DEPARTMENT OF ELECTRICAL & COMMUNICATION ENGINEERING

Acting Head of Department
Dr. **Kiss, P.,** Ph.D. (BUTE, Hungary), M.Sc. (BUTE, Hungary)

Deputy Head of Department
Kupale, G., M.Eng. (PNGUT), B.Eng, (PNGUT)

Professors
Professor **Hoole, P.R.,** D.Phil.Eng. (Oxford, UK), MSc. (Oxford, UK)

Associate Professors
Dr. **Pirapaharan, K.,** D.Phil. Eng. (Osaka, Japan), M.Eng. (Osaka, Japan), B.Sc. (Peradeniya, Sri Lanka)

Senior Lecturers

Lecturers
Aiau, S.S, M.Phil, B.Eng, (PNGUT), MIEPNG., Reg. Eng.(PNG).

Chen, D., M.IT (QUT, Australia), B.CS (VUW, New Zealand)

Fisher, J., M.Eng.Sc, (UOW, Australia), B.Eng, (PNGUOT)

Kavi, M., M.Eng. (UNSW, Australia), B.Eng. (PNGUT) Dipl. Communications Eng. (PNGUT)

Kunsei, H., M.Eng.Sc (UNSW, Australia), B.Eng. (PNGUT)

Senior Technical Instructors

Technical Instructors
Namba, J., B. Sc. (PNGUT)

Laboratory Manager
Sangin, D., Dipl. Comm.Eng. (PNGUT)

Principal Technical Officer (Communication)
Bonner, L., B.Eng.,(PNGUT), Dip. Elect. Eng.(PNGUT)

Principal Technical Officer (Power)
Embe, O., B.Eng. (PNGUT)

Principal Technical Officer (Computing)
Pek, C, B.Sc. (UPNG)

Senior Technical Officer (Power)
Warra, T, PETT Cert. (Hagen Tech.), Trades Cert. (POM Tech)

Senior Technical Officer (Computing)
Kevin, L., Dipl. Comp. Technology,(DBTI)

Technical Officer (Computing)
Makun, R., Dipl. Comp. Technology,(DBTI)

Karato, R., Dipl. Comp. Technology,(DBTI)

Technical Assistants
Pepi, F., Cert. Electrical (POM Tech.)

Cuthbert, P., Cert. Electrical (Multi Skills Training Inst. Lae)

Senior Stores Supervisor
Kondo, V., Dipl.Cert (Telrad, Israel), Cert. IT Studies (Telecom Training Col.)

Senior Secretary
Ketau, Q., SecCert, StenoCert, (Goroka Bus. Coll.)

Sandruweh, D., Dipl. Business Stud, SecCert (Polytech), StenoCert (Rabaul Tech)

The Department offers undergraduate courses in Electrical, Communication and Computer Engineering.
The Undergraduate Course leads to the Degree of Bachelor of Engineering in Electrical Engineering. This course has been designed to equip students with a broad knowledge of electrical engineering with opportunity to specialise in power or communications engineering during the final year. The course is of four years duration and is supported by extensive practical work performed in well-equipped laboratories. The first year of the degree course provides emphasis on basic studies in English, Mathematics, Physics and Engineering Science.

During the long vacations at the end of each year, students are expected to take employment with sponsors or organizations which deal in some aspect of Electrical and Communication Engineering.

Experience gained during these periods is regarded as an essential and integral part of the student's training. Students are required to accumulate at least ten weeks' vacation training experience during the course. This training must be approved by the Head of Department and all students are required to submit a report at the end of each training period. The major employers of degree graduates are Telikom PNG, the Papua New Guinea Electricity Commission, National Broadcasting Commission, Office of Civil Aviation, Department of Works, and mining industries.
The Department has a keen interest in rural outreach, and has research programmes in power systems, power electronics, microwave propagation (terrestrial and satellite communication), computer networks, micro hydro generation, power systems, power system protection, computer architecture, PLC's, and microprocessors and industrial control.

The students are streamed after completing the 3rd year programme into two streams, i.e. Power & Communication streams. The Department is introducing a third specialization in 2017, the Computer Engineering stream. The students are allowed to choose this option after finishing the first year.
In response to requests from industry to provide further training for graduate engineers, the Department offers specialist short courses, which can be given at the University or at the industrial site.
The Department has an extensive Master programme. This Master's degree is based on research to be presented as a thesis and will normally take two years to complete. Masters degrees are offered in propagation studies, control engineering and instrumentation, power systems and computer network. There will be shortly the opportunity to study for the M.Sc. by course work and dissertation in Power and Communication Engineering.

STRUCTURE OF COURSES

Code	**Semester**	**Average Weekly Hours**

BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING

Year 1	**First Semester**	
MA167	Engineering Mathematics 1	5
PH161	Physics I (Mechanics)	5
CH181	Chemistry for Engineers I	4
LA101	English Grammar & Composition I	3
ME171	Engineering Drawing and Graphics I	3
EE101	Introduction to Engineering	3
		23
Year 1	**Second Semester**	
MA168	Engineering Mathematics 2	5
PH162	Physics II (Electricity and Magnetism)	5
CH182	Chemistry for Engineers II	4
LA102	English Grammar & Composition II	3
ME172	Engineering Drawing and Graphics II	3
EE102	Computer Programing for Engineers	3
		23
Year 2	**First Semester**	
MA235	Engineering Mathematics 3	5
MN201	Engineer in Society	3
EE221	Digital Logic Systems	5
EE211	Electromagnetic Fields and Waves	5
EE213	Circuit Theory	5
EE237	Applicable Mathematics for Electrical Engineering	2
		25
Year 2	**Second Semester**	
MA236	Engineering Mathematics 4	5
EE202	Object Oriented Programming	5
CD361	Development Studies	3
EE252	Electrical Machines	5
EE222	Applied Analogue Electronics	6
EE214	Signals and Systems	5
		29
Year 3	**First Semester**	
MA333	Engineering Mathematics II EE (B)	4
EE311	Signals & Systems	3
EE321	Electrical Measurements Instrumentation	3
EE331	Telecommunication Principles I	4
EE341	Computer Architecture	4
EE351	Electrical Machines II	4
EE361	Control Systems I	3
EE382	Industrial Electronics and Computer Control	3
		28

Year 3 Second Semester

MA334	Engineering Mathematics III EE (B)	4
BA132	Introduction to Management	3
EE332	Telecommunication Principles II	4
EE342	Interfacing Techniques	3
EE352	Electrical Power Systems I	4
EE362	Control Systems II	4
EE372	Computer Aided Engineering	2
		<u>24</u>

Year 4 First Semester

BA482	Management for Engineers	3
EE411	Instrumentation Systems and Process Control	3
EE431	Thesis A	4

ADDITIONAL SUBJECTS:
POWER OPTION

EE421	Electrical Design I	3
ME401	Mechanical Engineering Systems	2
EE441	Electrical Power Systems II	4
EE451	Power Electronics I	3
		<u>22</u>

COMMUNICATION OPTION

EE461	Computer Communications	3
EE471	Communication Systems Analysis & Design	5
EE481	Antennas and Propagation	3
EE491	Microwave & Optical Systems	4
		<u>25</u>

Year 4 Second Semester

EE402	The Professional Engineer	2
EE412	Thesis B	8

ADDITIONAL SUBJECTS:
POWER OPTION

EE432	Electrical Machines III	3
EE442	Electrical Power Systems III	4
EE452	Power Electronics II	3
EE462	Electrical Design II	2
		<u>22</u>

COMMUNICATION OPTION

EE472	Satellite Communications	9
EE482	Data Communications	4
		<u>23</u>

*Both Power and Communication Options may not be available every year.

SUBJECTS TAUGHT BY THE DEPARTMENT

EE101	Introduction to Engineering
EE102	Computer Programing for Engineers
EE111	Introduction to Computing & Problem Solving I
EE112	Introduction to Computing & Problem Solving II
EE202	Object Oriented Programming
EE211	Electromagnetic Fields and Waves
EE213	Circuit Theory
EE214	Signals and Systems
EE221	Digital Logic Systems
EE222	Applied Analogue Electronics
EE237	Applicable Mathematics for Electrical Engineering
EE241	Computer and Software Engineering
EE252	Electrical Machines
EE264	Principles of Electrical Engineering for Mechanical Engineers
EE311	Signals and Systems
EE321	Electrical Measurements & Instrumentation
EE331	Telecommunication Principles I
EE332	Telecommunication Principles II
EE341	Computer Architecture
EE342	Interfacing Techniques
EE343	Computer Hardware
EE351	Electrical Machines II
EE352	Electrical Power Systems I
EE361	Control Systems I
EE362	Control Systems II
EE372	Computer Aided Engineering
EE382	Industrial Electronics and Computer Control
EE398	Electrical Engineering for Mining
EE402	The Professional Engineer
EE411	Instrumentation Systems & Process Control
EE412	Thesis B
EE421	Electrical Design I
EE431	Thesis A
EE432	Electrical Machines III
EE441	Electrical Power Systems II
EE442	Electrical Power Systems III
EE451	Power Electronics I
EE452	Power Electronics II
EE461	Computer Communications
EE462	Electrical Design II

EE471	Communications Systems Analysis & Design
EE472	Satellite Communications
EE481	Antennas and Propagation
EE482	Data Communications
EE491	Microwave & Optical Systems

SUBJECTS DETAILS

EE101 INTRODUCTION TO ENGINEERING

Lecture Hours per week:	**1**
Tutorial Hours per week:	
Laboratory Hours per week:	**2**
Credits:	**7**

Prerequisite: none

Corequisite: none

Learning Outcomes:
1. Become familiar with PNG University of Technology and the various Engineering Departments and various student resources on campus.
2. Comprehension of Mechanical Engineering and the different fields of science and engineering and their application to Mechanical Engineering.
3. Comprehension of Civil Engineering and the different fields of science and engineering and their application to Civil Engineering.
4. Comprehension of Electrical Engineering and the different fields of science and engineering and their application to Electrical Engineering.
5. Comprehension of Mining and Mineral Process Engineering and the different fields of science and engineering and their application to Mining and Mineral Process Engineering.
6. Ability to gain an awareness of the connections between all engineering fields and the wider world of application of science and mathematics to engineering.

Syllabus:
Common lectures:
- Civil, Mechanical, Electrical, Mining and Mineral Process Engineering
- Introduction to Engineering analysis tools and problem solving
- Become familiar with PNG University of Technology and the various Engineering Departments and various student resources on campus.
- Recognize the importance or oral, written and general academic skills, including team work where appropriate.
- Understand standards of academic ethics and can list important academic values and be able to understand academic honesty and PNG Unitech's code of conduct.
- Understand university level expectations about their academic performance and their personal conduct.
- Become comfortable discussing important academic topics with faculty.
  - Ability to gain an awareness of the connections between all engineering fields and the wider world.

Civil Engineering:
- Introduction to structural engineering:
- Nature of types of loads on structures:
  - dead, live, wind and earthquake loads; distribution of dead and live loads to different elements of simple structures.
- Materials used in building construction:
  - timber, steel, concrete and block masonry.
- Different types of steel sections:
  - Universal beams, columns and channels (parallel flanges and tapered flanges); purlins, plates, built-up sections, circular and hollow sections.
- Types of reinforcing bars:
  - plain and deformed bars, their grades and uses.
  - Requirements for form work in concrete construction assembly, removal and plumbing.
- Introduction to soil engineering:
  - Importance of foundations, Nature and classification of soils, Soil testing.
- Introduction to transportation engineering:

  - Construction and maintenance of roads, airports and harbours, Introduction to traffic engineering and road safety
- Introduction to Fluid Mechanics and Environmental Engineering:
  - Fluid properties, Hydraulic structures, Environmental pollution and prevention, Public health, Importance of water and waste treatment.

Electrical Engineering:
- Introduction to Electrical Engineering
  - Fundamentals of Electrical Engineering
  - Fundamental Electrical Quantities
  - Fundamentals of Electronics and Devices
  - Overview of computers and the computing process
- Introduction to Communication Engineering System
  - Communication Systems
  - ISO/OSI Models
  - The Network
- Introduction Electrical Power Systems
  - Non-Renewable and Renewable Energy
  - Electrical Power Generation, Transmission, Distribution and Access
  - The Electrical Power Grid

Mechanical Engineering:
- Fundamentals of Mechanical Engineering, and application of engineering physics and materials science for design, analysis, manufacturing, and maintenance of mechanical systems.
- Machine elements, fundamentals of structural elements, mechanical elements and types of assemblies.
- Engineering Mechanisms, fundamentals of types of mechanisms and mechanical systems.
- Fundamentals of power sources, mechanisms and controllers.

Mining and Mineral Process Engineering:
- Components of Mining and Mineral process engineering.
- Exploration, feasibility studies, construction, development and production.
- Surface and underground mining, unit operations; drilling, blasting, loading, haul and dump.
- Geomechanics application to mine design. Ore reserve estimation. Open pit and underground mine design concepts.
- Basic concepts of mineral economics and its implications on long term and short term mine design.
- Introduction to mineral processing. Crusching, grinding and sorting.
- Process flow sheet design concepts. Selecting a process flow sheet based on ore mineralogy and geochemistry. Hydrometurllary concept in mineral concentration. Pyrometallurgy concept in mineral concentration.

Text Book:
Lecture notes given in class.

Assessment:
Continuous Assessment - 100%

EE102 COMPUTER PROGRAMING FOR ENGINEERS

Lecture Hours per week:	**1**
Tutorial Hours per week:	**1**
Laboratory Hours per week:	**1.5**

Credits: **9**

Prerequisite: EE101

Corequisite: none

Learning Outcomes:
1. Conceptualize engineering problems to computational problems
2. Code basic computing problems using the C language
3. Understand and apply fundamentals of program flow control
4. Recognize and apply basic modular programing
5. Realize and apply fundamentals of data structures

Syllabus:

Introduction to computer systems:
- Engineering problems as computational problems
- Overview of computer systems
- Software design

Introduction to C:
- Code build process (editing, compiling, linking, executing)
- Elements of a C program; pre-processor directives; statements and expressions; functions; coding formatting style
- Simple data types; constants and variables; conversion between different data types; binary arithmetic representations
- The IDE environment

Program flow control:
- Conditions; relational operators; logical operators; precedence rules; selection structures
- Repetition and loop statements; while statements; for statements; increment and decrement operators; loop termination; nested loops; do-while statements
- Debugging

Modular programming:
- User functions; library functions; function declaration and definition; function calls; pass by value; scope rules; programs with multiple functions
- Pointers and addresses; pass by reference; pointer arithmetic
- File input/output

Simple data structures:
- Arrays; declaration and initialization; multi-dimensional arrays; searching and sorting arrays; pointers and arrays
- String arrays; string library functions; substrings; concatenation; strings vs. characters
- Engineering applications; matrix algebra; numerical integration and differentiation; quadratic equations
- Recursion
- Structures; structures and functions; arrays of structures; dynamic data structures

Text Book:

1. Aaron R Bradely, *Programming for Engineers: A Foundational Approach to Learning C and Matlab,* Edition XIV, Springer, 2011.

Assessment:

Continuous Assessment	- 60%
Final Examination	- 40%(1x3 hours)

EE111 INTRODUCTION TO COMPUTING & PROBLEM SOLVING I

Lecture Hours per week:	**1**
Tutorial Hours per week:	
Laboratory Hours per week:	**2**
Credits:	**7**

Prerequisite: none

Corequisite: none

Learning Outcomes:
1. Describe the main units of a computer system.
2. Describe the functions and relationships of different computer units.
3. Explain Microsoft Windows operation-system structure and functions.
4. Demonstrate understand of the Microsoft Windows environment.
5. Use spreadsheet programs (both MS Office Excel and OpenOffice.org Calc) for engineering applications and graphics.
6. Create engineering data entry form with database program.

Syllabus:

Introduction to Computing:
- Basic computer architecture, information and data processing.
- Operating system: functionality, management and operations, Microsoft Windows

Spreadsheet application for engineering:
- Cell formatting
- Charts and graphics
- Mathematical equations and functions

Data Entry interface:
- Relational database: tables, relationships, forms, queries, reports, macros, switch board
- Exporting and importing other applications

- Security and privacy.

Text Book:
Lecture notes given in class.

Assessment:
Continuous Assessment - 100%

EE112 INTRODUCTION TO COMPUTING & PROBLEM SOLVING II

Lecture Hours per week: **1**
Tutorial Hours per week: **1**
Laboratory Hours per week: **1.5**

Credits: **9**

Prerequisite: EE111

Corequisite: none

Learning Outcomes:
1. Conceptualize engineering problems to computational problems
2. Code basic computing problems using the C language
3. Understand and apply fundamentals of program flow control
4. Recognize and apply basic modular programing
5. Realize and apply fundamentals of data structures

Syllabus:
Introduction to computer systems:
- Engineering problems as computational problems
- Overview of computer systems
- Software design

Introduction to C:
- Code build process (editing, compiling, linking, executing)
- Elements of a C program; pre-processor directives; statements and expressions; functions; coding formatting style
- Simple data types; constants and variables; conversion between different data types; binary arithmetic representations
- The IDE environment

Program flow control:
- Conditions; relational operators; logical operators; precedence rules; selection structures
- Repetition and loop statements; while statements; for statements; increment and decrement operators; loop termination; nested loops; do-while statements
- Debugging

Modular programming:
- User functions; library functions; function declaration and definition; function calls; pass by value; scope rules; programs with multiple functions
- Pointers and addresses; pass by reference; pointer arithmetic
- File input/output

Simple data structures:
- Arrays; declaration and initialization; multi-dimensional arrays; searching and sorting arrays; pointers and arrays
- String arrays; string library functions; substrings; concatenation; strings vs. characters
- Engineering applications; matrix algebra; numerical integration and differentiation; quadratic equations
- Recursion
- Structures; structures and functions; arrays of structures; dynamic data structures

Text Book:
1. Aaron R Bradely, *Programming for Engineers: A Foundational Approach to Learning C and Matlab,* Edition XIV, Springer, 2011.

Assessment:
Continuous Assessment - 60%
Final Examination - 40%(1x3 hours)

EE202 OBJECT ORIENTED PROGRAMMING

Lecture Hours per week: **2**
Tutorial Hours per week:
Laboratory Hours per week: **3**

Credits: **13**

Prerequisite: EE102

Corequisite: none

Learning Outcomes:
1. Understand the concepts of objects and classes.
2. Develop understanding of user-defined and predefined class (object) types.
3. Able to formulate algorithms, to solve problems and to implement those solutions using objects oriented concept.
4. Able to handle inheritance, encapsulation, polymorphism in programming.
5. Develop an understanding of class construction using subprograms such as methods with basic data input output capability.

Syllabus:
Principles of Object-Oriented Programming:
- Encapsulation
- Data Abstraction
- Polymorphism
- Inheritance

Beginning with C++:
- Binary arithmetic operators
- Shortcut arithmetic operators
- Evaluating Boolean expressions
- Performing operation on STRUCT fields

Abstract Data Types, Class and object:
- Encapsulating class components
- Methods in class

Dynamic Linkage — Generic Programming, Constructors and Destructors:
- introducing constructor and destructor

Single Inheritance and multiple inheritances:
- Base classes, sub classes, inherited objects.

Polymorphism:
- Application on polymorphism
- virtual function
- dynamic linkage
- member function

Function overloading and operator overloading:
- Multiple definitions for same function in the same scope.

Pre-defined classes and objects:
- Use pre-defined classes in C++.

Encapsulation:
- data hiding and encapsulation
- private, protected and public members

Textbook:
1. Robert Lafore, *Object Oriented Programming* in C++, Sams Publishing, 4th Edition, 2014.
2. Joyce Farrell, *Object-Oriented Programming Using C++*, CENGAGE Learning, 4th Edition, 2009.

Assessment:
Continuous Assessment – 60%
Final Examination - 40%(1x3hrs)

EE211 ELECTROMAGNETIC FIELDS AND WAVES

Lecture Hours per week:	**2**
Tutorial Hours per week:	**1**
Laboratory Hours per week:	**1.5**
Credits:	**13**

Prerequisite: none

Corequisite: EE213, EE237

Learning Outcomes:
1. Understand the nature of electromagnetism and the use of vector analysis for field representation and analysis.
2. Evaluate the electric field and electric potential due to electric charges and the application of Gauss's law
3. Evaluate the magnetic field using the Ampere's law and the magnetic force, including the effect of magnetic materials
4. Understand and apply Maxwell's equations for slowly time varying fields.
5. Apply electromagnetic field theory and concepts to electromagnetic sensors, devices and systems.

Syllabus:
The nature of electromagnetism:
- Electric fields
- Magnetic fields
- Static and dynamic fields
- Travelling waves

Vector analysis:
- Use vector algebra in Cartesian, Cylindrical and spherical coordinate systems
- Calculate the gradient of a scalar function
- Calculate the divergence and curl of a vector function
- Apply Divergence theorem and Stoke's theorem

Electrostatics field and electric potential:
- Evaluate the electric field and potential due to any distribution of electric charges
- Apply Gauss's law
- Calculate resistance
- Calculate capacitance
- Resistive and capacitive sensors

Magnetostatics:
- Calculate the magnetic field using Ampere's law
- Calculate magnetic forces of a current carrying conduct in a magnetic field
- Apply Biot-Savart Law to calculate magnetic field due to current carrying conductors
- Apply Ampere's law

Magnetic materials and energy:
- Explain magnetic hysteresis
- Calculate inductance
- Relate magnetic energy to magnetic field distribution

Maxwell's equation's:
- Faraday's law, Lenz's law and the transformer
- Displacement and conduction current, Charge-current continuity equation
- Stationary loop in a time varying magnetic field, Moving conductor in a time-varying magnetic field
- Wave equation and wave properties
- Attenuation and phase delay
- Reflection of plane waves

Textbook:
1. Hayt and Buck, *Engineering Electromagnetics*, McGraw Hill
2. Hoole, Pirapaharan and Hoole, *Electromagnetics Engineering Handbook*, WIT-UK, 2013
3. JA Edminister, *Shaum's Outlines on Electromagnetics*, McGraw Hil

Assessment:

Continuous Assessment – 40 %
Final Examination - 60 %(1x3hrs)

EE213 CIRCUIT THEORY

Lecture Hours per week: 4
Tutorial Hours per week: 1
Laboratory Hours per week:

Credits: 20

Prerequisite: none

Corequisite: EE237

Learning Outcomes:
1. Understand fundamental concepts of Electrical Engineering
2. Understand and apply circuit laws to solve current and voltage as well as calculate power in DC circuits
3. Understand and apply circuit theory to solve steady state current and voltage as well as calculate real and reactive power in AC circuits.
4. Understand and apply circuit theory to solve steady state current and voltage as well as calculate real and reactive power in three phase balanced circuits
5. Analyse transient current and voltage characteristics in first order and second order circuits.
6. Simplify circuits into port network

Syllabus:
Basic Circuit Theory
- Circuit parameters
- Ohm's law
- Kirchoff's laws
- Voltage sources, current sources
- Node analysis
- Loop analysis
- Superposition
- Thevenin's and Norton's Theorems
- Maximum power transfer
- Energy storage elements in the network:
  - Capacitors
  - Inductors

Transients
- First-order RC series circuit
- First-order RL series circuit
- Second-order series RLC circuits
- Second-order parallel RLC circuits

AC Circuit Analysis
- Phasors and Phasor diagrams
- Complex-number notation
- AC circuit elements reactance, admittance, conductance, susceptance
- Analysis Techniques
- Power Calculations
  - Instantaneous power
  - Average power
  - Effective of RMS Values
  - Power factor
  - Complex power
- Using Fourier techniques
  - Fourier series
  - Fourier transform

Three-Phase Circuit Analysis
- Balanced three-phase circuits
- Star-delta and delta-star transformation
- Power relationships

Two-Port Networks
- Admittance parameters
- Impedance parameters
- Hybrid parameters
- Transmission parameters
- Interconnection of two-ports

Textbook:
1. J. David Irwins, R. Mark Nelms, *Basic Engineering Circuit Analysis*, Wiley-India Edition 9th Ed, 2008.
2. Boylestad, R. L, *Introductory Circuit Analysis,* 12th Edition, Prentice Hall, 2010.

Assessment:
Continuous Assessment – 40%
Final Examination - 60% (1x3hrs)

EE214 SIGNALS AND SYSTEMS

Lecture Hours per week: 2
Tutorial Hours per week: 1
Laboratory Hours per week: 1.5
Credits: 13

Prerequisite: EE102, EE213, EE237, MA235

Corequisite: none

Learning Outcomes:
1. Understand basics of mathematical representation and classification of signals and systems, and how signals can be represented by a continuum of impulses
2. Apply the basic concepts of sinusoidal signals to obtain the frequency spectrum and apply to sampling and aliasing.
3. Design and implement FIR filters as Linear Time Invariant (LTI) systems and perform the process of convolution
4. Obtain and apply the frequency response of FIR Filters
5. Understand and apply z-transforms to design FIR and IIR filters
6. Learn how to obtain the impulse response from the step response for continuous time signals.

Syllabus:
Mathematical representation of signals and systems and sinusoids:
- Mathematical representation of signals
- Mathematical representation of systems
- Classification of signals
- Sinusoidal signals

Spectrum Representation:
- Spectrum of a sum of sinusoids
- Periodic waveforms
- Fourier series
- Frequency analysis of Periodic signals
- Frequency modulation

Sampling and Aliasing:
- Sampling and reconstruction
- Discrete to Continuous conversion

FIR Filters:
- Discrete Time systems
- Running average and general FIR Filters
- Implementation of FIR Filters
- Linear Time Invariant Systems
- Convolution
- Sinusoidal response of FIR systems
- Properties of frequency response
- Running average filtering

z-Transforms:
- Definition of z-transform
- z-transform and Linear Systems
- Properties of z-transform
- Convolution with z-transform
- Useful filters

IIR Filters:
- General IIR differential equation
- Time-domain response
- Poles and zeros

LTI Systems and Continuous Time Signals:
- Continuous time signals
- Unit impulse
- Linear Time invariant systems

Textbook:
1. A Oppenheim and A. Wilsky with S. Hammid Nawab, *Signals and Systems*, Prentice Hall
2. H. Hsu, *Signals and Systems*, McGraw-Hill
3. PRP Hoole, *Smart Antennas and Signal Processing: for Communication, Radar and Medical Systems*, WIT-UK, 2001

Assessment:
Continuous Assessment – 40 %
Final Examination - 60 %(1x3hrs)

EE221 DIGITAL LOGIC SYSTEMS

Lecture Hours per week:	**2**
Tutorial Hours per week:	**1**
Laboratory Hours per week:	**1.5**
Credits:	**13**

Prerequisite: MA167, MA168, PH142

Corequisite: none

Learning Outcomes:
1. Interpret, convert, and represent different number systems and binary arithmetic.
2. Manipulate and examine Boolean algebra, logic operations, Boolean functions and their simplifications.
3. Design and analyse combinational logic circuits.
4. Design and analyse sequential logic circuits.
5. Represent a logic circuit design problem using finite-state machines (FSM).

Syllabus:

Digital systems:
- Digital computers and digital systems
- Binary, octal and hexadecimal number systems
- Complements
- Signed binary numbers
- Decimal and binary codes Introduction to binary logic

Boolean algebra:
- Basic definitions
- Theorems and properties of Boolean algebra
- Boolean functions
- Standard forms of Boolean functions
- Logic operations

Simplification of Boolean functions:
- Karnaugh map method
- Don’t care condition
- NAND and NOR implementation
- Exclusive-OR function

Combinational circuits:
- Analysis and design procedures
- Digital encoder, decoder, multiplexer and de-multiplexer and their application to realise a Boolean function
- Adders and Subtractors
- Multilevel NAND/NOR circuits and code conversion

Analysis of synchronous sequential circuits:
- Flip-flops
- Analysis of clocked sequential circuits
- State reduction and assignment

Design of sequential circuits:
- Flip-flop excitation tables
- Design procedures
- Counter designs
- Simplification of finite state machines

Registers, counters and memory devices:
- Shift registers
- Ripple counters
- Synchronous counters
- Timing sequences and Random Access Memory (RAM)

Algorithmic State Machines (ASM):
- ASM chart, timing issues

- Data and control aspects of ASM design procedures

Textbook:
1. M.M. Mano and M.D.Ciletti, *Digital Design*, , Prentice Hall, 4th edition, 2010.
2. Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with Verilog Design*, , McGraw-Hill, 3rd edition, 2009.

Assessment:
Continuous Assessment – 40 %
Final Examination - 60 %(1x3hrs)

EE222 APPLIED ANALOGUE ELECTRONICS

Lecture Hours per week:	**3**
Tutorial Hours per week:	**1**
Laboratory Hours per week:	**1.5**
Credits:	**18**

Prerequisite: EE213, MA235

Corequisite: none

Learning Outcomes:
1. Describe the formation of the p-n junction via energy level diagrams and physical structure.
2. Apply p-n junction diodes in circuits such as rectifiers.
3. Describe the structure, biasing and application of the BJTs.
4. Apply and analyse BJT as an amplifier.
5. Apply Operational amplifiers for different applications.
6. Analyse the analogue devices.

Syllabus:
Theory and the P-N Junction:
- Review of the atomic structure and bonding
- Covalent bonded structures in semiconductor
- Charge carriers and Energy levels
- Energy level diagrams
- Doping; n-type and p-type semiconductors
- Drift and Diffusion currents
- The P-N Junction
- P-N junction at Thermal Equilibrium
- Junction capacitance

P-N Junction Diodes and applications:
- P-N junction diode
- Characteristic curve of the p-n junction diode
- Type of diodes and respective applications
- Rectifier circuits: full and half wave rectifier circuits.
- Voltage regulators

Operation and biasing of BJTs and relevant applications:
- The Bipolar Junction Transistor (BJT)-NPN, PNP
- Biasing the transistor
- BJT operation characteristics
- Transistor as a switch

BJT as an amplifier:
- BJT transistor amplifier configurations: common-emitter, -collector, and -base
- Equivalent circuit models
- Gain and Impedance
- Common Emitter, Collector, and base amplifiers
- Power amplifiers: Class A, B, AB and C
- Class AB amplifier analysis

Operation Amplifiers:
- Op amp operation
- Differential amplifier
- Inverting amplifier
- Non-inverting amplifier

Analogue Devices:
- Filters
- Oscillators
- Feedback circuits

Textbook:
1. Thomas Floyd, *Digital Electronics*, Pearson Publication 9th Ed, 2008.
2. Paynter, Robert, *Introductory Electronic Devices and Circuits*, Prentice Hall, 7th Ed, 2005.

Assessment:
Continuous Assessment – 40 %
Final Examination - 60 %(1x3hrs)

EE237 APPLICABLE MATHEMATICS FOR ELECTRICAL ENGINEERS

Lecture Hours per week: 1
Tutorial Hours per week: 1
Laboratory Hours per week:

Credits: 6

Prerequisite: MA167, MA168

Corequisite: MA235

Learning Outcomes:
1. Understand the composition and mathematical background of Fourier Series
2. Understand the usage of Fourier Transform and its inverse
3. Be familiar with calculating with complex numbers on the complex plane.

Syllabus:
Fourier Series:
- Exponential series
- Sine/cosine series
- Coefficient characteristic with
  - Even function
  - Odd function

Fourier Transform:
- Fourier transform
- Inverse Fourier transform

Complex Analysis:
- From Algebra to Geometry and Back
- Geometric Properties
- Elementary Topology of the Plane
- Differentiation, Integration
  - Definition and Basic Properties
  - Anti-derivates
  - Cauchy's Theorem
  - Cauchy's Integral Formula

Text Book:
1. E. Kreyszig *Advanced Engineering Mathematics,* Wiley, 9th Edition, 2006.
2. J. Bak, Donald J. Newman, *Complex Analysis,* Springer, 3rd Edition, 2010.

Assessment:
Continuous Assessment - 40%
Final Examination - 60%(1x3 hours)

EE241 COMPUTERS AND SOFTWARE ENGINEERING

Lecture Hours per week: 3
Tutorial Hours per week:
Lab (Project) Hours per week: 1

Credits: 15

Prerequisite: EE111, EE112

Corequisite: EE221

Learning Outcomes:
1. Outline the basic functions of an operating system, such as file management, task management, user access and I/O management, and provide examples of each from popular operating systems such as DOS and UNIX.
2. Describe why formal system specification and design procedures are required throughout engineering before solutions are attempted.
3. Identify where the main costs of systems development are, and how to minimise those costs.
4. Recognise the main phases of the software life cycle.
5. Detail the characteristics of real-time systems and the special problems faced by designers of real-time systems.
6. Use a variety of formal system specification techniques, including flow charting, structured design and object oriented design methods.
7. Identify variable types such as integers, floating point, characters, strings, structures and pointers to each of these types and explain the need for such a diversity of variable types.
8. Develop simple algorithms and accompanying documentation for the solution of a number of problems involving data input, calculations, data sorting and structured data output.
9. Successfully complete a number of programming assignments in a HLL which implement the above algorithms.
10. Demonstrate competence in the operation of the MATLAB analysis package, by successfully completing a number of assignments in variable declaration, matrix manipulation, polynomial factorisation and elementary curve plotting and printing.

Syllabus:
Introduction to the basics of software engineering.
Principles of software system requirements, from the analysis of problems to the documentation of solutions, including specification, design, coding and maintenance.
Examples are given using a HLL (High Level Language).
Operating system functions.
Examples from widely used commercial systems such as the UCSD P-system, DOS and Unix.
Developing soft skills using MATLAB as a tool.

Textbook:
1. Fitzpatrick, J. M., Ledeczi, A., Computer Programming with MATLAB, MathWorks, Australia, 2013.

Assessment:
Continuous Assessment - 40%
Written Examination - 60% (1 x 3 hrs)

EE252 ELECTRICAL MACHINES

Lecture Hours per week: **2**
Tutorial Hours per week: **1**
Lab (Project) Hours per week: **1.5**

Credits: **13**

Prerequisite: EE213

Corequisite: none

Learning Outcomes:
1. To familiarize the constructional details, the principle of operation, prediction of performance, the methods of testing the single phase transformers and auto transformers and their connections.
2. To introduce the principles of electromechanical energy conversion in singly and multiply excited systems.
3. To study the working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed.
4. To study the working principles of DC machines as Generator and Motor types, determination of their no-load/load characteristics, starting and methods of speed control of motors.

Syllabus:
Single-phase Transformers:
- Construction of transformer
- Ideal transformer
- Non-ideal transformers
- Voltage regulation
- Maximum efficiency criterion
- Transformer parameters
- Per unit computation

Autotransformers:
- The autotransformer

DC generators:
- Mechanical construction, windings
- Induced emf equations
- Developed torque
- Magnetization characteristics
- Armature Reaction
- Types of DC Generators
- Voltage regulations
- Losses in DC generators
- Separately excited DC generators
- Shunt, series and compound excited generators
- Maximum efficiency criterion

DC motors:
- Introduction
- Operation of a DC motor
- Speed regulation
- Losses in a DC motor
- Types of DC motor
- Methods of speed control
- The Ward-Leonard system
- Torque measurement
- Braking/Reversing a DC Motor

Textbook:
1. B. S. Guru and M.R. Hiziroglu, *Electric Machinery & Transformers* 3rd Edition, Oxford University Press, 2003.
2. George McPherson and Robert D. Lueamore, *An Introduction to Electrical Machines and*

Transformers, 2nd Edition, John Wiley & Sons, Inc. 1990

Assessment:
Continuous Assessment – 40%
Final Examination - 60%(1x3hrs)

EE264 PRINCIPLES OF ELECTRICAL ENGINEERING FOR MECHANICAL ENGINEERS

Lecture Hours per week:	**3**
Tutorial Hours per week:	**1**
Laboratory Hours per week:	**1.5**
Credits:	**18**

Prerequisite: none

Corequisite: none

Learning Outcomes:
1. Understand basic AC and DC circuits
2. Understand single and three phase circuits and their operation
3. Understand AC and DC machines and controls
4. Understand the basic construction principles of AC generators and applications
5. Be familiar with different types of transformers, regulators and electrical generators when exposed to industry
6. Be familiar with the determination of different size/capacity of electrical machines

Syllabus:
Direct Current (DC):
- Direct Current circuits
- Primary and Secondary cells
- DC generators
- DC motors and controls
- DC machine windings

Alternating Current:
- Single phase circuits
- Three phase circuits
- Electromagnetic induction
- Transformers and regulators
- Alternating current generators
- Single phase motors.
- Synchronous motors and self-synchronous apparatus

Text Book:
1. Michael, A, *Electric Circuits and Machines,* 4th Edition, McGraw Hill Book Company, NY 1977.

Assessment:
Continuous Assessment - 60%
Final Examination - 40%(1x3 hours)

EE 311: SIGNALS & SYSTEMS

Lecture hours per week:	**3**
Tutorial hours per week:	
Laboratory hours per week:	**1**
Credits:	**15**

Prerequisite: MA235, MA236, EE211

Learning Outcomes:
The main objective is to provide an in depth foundation on the mathematical tools and techniques used in the study of Linear Systems. The course will build a sound background in Discrete Time and Continuous Time Linear Systems required for more advanced courses in the area of Electronics & Communication, Computer Science & Engineering and Control System & Power Engineering.

Syllabus:
Signals: Definition, classification, transformation of independent variables, basic continuous time (CT) and discrete time (DT) signals. Representation of an arbitrary signals by linear combination of the basic signals. Systems: definition, properties and classification of systems.
Linear Time-Invariant (LTI) Systems: Impulse response, convolution integral and summation, properties of LTI systems, causality and stability conditions. System described by linear constant coefficients differential and difference equations.
Fourier Techniques: Eigenfunction of LTI systems. Fourier series using complex exponentials.
Fourier transforms (FT): Definition and

properties. FT of periodic signals. Use of FT in analysis of linear systems - frequency response.
Laplace Transform (LT): Bilateral LT and region of convergence (ROC). Properties of LT. Relationship with FT. Use of LT in study of LTI systems-transfer function, poles and zeros, frequency response, stability.
Sampling of CT Signals: Sampling theorem. Reconstruction of signal from its sampled values.
Fourier Transform (FT) of Discrete Time Signals: Periodic spectrum. Brief introduction of DFT and FFT.
z-Transform: Definition, ROC, properties. Transfer function of DT system pole and zeros, stability, frequency response. Relationship with FT.
Introduction to Filters:
Ideal filters, type and degree of approximations. Butterworth, Chebysev, elliptic and computer aided approximations. Butterworth low pass filter function.

Introduction to Random Signals: Random variables, statistical averages, random process, and response of LTI systems to random signal input.
Use of Computer Tools: Students may be introduced to software tools (like MATLAB) in the evaluation of convolution, impulse response, magnitude and phase response of LTI systems through assignments.

Text Books:
A.V. Oppenhime, A.S. Willsky and I.T. Young, Signals and Systems, Englewood Cliffs, N.J.: Prentice Hall, 1983.
C.D. McGillen and G.R. Cooper, Continuous and Discrete Signal and System Analysis, New York, Holt Rinehart and Winston, 1984.

Practicals - computer simulations 12 hours

Assessment:
Continuous assessment - 40%
Written examination - 60% (1x3 hrs)

EE 321: ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Lecture hours per week: 2
Tutorial hours per week:
Laboratory hours per week: 1

Credits: 10

Prerequisite: EE211, EE212

Learning Outcomes:
On completion ofthis subject, the students should be able to:-
1. Define, explain and calculate errors: absolute, relative, systematic, FSD and random errors.
2. Explain principle of operationand applications of moving coil, moving iron, dynamometer and induction instruments.
3. Explain principle of operation and applications of current transformer (CT) and voltage transformer (VT).
4. Measure power in single and three phase systems, for balanced and unbalanced load and for any waveshape, using dynamometer wattmeters.
5. Use current and voltage transformers for three phase measurements and protection applications.
6. Use bridges for RCL measurements.

Syllabus:
Accuracy of measurements.Errors:absolute, relative, systematic, random, FSD error.Error of complex method.Error calculations.Moving coil instruments.Moving iron instruments.Dynamo-meter instruments.Dynamometer wattmeter.Induction instruments.Energy meter.Instrument transformers.Single and three phase power and energy measurements.DC and AC bridges.
Practical Sessions:4 x 3 hours

Textbook:
Gregory, B.A., An Introduction to Electrical Instrumentation and Measurement Systems,Macmillan,1982.

Assessment:
Continuous assessment - 100%

EE 331: TELECOMMUNICATION PRINCIPLES I

Lecture hours per week: 3
Tutorial hours per week:
Laboratory hours per week: 1

Credits: 15

Prerequisite: EE233, EE234

Corequisite: EE311

Learning Outcomes:
1. Understand and apply the principles of sampling, information content and information rate.
2. Understand and apply the concepts of information transmission through digital signal via pulse code modulation.
3. Understand and analyze Digital Multiplexing Techniques.
4. Understand and apply the use of lumped and distributed parameters in transmission lines.
5. Analyze transmission line parameters for lossy and lossless lines using direct calculation and the Smith chart.
6. Understanding wave equation and apply in plane-waves.

Syllabus:
Analogue to Digital Conversion
- Sampling (Nyquest Theorem)
- Quantization
- Line coding
- Source Coding (PCM)

Information Theory
- Information measure
- Shannon Law
- Channel capacity & Ideal communication
- Data rate
- Throughput

Multiplexing Methods
- FDM
- TDM

Transmission Lines
- Transmission line model
- Current and voltage derivation in terms of line parameters
- Lossless lines
- Lossy lines
- Reflection coefficient/SWR
- Power transfer
- Use of the Smith Chart

Plane-Waves
- Wave equation
- Electric and Magnetic field relationships
- Power calculations
- Reflection and transmitted components

Textbook:
1. Haykin, S, *Analogue and Digital Communications*, 2nd Edition,John Wiley & Sons, 2007
2. David J. Griffiths, *Introduction to Electrodynamics*, 4th edition , Prentice Hall, 2012

Assessment:
Continuous Assessment - 40%
Written Examination - 60%(1x3hrs)

EE 332: TELECOMMUNICATION PRINCIPLES II

Lecture hours per week: 3
Tutorial hours per week:
Laboratory Hours per week: 1

Credits: 15

Prerequisite: EE233, EE234, EE331

Learning Outcomes:
On completion ofthis subject, students should be able to:

1. Apply and Analyse the conventional AM, DSB-SC and SSB-SC modulation and demodulation principles in time and frequency domain.
2. Apply and Analyse the Frequency and Phase Modulation principles in time and frequency domain.
3. Model noise as an random signal and analyse noise models in time and frequency domain
4. Apply signal-noise calculations in analogue communication.

Syllabus:
Amplitude Modulation:

- Conventional amplitude Modulation
- Limitations in Amplitude Modulation
- DSB-SC modulation
- SSB-SC modulation
- Modulation and demodulation methods in various AM
- Power calculation of carrier and sidebands
- Time and Frequency domain analysis of AM signals

Angle Modulation:
- Properties of Angle-Modulated waves
- Relationship between PM and FM waves
- Narrow-Band Frequency Modulation
- Wide-Band Frequency Modulation
- Transmission bandwidth of FM waves
- Generation of FM waves
- Demodulation of FM waves

Random signal and Noise:
- Probability and Random variable
- Transformation of Random variables
- Gaussian Random Variable
- Spectra of Random Signal
- White Noise
- Narrowband Noise

Noise in Analogue Communication:
- Noise in Communication System
- Signal-to-Noise Ratio
- Noise in AM Receiver Using Envelop Detection
- Noise in SSB Receivers
- Detection of Frequency Modulation
- FM Pre-emphasis and De-emphasis

Textbook:
S. Haykin& M. Moher, "Introduction to Analog and Digital Communications", 2nd Edition, John Wiley & Sons, 2007.

Assessment:
Continuous Assessment - 40%
Final Examination- 60%(1x3hrs)

EE 341: COMPUTER ARCHITECTURE

Lecture hours per week: 3
Tutorial hours per week:
Laboratory hours per week: 1

Credits: 15

Prerequisite: EE241, EE242

Corequisite:

Learning Outcomes:

1. Describe the Von Neumann architecture and be able to detail the subsystems found in modern PC architectures.
2. Discover the working components of a microprocessor; defining the CPU instruction set and hardware resources.
3. Analyse the interactions between CPU, memory and I/O subsystems.
4. Provide a detailed description of the function of a number of commercially available 16 and 32 bit microprocessors and their bus systems, including their memory and I/O architectures.
5. Differentiate between software and hardware interrupts and explain the function of interrupt vector tables.
6. Describe and analyse the system design for the IBM PC, at a hardware and firmware level. This will include basic hardware design, BIOS structure, major subsystem interface requirements as well as the DOS disk structure.

Syllabus:
Computer architectures, hardware and software.CPU, ALU, memory, I/O.Bus architectures, I/O structure, interrupts.The inner workings of an IBM PC.

Textbook:
Mazidi, M.A., Mazidi, J.G., Causey, D. The x86 PC: assembly language, design and interfacing, 5th Edition, Prentice Hall, 2010

Assessment:
Continuous Assessment - 40%
Written Examination - 60%(1x3hrs)

EE342 INTERFACING TECHNIQUES

Lecture hours per week: 1
Tutorial hours per week:
Laboratory hours per week: 2

Credits: 7

Prerequisite: EE241, EE242, EE341

Corequisite:

Learning Outcomes:
1. Identify the difference between serial, parallel, synchronous and asynchronous interfaces, and provide a number of examples of each type.
2. Describe various analog to digital and digital to analog conversion techniques.
3. Provide the design for a number of simple digital interfaces, using memory mapping, software polling, hardware and software interrupt techniques.

Syllabus:
Introduction to microprocessor interfacing techniques.Microprocessor control of analog and digital equipment.Sensors in feedback systems.Digital I/O interfacing.A/D and D/A conversion.In addition, there is a number of assignments on interfacing analog and digital devices to the IBM PC, including the writing of simple software routines to operate the interface.The interfaces implement A/D and D/A functions, simple open and closed loop motor speed control, and a temperature controller.

Textbook:
Mazidi, M.A., Mazidi, J.G., Causey, D. The x86 PC: assembly language, design and interfacing, 5th Edition, Prentice Hall, 2010

Assessment:
Continuous Assessment - 100%

EE 343: COMPUTER HARDWARE

Lecture hours per week: 3
Tutorial hours per week:
Laboratory hours per week:

Credits: 13

Prerequisite:

Corequisite:

Learning Outcomes:
1. Describe the principle components and peripherals of a computer system
2. Analyse how each component functions individually and as a system.
3. Diagnose and repair basic faults.
4. Describe the exchange of data between computer systems in a networks.

Syllabus:
Von Neumann architecture, milestones in computer architecture. Mother board and contents. CPU organisation; memory:-cache, main secondary. Arithmetic and logical units. Control of processing, memory management. Input, output, terminals, modems, mice, printers, font sets. Bus architecture, examples of bus systems, examples of modem chips, interfacing, interrupts. Basic diagnostics and fault finding for microcomputers. Networking and communications, protocols, reliability, costs, interfaces, multiplexors'. Data communication, network hardware.

Textbook:
Tanenbaum& Austin, Structured Computer Organisation, Prentice Hall, 6th Ed., (2013).

Assessment:
Continuous Assessment: 50%
Examination: 50%

EE 351: ELECTRICAL MACHINES II

Lecture hours per week: 3
Tutorial hours per week:
Laboratory hours per week: 1

Credits: 15

Learning Outcomes:
On completion ofthis subject, students should be able to:-

1. Understand the concept of rotating magnetic field produced by 2-phase and 3-phase currents.
2. Know the constructional details of cylindrical rotor and salient pole synchronous machines.
3. Solve problems using the simple equivalent circuit of the synchronous machine.
4. Draw the phasor diagram of the synchronous machine operating as a motor or generator at lagging, leading and unity power factors respectively.
5. Evaluate the synchronous impedance and short circuit ratio of the machine from the open-circuit and short-circuit tests.
6. Develop the power-angle equation of the synchronous machine, and to determine its maximum power limit.
7. Draw the phasor diagram and develop the power-angle relations of a salient-pole machine using the two-reaction theory.
8. Know the constructional features of the induction motor.
9. Solve problems on induction motor based on its equivalent circuit and phasor diagram.
10. Establish the relationship; rotor input: copper loss: output 1:s:(1-s).
11. Discuss the torque-speed curve, determine the maximum torque, and the slip at which it occurs, and the effect of rotor resistance on torque-speed characteristic.
12. Determine the effects of star-delta, auto-transformer, and rotor-resistance starters on starting torque and starting current of the induction motor.
13. Know the principle of operation of solid state drives for induction motors, e.g., squirrel-cage motor with AC power controller and with inverter.

Syllabus:
The Three-Phase Synchronous Machine: Constructional type, rotating magnetic field, e.m.f. equation including winding pitch and distribution factors. The Three-Phase Synchronous Generator: Winding, generator operation, armature reaction, phasor diagram: o/c, s/c tests, two-axes theory, parallel operation.Short-circuit transients, various reactances and time constants. The **Three-Phase Synchronous Motor:** Principle of operation, phasor diagram, starting, V-curves, torque-angle characteristics.
Fractional KW Motors:
Single-phase induction motors:Theory and performance, starting methods, split-phase, capacitor start/run; and shaded-pole arrangements and applications, starting and running performance, testing of small motors.
Induction Motor:
Basic theory and construction, windings, phasor diagram and equivalent circuit, torque-speed characteristics, testing, starting and speed control, principle of operation of solid state drives for induction motors, variable speed a.c machines.
Practical sessions:6 x 3 hours

Textbooks:
Fitzgerald, Kingsley &Umans:Electric Machinery, McGraw Hill, 4th Edition, 1983.
Slemon, G.R., Electric Machines and Drives, Addison Wesley,1982.

Assessment:
Continuous Assessment - 40%
Written Examination - 60% (1x3 hrs)

EE352 ELECTRICAL POWER SYSTEMS I

Lecture Hours per week: 2
Tutorial Hours per week: 1
Laboratory Hours per week: 1

Credits: 12

Prerequisite: EE103, EE212

Corequisite: none

Learning Outcomes:

1. Analyse power systems electrical networks using basic device models and circuit theory.
2. Describe the core components of electrical power systems (generation, transmission and distribution).
3. Use software (Matlab or Mathcad) to analyse and model l transmission line parameters.

4. Describe the main components of the broader power system operations (including utilization and protection).
5. Sizing the low voltage system during the planning of the electrical network of a typical household customer.

Syllabus:
Introduction, Fundamentals:
- History of Electric Power System
- Structure of Electric Power System
- Subscript Notations
- DC vs. AC Power
- Phasors
- Single and Three Phase Power Circuits
- Complex Power

Calculation Methods:
- Calculating on Common Voltage Level
- Per Unit Representation of Systems and Circuit Analysis

Power Transformers:
- The Ideal Transformer
- Equivalent Circuit for Practical Transformers
- Connection Types and Phase Shift
- Per Unit Equivalent Circuits for Transformers
- Three-Winding Transformer
- Autotransformers

Transmission Lines:
- Transmission Lines Design Considerations
- Line Resistance and Shunt Conductance
- Line Inductance
- Series impedances
- Line Capacitance
- Shunt admittances
- Parallel circuit three phase lines

Transformers:
- Construction
- Three-phase connections
- Polarity, phase shift, vector groupings
- Parallel operation, on-load tap changing.

Switching devices:
- Circuit breakers
    - Arc extinction, general construction of different types
    - Auxiliary equipment, testing, rating
- Disconnectors

Utilisation:
- Earthing Requirements & Techniques
- Hazardous Installation & Safe Wiring Practices

Text Book:
1. Glover J.D, Sarma M.S. and Overbye T.J, *Power System Analysis and Design,* Cengage Learning, 5th Edition, 2012.
2. Weedy B.M. and Cory B.J., *Electric Power Systems,* John Wiley, 4th Edition, 2012.
3. Elgerd O.I, *Electric Energy Systems Theory – An Introduction,* McGraw Hill, 2nd Edition, 2014

Assessment:
Continuous Assessment - 40%
Final Examination - 60%(1x3 hours)

EE 361: CONTROL SYSTEMS I

Lecture Hours per week: **2**
Tutorial Hours per week:
Laboratory Hours per week **1**

Credits: **10**

Prerequisite: EE241, EE252

Corequisite: EE311, MA333

Learning Outcomes:
On completion ofthis subject, students should be able to:-
1. Understand the fundamentals and operation of open and closed-loop control systems.
2. Apply MATLAB in the programming and simulation of first and second order control systems.
3. Derive mathematical models of first and second order control systems using ordinary differential equations, transfer functions, block diagrams and signal flow graphs.
4. Derive mathematical models of simple RLC electric circuits, mechanical translational and rotational systems.
5. Derive mathematical models of d.c. generator and system with gearing.
6. Design a closed-loop control system of the

required accuracy.

Syllabus:
Introduction to control concepts:
Open and closed-loop systems.
Computer simulation methods:
BCSSP and PC MATLAB programming.
Mathematical modelling:
Ordinary differential equations, Laplace Transform applications, transfer function, block diagrams. Mathematical modelling of electric RCL circuits and mechanical translational systems. First and second order systems.
System sensitivity to disturbances:
Closed-loop vs open loop systems.Closed-loop system design. Mathematical modelling of mechanical rotational systems. Model of d.c. generator. Model of a system with gearing.
Practical Sessions: 6 x 3 hours

Textbook:
Ogata, K., Modern Control Engineering, Prentice-Hall, 1990.

Assessment:
Continuous Assessment - 40%
Written Examination- 60% (1x3 hrs)

EE 362: CONTROL SYSTEMS II

Lecture hours per week: **3**
Tutorial hours per week:
Laboratory hours per week: **1**

Credits: **15**

Prerequisite: EE311, MA333, EE361

Learning Outcomes:
On completion ofthis subject, students should be able to:-

1. Derive the mathematical models of dc servo-motor position and speed control systems.
2. Apply MATLAB in the analysis of the time response of first and second order control systems.
3. Derive mathematical models of first and second order control systems using Laplace Transform method.
4. Apply Routh and s-plane method for control system stability determination.
5. Design and determine the stability of control systems in the frequency domain using Nyquist diagram and Bode plots
6. Evaluate system operation and design of closed-loop control system using MATLAB programme.

Syllabus:
Mathematical modelling of servo-motor, position control system and speed control system.Transient response analysis of first and second order systems for step, impulse and ramp input. Analytical solution using Laplace Transform. Graphical interpretation. Position control system investigation using computer simulation (PC MATLAB).Position control system design and optimization using PC MATLAB. Types of controllers: PD, PI, PID control. Position control system with P, PI and PID controllers.Velocity feedback.Error analysis. Stability analysis: Stability in s-plane Routh stability.Frequency response analysis. Nyquist diagram and Bode plots. Gain and phase margins. Frequency response using MATLAB. Compensation techniques.

Practical Sessions: 3 x 6 hours

Textbook:
Ogata, K., Modern Control Engineering, Prentice-Hall, 1990.

Assessment:
Continuous Assessment - 40%
Written Examination - 60% (1x3 hrs)

EE 372: COMPUTER AIDED ENGINEERING

Lecture hours per week:
Tutorial hours per week:
Laboratory hours per week: **2**

Credits: **3**

Prerequisite: EE233, EE234, EE261, EE262

Learning Outcomes:
On completion ofthis subject, students should be able to:-
1. use a number of electrical design aids in the course of their everyday work.
2. Produce a detailed plan for a project including the identification of suitable project milestones, estimates of time required, materials costs and projected benefits accrued from its completion.
3. Successfully complete a project from a detailed proposal, using a project plan as identified above followed by an oral presentation and a written project report.

Syllabus:
This course introduces students to a number of electrical engineering design and simulation packages.For the first part of the course, students are exposed to a PCB layout package and a circuit simulator.They are required to complete a number of assignments using these packages.In addition students will undertake a major project (8 weeks or more), requiring a written report and a 15-20 minute talk on their experiences.This course will act as a springboard to the final year by introducing students to a range of engineering techniques; and to the methods of project planning, time management, report writing and confidence building through verbal and written presentation of results.

Assessment:
Continuous assessment - 100%

EE 382: INDUSTRIAL ELECTRONICS AND COMPUTER CONTROL

Lecture Hours per week: 2
Tutorial Hours per week: 0
Laboratory Hours per week 1

Credits: 10

Prerequisites: Nil

Learning Outcome
To develop an understanding of the electronic devises and circuits, electronic analogue and digital measuring instruments such as transducers and PC based instruments and microcomputer control and applications.
On the completion of the subject, the student should be able to:-
1. Understand the fundamental principles of electronic devices and circuits and their applications.
2. Understand the principles of operation of electronic analogue and digital instrumentation.
3. Understand the operation of PLC based instrumentation systems.
4. Understand the construction, logic and operation of Programmable Logic Controller (PLCs)
5. Understand the application of PLCs for control of various industrial processes in manufacturing industries.
6. Design industrial process control using flow charts, PLC wiring diagram and PLC Ladder diagram programs.

Syllabus:
Electronic devices and circuits, analogue and digital circuits and techniques, electronic measurements and control; micro-computer control and applications; Principles of Engineering instrumentation; transducers and instrumentation systems, PC based instrumentation; PLC – Programmable Logic Controllers with its construction and its application using various languages such as Boolean Statements, Static logic and Ladder diagrams. Emphasis may be placed on logical thinking and efficient, logical program development.

Textbook:
Newman, M., Industrial Electronics and Controls, John Wiley & Sons, New York, 1986.

Reference:
Ramsay, D.C., Principles of engineering Instrumentation, Halstead Press, New York, 1996.

Assessment:
Continuous Assessment - 60%
Written Examination - 40% (1x3 hrs)

EE 398: ELECTRICAL ENGINEERING FOR MINING

Lecture hours per week: 3
Tutorial hours per week:
Laboratory hours per week: 1

Credits: 15

Objective:
On completion ofthis subject, students should be able to:-
1. Describe the main features of electric power generation, transmission and distribution.
2. Discuss the problems of electrical installations in mines.
3. Describe methods of measurement in mining applications.

Syllabus:
Introduction to electric power generation, transmission and distribution systems. Motor characteristics, theory and control and application in mining. Special problems of electrical equipment in mines, flame proofing, intrinsic safety, earth leakage protection.Concepts of instrumentation in mining. Control systems. Telemetry in instrumentation. Electrical safety regulations in mines.Transducers.

Textbook:
Cummins, A.A., and Giuen, I.A, (eds.) SME Mining Engineering Handbook, SME, NY 1973.
Assessment:
Continuous assessment- 50%
Written examination - 50% (1x3 hrs)

EE 402: THE PROFESSIONAL ENGINEER

Lecture hours per week: 2
Tutorial hours per week:
Laboratory hours per week:

Credits: 9

Learning Outcomes:
On completion ofthis subject, students should be able to:-
1. Explain aspects of law, business and ethics in engineering.
2. Communicate verbally and through other media.

Syllabus:
Topics of relevance to a practising professional engineer, including aspects of law, business, ethics and responsibility. Communication skills, covering topics such as report writing, interviews, meetings and public speaking.

Assessment:
Continuous Assessment - 100%

EE 411: INSTRUMENTATION SYSTEMS AND PROCESS CONTROL

Lecture Hours per week: 2
Tutorial Hours per week:
Laboratory Hours per week 1

Credit Hours: 2
Credits: 10

Prerequisite: EE241, EE251, EE262, EE321

Learning Outcomes:
On completion ofthis subject, students should be able to:-
1. Understand the principles of operation of electronic analogue and digital instrumentation and their applications in instrumentation systems.
2. Understand the operations of PLC based instrumentation systems.
3. Understand the construction, logic and operation of Programmable Logic Controller (PLCs)
4. Apply the PLCs for control of various industrial processes in mining, manufacturing industries and traffic control.
5. Design flow charts, PLC wiring diagram and PLC Ladder diagram programs for process control systems.
6. Analyze and execute the developed PLC programs and monitor on-line process

Syllabus:
Electronic Instruments and Instrumentation Systems:
Electronic analogue and digital measuring instruments.Transducers.Instrumentation systems.PC based instrumentation, VIS - Virtual Instrumentation Systems. Industrial Process **Control:**
Sequential control.Relay control.PLC - Programmable Logic Controller.Construction.
Languages:
Boolean Statements, Static Logic, Ladder Diagrams.PLC applications.

Practical Sessions: 8 x 3 hours3 Laboratory projects.

Textbook:
Newman, M., Industrial Electronics and Controls,John Wiley & Sons, 1986.
Korzeniowski, K., Application of Programmable Logic Controllers to Industrial Process Control, Departmental Handout, 1990.

Assessment:
Continuous assessment - 100%

EE 412: THESIS (B)

Hours per week:	**8**
Lecture hours:	**2**
Individual work:	**6**
Credit Hours:	**8**
Credits:	**36**

Learning Outcomes:
On completion of this subject, students should be able to:-
1. Make design decisions and present design results in public discussion.
2. Produce a technical report on a design project.

Syllabus:
A project and dissertation carried out on an individual basis with a member of staff.

Assessment:
Continuous assessment - 100%

EE 421: ELECTRICAL DESIGN I

Lecture hours per week:	**3**
Tutorial hours per week:	
Laboratory hours per week:	
Credits:	**13**

Prerequisite: EE211, EE223, EE234, EE252, EE351, EE352, EE372

Learning Outcomes:
On completion of this subject, students should be able to:-
1. Explain the philosophy of engineering design as a complex problem-solving activity to satisfy some human need.
2. Discuss the importance of an operational model of the design process and identify its main phases.
3. Interpret the concepts of size ranges, preferred number series, similarity laws and modular system/products.
4. Substantiate the importance of standardisation and classify and use standard specifications in common design situations.
5. Identify the various constraints and essential economic factors in design of engineering systems/products.
6. Produce a checklist of objectives in embodiment design.
7. Perform design calculations of main dimensions of the stator and rotor core and of armature winding details for cage and slip-ring induction motors.
8. Perform design calculations of main dimensions of the stator and rotor core and of armature winding details for cylindrical and salient-pole synchronous generators.
9. Perform design calculations of main dimensions of the armature and of armature winding details for DC motors and generators.
10. Perform design calculations of main dimensions of the core of single and three-phase transformers and of transformer winding details.
11. Perform design calculations of basic electronic circuits such as rectifiers, filters,

amplifiers, comparators, oscillators, switching regulators, DC power supplies, inverters and converters, opto-couplers and selected digital circuits.

Syllabus:
Philosophy of engineering design, operational model of the design process, size ranges, preferred number series, similarity laws, modular systems, standardisation and standard specifications, design constraints, economic factors in design.Design of power apparatus:a.c. and d.c. rotary machines and transformers.Design of selected basic electronic circuits.

Textbook:
Svensson, N.L., An Introduction to Engineering Design,UNSW Press, 1990.
Say, M.G., Alternating Current Machines, Pitman Publishing Ltd, ELBS Edition, 1980.
Say, M.G. and Taylor, E.O., Direct Current Machines, Pitman Publishing Ltd, ELBS Edition, 1980.
Mitchell, F.H., Jr., and Mitchell, F.H., Sr., Introduction to Electronics Design,Prentice-Hall International, Inc. 1988.

Assessment:
Continuous assessment - 100%

EE 431: THESIS (A)

Hours per week:	**4**
Lecture Hours:	**12**
Individual Work:	**3**

Credits: **18**

Learning Outcomes:
On completion of this subject, students should be able to:
1. Make design decisions and present design results in public discussion.
2. Produce a technical report on a design project.

Syllabus:
A project, or projects, involving analysis, design and implementation carried out on an individual basis.

Assessment:
Continuous assessment - 100%

EE 432: ELECTRICAL MACHINES III

Lecture hours per week:	**2**
Tutorial hours per week:	
Laboratory hours per week:	**1**

Credits: **10**

Learning Outcomes:
On completion ofthis subject, students should be able to:-
1. Describe the torque-speed load characteristics of induction machines.
2. Explain the industrial applications of induction machines.

Syllabus:
Review of induction machines theory. Torque - speed load characteristics of induction motor. Industrial applications and selection of drives. Starting and speed control.Induction generator.

Textbook:
Guru, B.S. &Miziroglu, M.R., Electric Machinery and Transformers, 3rd ed., Oxford University Press.

References: Manufacturers Manuals.

Assessment:
Continuous Assessment - 40%
Written Examination - 60% (1x3 hrs)

EE441 ELECTRICAL POWER SYSTEMS II

Lecture Hours per week:	**3**
Tutorial Hours per week:	**1**
Laboratory Hours per week:	

Credits: **15**

Prerequisite: EE352

Corequisite: none

Learning Outcomes:
1. Calculating with the differential equations and representative techniques of transmission lines.
2. Understanding the stability limits of the transmission lines under steady state conditions.
3. Calculate the variation of frequency with time for single-area and two-area systems for step-load increases for both controlled and uncontrolled cases.
4. Explain the methods of controlling the voltage and reactive power in a power system.
5. Calculate the fault levels in a system for different types of fault.
6. Introducing the sequential networks, calculating under unbalanced conditions.
7. Analyse transient processes in power systems, calculate switching and lightning over-voltages in simple systems.

Syllabus:
Steady State Operation of Transmission Lines:
- Medium and short line approximation
- Transmission line differential equations
- Equivalent Π-circuit, A, B, C, D parameters
- Lossless lines, steady state stability limit
- Maximum power flow

Automatic Generation Control:
- Frequency control and power-frequency relation
- Transfer function model for control
- Generator characteristics and governor setting
- Effect of tie-line power on interconnected systems

Control of Voltage and Reactive Power:
- Injection of reactive power and synchronous condensers
- Tap changing transformers
- Induction regulators and AVR
- Economics of reactive power generation
- Reactive power compensation

Short-Circuit Calculations:
- Three-phase symmetrical fault,
- Symmetrical components
- Unsymmetrical faults
- Sequence reactances
- Current limiting reactors
- Fault level in typical systems
- Neutral ground

Power System Transients:
- Generation of overvoltages
- Propagation of surges
- Transmission and reflection at discontinuities
- Switching transient calculation
- Current chopping

Text Book:
1. Glover J.D, Sarma M.S. and Overbye T.J, *Power System Analysis and Design,* Cengage Learning, 5th Edition, 2012.
2. Weedy B.M. and Cory B.J., *Electric Power Systems,* John Wiley, 4th Edition, 2012.
3. Elgerd O.I, *Electric Energy Systems Theory – An Introduction,* McGraw Hill, 2nd Edition, 2014

Assessment:
Continuous Assessment - 40%
Final Examination - 60%(1x3 hours)

EE442 ELECTRICAL POWER SYSTEMS III

Lecture Hours per week: 4
Tutorial Hours per week:
Laboratory Hours per week:

Credits: 18

Prerequisite: EE441

Corequisite: none

Learning Outcomes:
1. Understand the importance of insulation co-ordination.
2. Decide appropriate protection schemes for generators, transformers, feeders, busbars etc.
3. Explain the application of surge diverters for overvoltage protection.
4. Describe load flow control in a power system.
5. Understand the optimal power flow problem and economic optimization of generation scheduling.
6. Understand the difference between steady state and transient stability.
7. Calculate the swing curve of the system for large disturbances.

8. Conceptualize the power distribution process from the point of view of a distribution company.

Syllabus:
Power System Protection:
- Overcurrent protection, earth leakage schemes
- Balance differential schemes
- Distance (impedance) scheme
- Generator, transformer, busbar protection
- Carrier-current protection
- Relay co-ordination
- Insulation co-ordination
- Overvoltage protection

Load Flow Calculations:
- Modelling of power system components
- Load flow problem formulation
- Develop load flow equations
- Mismatch formulation of load flow problems
- Iterative methods of load flow calculations, GS and NR methods
- Use of computer programs for load flow study , ETAP, PowerWorld, etc
- Load flow control

Economic Operation:
- Fuel cost & Incremental fuel costs
- Cost of loss in transmission
- Unit commitment and distribution of load between plants
- Economic dispatch
- Principle of automatic load dispatch

Power System Stability Analysis:
- Steady-state power limits
- Load instability
- Synchronous instability
- Transient power limits
- Rotor movement and equation of motion
- Step-by-step calculation of the swing curve
- Equal-area criterion
- Critical clearing angle
- Improving system stability
- Computer aided transient stability analysis

Power Distribution:
- Introduction to distribution
- Primary and Secondary distribution
- Distribution Reliabilty
- Smart Grids

Text Book:
1. Glover J.D, Sarma M.S. and Overbye T.J, *Power System Analysis and Design,* Cengage Learning, 5th Edition, 2012.
2. Weedy B.M. and Cory B.J., *Electric Power Systems,* John Wiley, 4th Edition, 2012.
3. Elgerd O.I, *Electric Energy Systems Theory – An Introduction,* McGraw Hill, 2nd Edition, 2014

Assessment:
Continuous Assessment - 40%
Final Examination - 60%(1x3 hours)

EE 451: POWER ELECTRONICS I

Lecture hours per week: **3**
Tutorial hours per week:
Laboratory hours per week:

Credits: **13**

Learning Outcomes:
On completion of the subject, students should be able to:-
1. Explain the use of semiconductors in power systems.
2. Describe the operation of rectifiers, converters and inverters.

Syllabus:
Single and three-phase semiconductor rectifying circuits. Regulation, control and overlap. Silicon controlled rectifiers, converters and inverters.

Textbook:
Rashid, M.H., Power Electronics: Circuits, Devices and Applications, Prentice-Hall,1988, 2nd ed.

Assessment:
Continuous Assessment - 40%
Written Examination - 60% (1x3 hrs)

EE 452: POWER ELECTRONICS II

Lecture hours per week: **3**
Tutorial hours per week:
Laboratory hours per week:

Credit Hours: 3
Credits: 13

Learning Outcomes:
On completion ofthis subject, students should be able to:-
1. Describe inverter techniques.
2. Describe uninterruptible and switched mode power supplies.

Syllabus:
Forced-commutated inverter techniques. AC and DC variable speed drives. Battery chargers. Uninterruptible power systems. DC power links.

Textbook:
Rashid, M. H., Power Electronics: Circuits, Devices and Applications, Prentice-Hall,1988, 2ndед.

Assessment:
Continuous Assessment - 40%
Written Examination - 60% (1x3 hrs)

EE 461: COMPUTER COMMUNICATIONS

Lecture hours per week: 3
Tutorial hours per week:
Laboratory hours per week:

Credits: 13

Prerequisite: EE371, EE342

Corequisite: EE471

Learning Outcomes:
1. Describe the basic telecommunication networks and principles of their operation.
2. Discuss the basic computer networks and computer networking principles.
3. Interpret the concepts of OSI and TCP/IP reference models.
4. Explain the concept of protocols and services.
5. Describe transmission layer protocols, packet concept and error assessment.
6. Explain advantages of level structured approach, inter-level protocols and standards.

Syllabus:
Purpose of telecom networks. Basic networks, ideal transmission link, voice to digital signal. Human switch point (the operator), operator v. automatic local call connect, channel associated signalling.
Automatic crosspoint switch, inter-switch linkage, scale of modern network, the automated network challenge. Circuit switched networks, packet switched networks.
Computer networking principles and engineering:
wide-are networking, local area networks network topology. Communication hardware and software protocols.
Open-system-interconnection model TCP/IP reference model.
Transmission link digital capability (level 1). Basic characteristics of copper, otpical fibre & radio, sources of error, power budgets, bandwidths, simple system design.
Transmission layer protocols, purpose and structure (level 2). Packet concept, error assessment, response to error, error correction.

Physical structures at level 2: memory processing and control.

Network functionality at level 3, purpose and range. Header, networking information, switching function, simple switching architecture & control, routing and queuing concepts.

Service enabling and level 4 objective.
Construction of end to end circuits, common channel signalling concepts, switch to switch communication, the call model. Virtual channel concepts, buffered queues, basic traffic issues. Implementation of software control, data structures, link lists etc..

The complete level diagram, advantages of

level structured approach, inter-level protocols, standards consistent signalling, effecting global communications.

Textbook:
Kurose & Ross, Computer Networking: A Top-Down Approach, 6th Edition, 2013

Assessment:
Continuous Assessment - 40%
Written Examination - 60%(1x3hrs)

EE 462: ELECTRICAL DESIGN II

Lecture hours per week: 2
Tutorial hours per week:
Laboratory hours per week:

Credits: 9

Learning Outcomes:
On completion of the subject, students should be able to:-
Apply published standards to the design and installation of power equipment and systems.

Syllabus:
Design techniques applied to power equipment and systems; use and choice of materials; component and equipment limitations; use of standards; testing and maintenance procedures.

Textbook:
SAA Wiring Rules, Australian StandardAS3000-1991, 10th Ed., StandardsAssociation ofAustralia.

Assessment:
Continuous assessment - 100%

EE 471: COMMUNICATION SYSTEMS ANALYSIS & DESIGN

Lecture hours per week: 4
Tutorial hours per week:
Laboratory hours per week: 0.8

Credits: 19

Prerequisite: EE311, EE331, EE332

Corequisite: EE481, EE491

Learning Outcomes:
On completion ofthis subject, students should be able to:

1. Describe the trade-offs in real systems between signal-to-noise ratio, bandwidth and rate of information transfer.
2. Evaluate error control coding.
3. Evaluate modulation - demodulation methods and techniques.
4. Analyze the basic principles underlying a communication system.
5. Analyze the digital base-band and pass-band signals.
6. Select which type of modulation to use for a specific application.

Syllabus:
Pulse Modulation

- Review Sampling & PCM
- Delta Modulation
- Differential PCM
- Line codes

Baseband Data Transmission

- Baseband transmission of digital data
- Intersymbol Interference Problem
- Nyquist Channel
- Transmission of M-ary Data
- The Eye Pattern
- Digital Band-Pass Modulation Techniques
- Preliminaries
- Binary Amplitude-Shift Keying
- Phase-Shift Keying
- Frequency-Shift Keying
- Summary of Three binary signaling Schemes
- Noncoherent Digital Modulation Schemes
- M-ary Digital Modulation Schemes

Random Signals and Noise

- Probability and Random Variables
- Expectation
- Transformation of Random Variables
- Gaussian Random Variables
- The Central limit Theorem
- Random Process
- Correlation of Random Process

- Spectra of Random Signals
- Gaussian Processes
- White Noise
- Narrowband Noise

Noise in Digital Communications

- Bit Error Rate
- Optimum Detection – BPSK, QPSK
- Optimum Detection – QAM, FSK
- Differential Detection of Noise

Textbook:

A.B. Carlson & P.B. Crilly, 'Communication Systems', McGraw Hill, 2010

Assessment:

Continuous assessment - 40%
Written examination - 60%(1 x 3 hours)

EE472 SATELLITE COMMUNICATIONS

Lecture Hours per week: 4
Tutorial Hours per week: 2
Lab (Project) Hours per week: 3

Credits: 27

Prerequisite: EE311, EE471, EE491

Corequisite: EE482, EE492

Learning Outcomes:

1. Evaluate the up and downlink budgets in a satellite earth station link.
2. Investigate and Analyse protocols for multiple access and collision detection in satellite communication.
3. Evaluate the performance of digital modulation techniques and design the appropriate coding depends on bandwidth and error rate used in satellite communication.
4. Analyse radar principles in surveillance and weather including limitation analysis.
5. Analyse the principles of the ILS, and MLS and compare their merits.
6. Understand and Analyse of new developments in electronic navigation.

Syllabus:

Link Budget:

- Friis Transmission Equation
- Thermal noise, Noise factor, Noise figure
- Friis Formula for noise
- G/T ratio
- Path Loses
- Up-link and Down-link signal to noise ratio
- Overall signal to noise ratio
- Satellite Locations and Path
- Satellite Locations and Path

Multiple Accesses:

- Satellite access schemes
- FDMA, TDMA, CDMA and SDMA access schemes
- Hybrid access schemes
- Frequency reuse methods
- Frequency hopping
- Co-channel Interference

Digital Modulation:

- Amplitude, Phase and Frequency Shift Keying
- IQ modulation
- Performance of PSK, BPSK, QPSK and QAM
- Carrier to Noise with respect to BER for different digital modulation schemes.

Medium range Radio-navigation Systems:

- Conventional VOR
- Doppler VOR
- Distance Measuring Equipment (DME)

Surveillance Systems:

- Principles of radar
- Surveillance Radar
- Weather Radar
- Secondary Surveillance Radar
- Continuous wave radar

Airborne Navigation System:

- Instrument Landing System (ILS)
- The Microwave Landing System (MLS)
- Performance comparison ILS and MLS
- Airborne collision avoidance system
- Search and Rescue vis satellite

Earth station Devices:

- Band Spectrums
- Antenna unit
- Tracking and Control units
- Transponders
- Amplifiers, Multiplexer, Oscillators
- Coding Principles considering bandwidth and error rate.

Textbook:
1. Gerard Maral, Michel Bousquet, and Zhili Sun, *Satellite Communication Systems: Systems, Techniques and Technology,* 5th Edition, Wiley, 2009.
2. Laurie Tetley and David Calcutt, *Electronic Navigation Systems,* 3rd Edition, Reed Elsevier Publishing, 2001

Field Trip:
Students must be taken for field trip to satellite earth station and airport to get familiar with the navigation systems.

Assessment:
Continuous Assessment – 60%
Final Examination - 40%(1x3hrs)

EE 481: ANTENNAS AND PROPAGATION

Lecture hours per week: 3
Tutorial hours per week:
Laboratory hours per week:

Credits: 13

Learning Outcomes:
1. Understand the principle of antenna and the different principles on which antennas operate: wire, travelling wave, aperture and array antennas.
2. Define and apply basic parameters of the antenna.
3. Analyze the performance of short dipole antenna, deriving radiation fields and all antenna parameters.
4. Evaluate the characteristics and performance and applications of all four types of antennas.
5. Analyze the propagation of antenna transmitted signals in the presence of other objects, reflectors and attenuators.
6. Design antenna systems using Friis and Radar equations

Syllabus
This subject addresses the basic characteristics, parameters, function, analysis and applications of communication and radar HF, VHF, UHF and SHF antennas and the propagation of signals transmitted by them. Basic parameters such as directivity, antenna impedance, gain, radiation pattern, beam width, radiation resistance, antenna temperature, etc. are defined and the radiated electric and magnetic fields are derived from the integral form of Maxwell's equations. From the radiated fields the basic parameters are obtained, and the radiation patterns are sketched in both E- and H- planers. The analysis is then extended to the other types of antennas including wire, travelling wave, aperture and array antennas. Practical issues such as impedance matching, antenna installation and pattern and gain measurements are also described. The Friis transmission and Radar equations are derived and applied to understand the function of the antennas when part of a whole system and the impact of the medium on the signals transmitted, including attenuation and reflection.

40% Continual Assessment
60% Final Examinations

Textbook
Antenna Theory and Design, 3rd Edition, Warren L. Stutzman, Gary A. Thiele, 2013

EE 482: DATA COMMUNICATIONS

Lecture hours per week: 3
Tutorial hours per week:
Laboratory hours per week: 1

Credits: 15

Prerequisite:

Corequisite:

Learning Outcomes:
1. Understand and explain basics of packet switching data networks.
2. Describe various methods of synchronous communication using framing and packetisation techniques, error detection and correction, Automatic Repeat Request.

3. Describe various synchronous data communication protocols and formats such as SDLC, HDLC, X.25, IEEE 802 series, TCP/IP, ISDN, Frame Relay and etc.
4. Design a network architecture based on OSI's seven layer model.
5. Analyse reliability and failure rate, in terms of MTBF and MTTF, bathtub curve.
6. Develop an understanding of probability of packet collision theory, queuing theory and traffic.

Syllabus:

Basics of data network communication, channel capacity and utilisation, TRIB calculations, error detection and correction, basic coding theory, Cyclic Redundancy Code generation, asynchronous versus synchronous communication, EIA serial communication standards, various modem protocols and CCITT recommendations, Aloha network, dedicated versus circuit switched networks, packet switching networks, public data networks, investigation ofX.21 and X.25 network, SDLC, HDLC and IEEE 802 series framing formats, TCP/IP protocols, ISDN, Frame Relay, FDDI versus CDDI and several other Internetwork communication standards. Study of Network Architecture based on Open System Interconnection's 7 layer model, Backbone network architecture, Routing protocols.

Study of reliability theory, failure rate, bathtub curves, Meantime Between Failure rate (MTBF) and Meantime To Failure (MTTF), Queuing theory and traffic.

Textbook:

Stallings, W., Data and Computer Communication, 10^{th} Edition, 2013

Assessment:

Continuous Assessment - 40%
Written Examination - 60%(1x3hrs)

EE 491: MICROWAVE AND OPTICAL SYSTEMS

Lecture hours per week: 3
Tutorial hours per week:
Laboratory hours per week: 1

Credits: 15

Prerequisite: EE311, EE331, EE332

Corequisite: EE471, EE472

Learning Outcomes:

On completion ofthis subject, students should be able to:

1. Analyse the propagation characteristics of plane wave in different media.
2. Analyse the different types of microwave waveguides
3. Analyse complex microwave circuits using network parameters
4. Design microwave circuit components for waveguide T-junctions such as magic-T and directional couplers as well as isolators.
5. Apply concepts of the optical communication methods

Syllabus:

Wave Equation

- Derivation of wave equation
- Wave equation of plane wave
- Lossless and lossy medium
- Influence of wave frequency in the medium characteristics
- Power flow in terms of transmitted and reflected power.

Waveguides

- Rectangular wave guides – Analysis, TE & TM modes, Impossibility of TEM mode,
- Concepts of cut-off frequencies, dominant mode and degenerate modes,
- Filter characteristics of wave guides,
- Sketches of Electric & Magnetic fields for different modes in the cross section of the rectangular guide,
- Velocities, wavelengths and impedance relations. Power losses in rectangular guide.
- Introduction to circular wave guides and dominant mode fields.
- Cavity resonators– principles and types –

- Rectangular and Circular- applications. Illustrative problems.

Network Parameters of Microwave Circuits
- Even and odd properties of Zin.
- N port circuits.
- Formulation & symmetry of scattering matrix.

Microwave Components
- Coupling probes & loops,
- Waveguide phase shifters and attenuators.
- Microwave Hybrid Circuits: E-plane-T, H-plane-T and Magic-T.
- Directional Couplers.
- Ferrite components – Circulator, Isolator and Gyrator, their applications.
- Scattering Matrix - Significance, formulation and properties,
- S-matrix of waveguide- T junctions, Directional Coupler, Circulator and Isolator.

Optical Communication
- Attenuation and dispersion
- Optical signal sources
- Modulation and demodulation
- Advantage and applications
- Transmitter and receiver performance
- Optical signal processing
- Noise and overall system performance

Textbook:
R.E. Collins. "Foundations for Microwave Engineering." Wiley, Second edition, 2007.

Assessment:
Continuous Assessment - 40%
Written Examination - 60%(1x3hrs)