless data communication (Mobile IP), satellite communication (Networking, LEO), Sonet and SDH, wave division multiplexing (WDM), the internet (TCP/IP, VoIP, networking, management)

### Research project: Theory 732 (EPT 732)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	10 lectures per week
<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com

**Period of presentation** Semester 1 or Semester 2

**Module content**

This module will cover the essential theoretical background of the student's proposed M Eng topic and include inter alia the following:

- (i) Field definition and descriptions
- (ii) In-depth study into background and theory relevant to the problem to be addressed
- (iii) Problem definition and description
- (iv) Mathematical simulations of the problem

**Research project: Design and laboratory 733 (EPT 733)**

**Module credits** 32.00

**Prerequisites** No prerequisites.

**Contact time** 10 lectures per week

**Language of tuition** English

**Academic organisation** Electrical, Electronic and Com

**Period of presentation** Semester 1 or Semester 2

**Module content**

This module will include extensive laboratory experiments to test the principles and possible solutions of the proposed M Eng research project and will include inter alia the following. These will include hardware and/or software experiments:

- (i) Introduction to instrumentation and measuring techniques in general and specifically as applied in the field of research.
- (ii) Structured laboratory work to introduce the specific problem investigated for the research undertaken.
- (iii) Structured laboratory work to test the proposed solution for the problem addressed.
- (iv) Confirmation experiments.

**Electronic defence - electronic countermeasures 780 (ELB 780)**

**Module credits** 32.00

**Prerequisites** No prerequisites.

**Contact time** 10 lectures per week

**Language of tuition** English

**Academic organisation** Electrical, Electronic and Com

**Period of presentation** Semester 1 or Semester 2

## Module content

Radar, including aspects such as: radar frequency bands and their characteristics, radar types (eg tracking vs search radar), the radar range equation, radar cross-section (RCS), target characteristics such as scintillation and glint, pulse compression, coherent and non-coherent integration (eg Doppler processing), range and Doppler ambiguities, target tracking including simple tracking filters and angle-tracking techniques (eg monopulse), high range-resolution (HRR) techniques, and environmental effects such as atmospheric attenuation and multipath. Electronic attack (EA) - also referred to as jamming or electronic countermeasure (ECM) - including the relationship between good system design and EP, and basic EP techniques to counter the EA techniques listed above.

## Solid-state lighting 732 (ELV 732)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	2 lectures per week
<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 1

## Module content

Photometry (quantities, units and definitions), light and vision (photopic, scotopic and mesopic), solid-state light sources, LED and OLED sources (luminous efficacy, rated life, thermal dependence, etc.), drive and control electronics for SSL (linear and on-linear dimming, thermal and light feed-back control, luminaire fundamentals and design, lighting design (CAD), specific lighting applications (task and ambient, indoor and outdoor, safety and security, automotive), SSL measurements (photometric, colorimetric, electrical and thermal). Cost-effective energy efficiency: principles and life cycle cost calculations. International standards and testing.

## Intelligent systems 732 (EAI 732)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	10 lectures per week
<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 1

## Module content

This module provides the theoretical background necessary to understand, research and develop real-world software and hardware systems that incorporate and exhibit intelligent behaviour. The module incorporates advanced theory from fields such as Artificial Intelligence, Computational Intelligence, Machine Learning, Pattern Recognition and Signal Processing. Core topics of the module include: Bayesian Theory, Neural Networks, Kernel Methods, Graphic Models, and Numerical Bayesian Methods.

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### Advanced topics in intelligent systems 733 (EAI 733)

<b>Module credits</b>	32.00
<b>Prerequisites</b>	EAI 732
<b>Contact time</b>	10 lectures per week
<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 1 or Semester 2

#### Module content

The aim of the module is to augment the general background provided by the EAI 732 module with the specific theoretical background required for MEng. The module will, depending on the intended research field of the student, incorporate advanced theory from fields such as: Digital Image Processing, Computer and Robotic Vision, Probabilistic Robotics, Data Fusion, Hardware and Software Parallel Processing, Real-Time and Reactive Systems.

### Electronic defence - electronic support 781 (ELB 781)

<b>Module credits</b>	32.00
<b>Contact time</b>	32 contact hours per semester
<b>Language of tuition</b>	English
<b>Academic organisation</b>	Electrical, Electronic and Com
<b>Period of presentation</b>	Semester 1 or Semester 2

#### Module content

The role of electronic support (ES) receivers from tactical and strategic perspectives. ES system architectures including analogue and digital receivers. The following topics will be considered: signal detection, parameter estimation including direction finding (DF) angle of arrival (AoA) estimation and pulse repetition interval (PRI) tracking, emitter classification and low probability of detection (LPD) and low probability of intercept (LPI) techniques to counter ES receivers.

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The information published here is subject to change and may be amended after the publication of this information. The [General Regulations \(G Regulations\)](#) apply to all faculties of the University of Pretoria. It is expected of students to familiarise themselves well with these regulations as well as with the information contained in the [General Rules](#) section. Ignorance concerning these regulations and rules will not be accepted as an excuse for any transgression.