SCHOOL OF ELECTRICAL AND COMMUNICATIONS ENGINEERING

Head of School

Dr. Joseph Fisher, Ph.D. (PNGUoT), M. Eng. (University of Wollongong), BEng (PNGUoT)

Deputy Head of School

Gibson Kupale, M.Eng. (PNGUoT), B.Eng., (PNGUoT)

Professors

Professor **Dr. Paul R. Hoole,** D.Phil. Eng. (Oxford, UK), MSc. (Oxford, UK)

Professor **Dr. Kanthavel Radhakrishnan,** Ph.D. (Anna University, India), M.E. (Madurai Kamaraj Univ. India), B.E (Manomaniam Sundaranar Uni. India), M.E. (Madurai Kamaraj Univ.), PDF (USA)

Professor **Dr. Raj Kumar,** Ph.D. (Banasthali University India), M. Tech. (National Institute of Technology India), B.E (JRN Rajasthan Vidyapeeth University, India).

Associate Professors

Dr. Ashish Kumar Luhach, Ph.D., (Banasthali University, India), M.S, (Latrobe University, Australia), B.E, (M.D. University, India)

Senior Lecturers

Joseph Fisher, PhD (PNGUoT), M. Eng. (University of Wollongong), B. Eng (PNGUoT)

Hikma Shabani, PhD (International Islamic University Malaysia), M.Sc., (International Islamic University, Malaysia), B. Eng., (Université du Burundi,),

Lecturers

Sammy S. Aiau, Ph.D. (PNGUoT), M. Phil, B.Eng., (PNGUoT), MIEPNG., Reg. Eng. (PNG).

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

Herman Kunsei, IEEE, PGCert. (PNGUoT), MPhil (UQ, Australia), M. Eng. Sc (UNSW, Australia), B.Eng. (PNGUoT)

Josuha Yuanko, B.Eng.Sci. (PNGUoT, PNG), B.Eng. (PNGUoT, PNG)

James Dugumari, M.Eng. (VUT, Australia), B.Eng. Electrical (PNGUoT)

Dr Ravindra Luhach, Ph.D. (Banasthali University, India), M.E (M.D. University, India), B.E (M.D. University, India)

Seasonal Academic

Mathew Pua, MPhil (PNGUoT), B.Eng. Electrical Eng. (PNGUoT)

Edmond Nagombi, M. Sc. in GIS Remote Sensing (Flinders Univ., Australia), B.Eng. Electrical Eng. (PNGUoT), B.Sc. (Applied Physics, PNGUoT)

Isaiah Koldai, MPhil (PNGUoT), B.Eng. Electrical (PNGUoT)

Wilson Kepa, MPhil (PNGUoT), B.Eng. Electrical (PNGUoT)

Tutors

Rani Maeoaka, B.Eng. Electrical (PNGUoT)

Benjamin Tigom, M. Eng. (PNGUoT), B.Eng. Elect (PNGUoT)

Ricky Terry, B.Eng. Elect (PNGUoT)

Technical Team

Acting Laboratory Manager

Rhonda Karato, BSc (PNGUoT)

Principal Technical Officer

Charlie Pek, B.Sc. (UPNG)

Elias Mandawali, B. Eng. Electrical (Comm, PNGUoT), DIP. Elect. Eng (Comm, PNGUoT)

Senior Technical Officers

Louis Kevin, Dipl. Comp. Technology, (DBTI)

Technical Officers

Vincent Kondo, DIP. Telecom Systems-City & Guilds of London Institute, DIP. Telecommunications, (Telrad International, Israel), Tech.Cert in Telecom Systems-City & Guilds of London Institute, Tech.Cert in Telecom (Telikom Training College, Lae), Cert. Business Studies (PNGUoT)

Sylvester Naout, B. Eng. Electrical (Power, PNGUoT), Cert. Electronic Troubleshooting & Maintenance (PNGUoT), Cert. IFP – Energy Transition, Innovation towards Low Carbon Future, Technical Trade Cert. Electrical Technology (Don Bosco, Vanimo), Technical Trade Cert. Information Technology (Don Bosco, Vanimo)

Stores and Procurement

Queenie Onopiso, Dipl. Business Stud (Polytech), SecCert, StenoCert, (Goroka Bus. Coll.)

Artisan

Byron Ambo, Trade Certificate (Carpentry)

Administration Team

Secretary

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

Admin

Denillah Maisen, B. Arts (Social & Religious Studies) (Divine Word Uni, PNG)

Ancillary Staff

Nick Wagu

Clement Mendo

Pomona Namba

Undergraduate Degree Programs

The Department of Electrical and Communications Engineering offers an Honors program in two majors; power engineering and communications engineering. The Department offers the following four-year academic programs leading to:

(a) Bachelor of Electrical Engineering with Honors in Power Engineering
(b) Bachelor of Electrical Engineering with Honors in Communications Engineering

These degree programs are designed to produce graduates with the skills and ability to systematically apply their engineering knowledge in an ethical and morally responsible manner in providing practical and sustainable solutions to engineering programs while upholding a level of sensitivity to social, cultural, legal, and environmental issues in society. Our graduates will be able to pursue careers in industry, academia, or government sectors. The skills set enables our graduates to secure employment in the areas of power systems, from generation to transmission to substations, control systems, instrumentations, the Internet of Things, data communications, data and network security, wireless communications systems, and project management.

The electrical engineering graduate will have the skills and ability to systematically apply their engineering knowledge in an ethical and morally responsible manner in providing practical and sustainable solutions to engineering problems while upholding a level of sensitivity to social, cultural, legal, and environmental issues in society.

The first year of each course is designed to form a common foundation upon which years 2, 3, and 4 of the separate professional options are based. As such all four subjects in the first year are common to all engineering departments. In the second year onwards, the subjects are specific to the electrical engineering field. In the third year, students are streamed into their majors with the selection of the available electives.

Under the Honors program, each student is required to complete 450 hours of professional work experience (PWE) before he or she is allowed to graduate. The student is required to keep a log of the hours spent in an organization in a log book. After accumulating the required hours, the student will write a report of the work based on the log book and a reflective journal, reflecting on the work experience. The reflective journal should discuss the link between the experience gained and how it addresses Engineers Australia (EA) stage one competencies.

Entry requirements for undergraduate programs (any one of the following):

i) School leavers: Grade 12 School Leavers: SAT_P Test Score, Minimum of B grades or better in Major Mathematics, Physics, Chemistry, and English.

ii) All non-school leavers entering into Electrical Engineering programs: as in school leaver requirements except that upon acceptance with the minimum requirement will do entry exams instead of STAT-P test.

iii) Diploma Certificate from the National Polytechnic (Polytech) Institute of Papua New Guinea with Credit grades in electrical engineering-related subjects are invited to do entry exams before entry.

iv) Non-school leavers who score an overall average over 80% in the entry examinations will be considered, however, the final decision is subject to the availability of space.

v) Diplomas from outer universities will be selected on a case-by-case basis.

Post Graduate Degree Programs

The department also offers postgraduate degrees in Master of Engineering Science (M.Eng.), Master of Philosophy (MPhil), and Doctor of Philosophy (Ph.D.) by research in any electrical and related field. Master of Engineering Science is coursework with eight subjects and one semester on original research in the electrical engineering field.

Entry requirements for postgraduate:

The entry requirement for a Master of Philosophy is a Bachelor's Degree in Electrical Engineering with above-average grades from a recognized university and for a PhD program Master of Philosophy or coursework with at least 1 year of research is required.

COURSE STRUCTURE

BACHELOR OF ELECTRICAL ENGINEERING (HONOURS) MAJORING IN COMMUNICATIONS AND POWER

First Year First Semester

Code	Subject	Contact Hours	Credit
EN111	Engineering Practice and Sustainability	6	15
EN112	Engineering Mathematics I	6	22
EN113	Engineering Materials and Properties	6	18
EN114	Engineering Computation	6	17

First Year Second Semester

EN121	Engineering Mathematics II	6	22
EN122	Engineering Mechanics	6	18
EN123	Introduction to Circuits and Electronics	6	16
EN124	Introduction to Engineering Design	6	15

Second Year First Semester

Code	Subject	Contact Hours	Credit
EN211	Computer-Aided Design (CAD)	6	15
EN212	Engineering Mathematics III	6	16
EE211	Electromagnetic Fields Theory	6	17
EE212	Introduction to C Programming	6	15

Second Year Second Semester

EN221	Engineering Modelling	6	18
EE221	Digital Logic Systems	6	16
EE222	Analog Electronics and Circuits	6	17
EE223	Circuit Theory	6	17

Majoring in Communications

Third Year First Semester

Code	Subject	Contact Hours	Credit
EE311	Signals and Systems	6	17
EE312	Electrical Measurements and Instrumentation	6	16
EE313	Electric Machines	6	17
EE314	Data Communications & Networking (Elective)	6	18
EE315	Electrical Power Systems I	6	17

Third Year	Second Semester		
EN321	Project Management and Economics	6	18
EE321	Communications Systems	6	16
EE322	Electrical Integrated Design	6	14
EE323	Mobile Communications (Elective)	6	17
EE324	Machines and Drives	6	17
*EN000	Professional Work Experience		

Majoring in Power

Third Year	First Semester		
Code	Subject	Contact Hours	Credit
EE311	Signals and Systems	6	19
EE312	Electrical Measurements and Instrumentation	6	16
EE313	Electric Machines	6	19
EE315	Electrical Power Systems (Elective)	6	19

Third Year	Second Semester		
EN321	Project Management and Economics	6	20
EE321	Communications Systems	6	18
EE322	Electrical Integrated Design	6	14
EE324	Electrical Machines and Drive Controls (Elective)	6	19
*EN000	Professional Work Experience		

Majoring in Power

Fourth Year	First Semester		
Code	Subject	Contact Hours	Credit
EN411	Research Project A	6	20
EE411	Control Systems	6	17
EE413	Embedded Systems Design and Interfacing (Elective)	6	16
EE414	Electrical Power Systems II (Elective)	6	17
EE415	Power Electronics I (Elective)	6	17
EE417	Digital Signal Processing (Elective)	6	16

Fourth Year	Second Semester		
EN421	Research Project B	6	20
EE421	Instrumentation and Process Control	6	17
EE424	Electrical Power Systems III (Elective)	6	17

EE425	Renewable Energy (Elective)	6	17
EE426	Power Electronics II (Elective)	6	17

Majoring in Communications

Fourth Year First Semester

Code	Subject	Contact Hours	Credit
EN411	Research Project A	6	20
EE411	Control Systems	6	17
EE412	Information Theory (Elective)	6	19
EE413	Embedded Systems Design and Interfacing (Elective)	6	16
EE416	Microwave and Optics (Elective)	6	17
EE417	Digital Signal Processing (Elective)	6	16

Fourth Year Second Semester

EN421	Research Project B	6	20
EE421	Instrumentation and Process Control	6	17
EE422	Computer Networks and Design (Elective)	6	17
EE423	Network Security Concepts (Elective)	6	17
EE425	Renewable Energy (Elective)	6	17
EE427	Antennas and Radars (Elective)	6	17

*EN000 Professional Work Experience – The subject requires students to complete 450 hours of professional work experience at any time after completing the first year. This subject will not have any credit points and will be assessed with pass/fail.

Graduate Capability Statement

Our electrical engineering graduates will systematically apply their professional engineering knowledge, skills, and ability across power and communications to solve complex engineering problems. They will be ethically, socially, culturally, legally, and environmentally aware and responsible.

Electrical and Communications Engineering Course Learning Outcomes – Mapped to EA Stage 1 Competencies

The following table shows how the CLOs address all EA Stage 1 Competencies. The combined mapping details for all SLOs to Engineers Australia Stage 1 Competencies provide finer detail.

Course Learning Outcomes*	**Engineers Australia Stage 1 Competencies**
1. Deep understanding of the sciences, math, information systems, and engineering fundamentals that underpin the electrical and communication engineering discipline.	1.1, 1.2
2. An in-depth understanding of the body of knowledge of the electrical and communication engineering discipline.	1.2, 1.3
3. Collection, synthesis, and application of electrical and communication engineering information.	1.4, 1.5, 2.1, 2.3, 2.4, 3.4
4. Undertaking research, analysis & evaluation of ideas and concepts within electrical and communication engineering	1.3, 1.4, 1.6, 2.1, 2.3, 2.4, 3.2, 3.4
5. Applying problem-solving skills to complex electrical and communication systems and processes.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3
6. Undertake design in electrical and communication engineering and manage engineering projects.	1.6, 2.2, 2.4, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6
7. Communication via multiple media to diverse audiences, undertaking team roles, teamwork, and providing team leadership.	2.4, 3.2, 3.3, 3.4, 3.5, 3.6
8. Behaving in an ethical and professional manner and respecting others.	1.6, 2.4, 3.1, 3.4, 3.5, 3.6
9. Being cognisant of the importance of sustainability and the environmental impact of engineering.	1.5, 1.6, 3.1, 3.3, 3.4

EN111 ENGINEERING PRACTICE AND SUSTAINABILITY

Programs Common to all Bachelor of Engineering Courses

Subject Name Engineering Practice and Sustainability

Subject Code EN111

Duration 13 Lecture Weeks, 1 Exam Week, 1 Mid-Semester Week

Contact Hours 6 hours per week (2 Lectures, 2 Tutorial, 2 Project)

Credit Points 18

Delivery Mode On Campus

Prerequisites Nil

Corequisites Nil

Coordinator TBA

Synopsis

This subject provides students with an overarching introduction to the broad elements of professional engineering practice and their core competencies. The role of engineers in society is explored along with the social, political, and economic issues that may influence the role. The subject adopts a problem-based learning approach where student teams review a hypothetical engineering case study involving multiple, ethical and environmental-related issues to critically analyse possible outcomes. Findings are presented via progressive and final reports culminating in a teamwork presentation to allow students to demonstrate the attainment of good communication skills.

Subject Themes/Topics

Topic	Themes	Topic Details
1	Introduction to professional conduct and ethical engineering practices	a) Role of Engineering in a development context b) Engineering Ethics and Society
2	Team Building in Engineering Teams	a) Effective Communication b) Assertive Listening c) Critical Thinking d) Organizational Communication
3	Theories of Development	a) Sociological Theory b) Psychological Theory c) Other relevant theories
4	Social Change & Technology in the economic and political context of society	a) Social Change b) Technology Change
5	Sustainable engineering practice in social, economic, and political contexts.	a) Principle of Sustainability b) Environmental Sustainability c) Engineering Economics & Development
6	The role of media communication in an engineer's world	a) Role of Media Communication b) Engineers in the real world c) Subject summary

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Demonstrate various concepts of professional and ethical conduct and practices in this contemporary engineering and development context.
2. Demonstrate team building, relationship, and stakeholder engagement behaviours in engineering and development problem-solving situations.
3. Research the range of environmental, technical, and social elements involved in engineering challenges.

4. Apply skills in accessing, evaluating, and summarizing information to communicate ideas and present arguments individually and within teams.
5. Apply a variety of Engineering Practices and strategies to meet engineering needs in complex social, political, and economic environments.
6. Investigate, analyses, and use a range of communication skills (speaking, writing, drawing, and listening); and select and apply appropriate channels of communication in the sustainability process individually and within teams.

Assessment Tasks and Weightings – 100% Continuous

There is no final examination in this Subject. To pass this subject student must obtain 50% overall and a minimum of 40% in the Major Project Report.

Assessment Type	Mark (%)
Assessment 1: A Short Paper (concept understanding)	20
Assessment 2: A Short Test	15
Assessment 3: Major Project Report	40
Assessment 4: Problem-Based Project (Practical Application)	25

Students must also refer to the Subject Assessment Details

Assessment 1 – A Short Essay Paper: A concept-based short essay paper outlining the students' understanding of general concepts, definitions, and explanations relevant to the themes within Topics 1 & 2 covered in the lectures. The paper relates to professional conduct and ethical practices, their role in society, and team building. The essay contributes 20% towards the final grade for the subject.

Assessment 2 – A Short Test: A concept-based closed book assessment, testing students' abilities and comprehension of the various concepts covered in the Topics. The test contributes 15% towards the final grade for the subject.

Assessment 3 – Major Project Report: A professional engineering structured report with individual and team components that outlines and communicates the project design/initiation processes, objectives, rationale, and outcomes. The Major Project Report contributes 40% towards the final grade for the subject.

Assessment 4 – Problem-Based Project: A group professional report on resolving contemporary engineering-associated issues prevalent in PNG. All team members will contribute and grades will be as a function of team and individual performance. The presentation contributes 25% towards the final grade for the subject.

It is important that all students familiarize themselves with the University of Technology Assessment Guidelines including those on plagiarism at www.unitech.ac.pg.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 13-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

No specific Text

References

1. William E. Kelly, Ph.D., P.E.; Barbara Luke, Ph.D., P.E., D.GE; and Richard N. Wring, Ph.D., (2017). Engineering for Sustainable Communities, ASCE
2. American Society of Civil Engineers, (2004). Sustainable Engineering Practice: An Introduction.
3. David T. Allen & David R. Shinnard (2011). Sustainable Engineering: Concepts, Design and Case Studies 1st Education
4. Braden R. Allenby, (2011). The Theory and Practice of Sustainable Engineering 1st Edition

Readings and Resources:

Lecture notes and PowerPoints will be uploaded to the Google Classroom.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN112 ENGINEERING MATHEMATICS I

Programs Common to all Bachelor of Engineering Courses

Subject Name Engineering Mathematics I

Subject Code EN112

Duration 13 teaching weeks, 1 exam week, 1 mid-semester week break

Hours 6 (4 hours lectures, 2 hours tutorials)

Credit Points 22

Delivery Mode On-campus

Prerequisites Nil

Co-requisites Nil

Coordinator TBA

Synopsis

The Subject provides students with the fundamental mathematical concepts, principles, and analytical processes that underpin all disciplines of Engineering. The topic of functions is important as studying the behavior of systems and limits helps to critically analyze the limitations of systems. Differentiation and integration techniques help to calculate features and characteristics of a system while complex numbers help to represent systems where the natural numbers cannot adequately cater.

Subject Topics

1. Functions & Limits: Functions: Types of functions; Composition of functions; Inverse functions; Logarithmic and exponential functions; Trigonometric and hyperbolic functions; Inverse trigonometric and hyperbolic functions.
2. Sequence and Series: Infinite Series and Processes: Sequences; Partial sums; Tests for convergence of a series of real numbers; Power series; radius and interval of convergence of a power series; Taylor and Maclaurin series.
3. Differentiation & Applications: Differentiation: Differentiation by using limits; Techniques of differentiation; Applications of differentiation - maxima and minima, tangents to curves, small increments
4. Integration & Applications: Integration: Anti-derivatives; The First and Second Fundamental Theorems of Calculus; Techniques of integration - substitution, by parts; Applications of integration - the area enclosed between two curves, volumes of solids of revolutions.
5. Complex Numbers: Cartesian, polar, and exponential forms of a complex number; Euler's Formula; De-Moivre's Theorem; Roots of a complex number.
6. Probability and Statistics: Introduction to data analysis and applications of Binomial, Poison, normal distributions, and chi-square distribution in engineering. Use of different statistical techniques such as regression analysis.

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Demonstrate a clear understanding of trigonometric, logarithmic, exponential, and hyperbolic functions, and their inverses.
2. Test series for convergence, and find radii and intervals of convergence of power series.
3. Apply the techniques of differentiation to solve problems involving maxima and minima and related rates.
4. Use integration to find areas enclosed between curves, and volumes of solids of revolution.
5. Solve problems involving complex numbers.
6. Apply probability and statistics in solving engineering problems and analyzing data

Assessment Tasks and Weightings

To obtain a pass grade in this Unit 50% overall must be achieved and at least 50% achieved in the final examination.

Unit Assessment consists of three assignments, three tests, and a final examination as summarized below. Students must also refer to the Assignments, Tests, and the Subject Assessment Guide for Engineering Mathematics I where detailed information is provided for each assignment.

> **AT1: Assignment 1** The assignment provides students with the opportunity to evaluate and critically analyze different types of functions and series. It contributes 10% of the total marks for the Subject.

AT2: Test 1 The test provides students with the opportunity to recall, interpret, and solve problems involving function sequences and series. It contributes 10% of the total marks for the Subject.

AT3: Assignment 2 This assignment involves selecting and evaluating the techniques of differentiation and techniques of integration to solve application problems. The assignment is worth 10% of the total marks for the Subject

AT4: Test 2 The test provides students with the opportunity to recall, interpret, and solve problems involving differentiation and integration. It contributes 5% of the total marks for the Subject.

AT5: Assignment 3 This assignment involves solving problems using complex numbers. The assignment is worth 10% of the total marks for the Subject.

AT6: Test 3 The test provides students with the opportunity to recall, interpret, and solve problems involving complex numbers. It contributes 5% of the total marks for the Subject.

AT7: Final Examination: The final examination is of 3 hours duration. The final exam is worth 50% of the total marks for the Subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Stroud K.A .Engineering Mathematics: Programs and Problems. 6th Edition (ELBS/Macmillan 2000)
2. Anton H, Calculus with Analytical Geometry, 6th Edition (Wiley 1999)

References

1. Kreyszig E, Advanced Engineering Mathematics, 7th Edition Wiley, 1999.

Readings and Resources

Scientific Calculator: Students to provide

Weekly Tutorial worksheets

Mathematical software

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN113 ENGINEERING MATERIALS AND PROPERTIES

Programs Common to all Bachelor of Engineering Courses

Subject Name Engineering Materials and Properties

Subject Code EN113

Duration One semester

Contact Hours 6 Hours (3 Lectures + 3 practical)

Credit Points 18

Delivery Mode On-campus

Prerequisites Nil

Co-requisites Nil

Coordinator TBA

Synopsis

Engineering Materials and Properties provides students with the opportunity to attain a fundamental knowledge of materials used in the different fields of engineering. It will impart cognitive skills to think critically about the materials relevant to industrial and domestic applications. The subject examines the physicochemical properties of materials and how they impact their design and applications in engineering. The materials studied cover the broad spectrum from hydrocarbons through to metals, lubricants, cement, nanomaterials, polymers, and ceramics. The subject adopts a hands-on experimental approach through the use of laboratory practical sessions that enhance the theoretical concepts.

Subject Topics

1. Topic 1: Structure of Solids

   Classification of engineering materials, Structure-property relationship in engineering materials, Crystalline and non-crystalline materials, Miller Indices, Crystal planes, and directions, Determination of crystal structure using X-rays, Inorganic solids, and Silicate structures, and their applications. Defects; Point, line, and surface defects.

2. Topic 2: Mechanical Properties of Materials

   Elastic, Inelastic, and Viscoelastic behavior, Engineering stress and engineering strain relationship, true stress - true strain relationship, review of mechanical properties including tensile, bending, and shear.

3. Topic 3: Equilibrium Diagrams

   Solids solutions and alloys, Gibbs phase rule, Unary and binary eutectic phase diagrams, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.

4. Topic 4: Electrical and Magnetic Materials

   Conducting and resistor materials, and their engineering application; Semiconducting materials, their properties and applications; Magnetic materials, Soft and hard magnetic materials and applications; Superconductors; Dielectric materials, their properties and applications. Smart materials: Sensors and actuators, piezoelectric, magnetostrictive, and electrostrictive materials.

5. Topic 5: Corrosion Processes

   Corrosion, causes of corrosion, Types of corrosion, and Protection against corrosion including coatings such as paints and galvanizing.

6. Topic 6: Material Selection

   Overview of properties of engineering materials. Selection of materials for different engineering applications.

Subject Learning Outcomes

After completing this subject, students will be able to:

1. Demonstrate fundamental knowledge of the structures of solids and their analysis.
2. Demonstrate how to assess the mechanical properties of different materials to determine their uses for various engineering disciplines.
3. Apply equilibrium diagrams relevant to the various engineering disciplines to discern alloying outcomes.

4. Achieve the capacity to investigate and evaluate the properties of Electrical and Magnetic materials for engineering applications.
5. Undertake the selection of materials for engineering tasks based on non-dimensional analysis based on a wide stratum of parameters such as tensile, bending and shear strength, resistivity, and corrosion resistance.
6. Develop teamwork and communication skills by participating in laboratory practical sessions and writing reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject, 50% overall must be achieved. Formative assessments will contribute 50% and summative final written examinations will contribute 50% to the overall assessment.

Subject Assessment consists of assignments, laboratory work, and a final examination as summarized below. Students must also refer to the Assignments and the Subject Assessment Guide for Engineering Materials and Properties where detailed information is provided for each assessment.

1. **Assignment 1 (team) -** The assignment provides students with the opportunity to undertake a critical analysis of engineering materials. It contributes 5% of the total marks for the Subject.
2. **Test -** There will be 2 tests. They contribute 20% of the total marks for the Subject.
3. **Laboratory Sessions (team)** – Group experimental work contributes 25% of the total marks for the Subject.
4. **Final Examination**: The final examination is of 2 hours duration consisting of two parts. Part A is compulsory. Part B consists of a selection. The final exam is worth 50% of the total marks for the Subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 14 weeks of teaching as per the PNG National Qualification Framework.

Textbooks

1. W.D. Callister, Materials Science and Engineering; John Wiley & Sons, Singapore, 2002.
2. W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008

Reference Textbooks

1. V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.
2. S. O. Kasap, Principles of Electronic Engineering Materials; Tata Mc-Graw Hill, 2007.
3. L. H. Van Vlack, Elements of Material Science and Engineering; Thomas Press, India, 1998.
4. K. G. Budinski, Engineering Materials – Properties and selection, Prentice Hall India, 1996.

Web references:

- www.tndte.com
- nptel.ac.in/downloads
- www.scribd.com
- cuiet.info
- www.sbtebihar.gov.in

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN114 ENGINEERING COMPUTATIONS

Programs Common to all Bachelor of Engineering Courses

Subject Name Engineering Computations

Subject Code EN114

Duration 13 teaching weeks, 1 exam week, 1 mid-semester break week

Contact Hours 6 (4 Lectures, 2 Laboratories)

Credit Points 18

Delivery Mode On-campus

Prerequisites Nil

Co-requisites Nil

Coordinator TBA

Synopsis

The subject introduces students to engineering problem-solving through the use of computer-aided engineering software with a strong emphasis on data collection and analysis tools. It explores the use of Excel, Matlab, and SAP JMP as a tool to import, cleanse, analyze, manipulate, and report engineering data. Data science methodology is implemented through the use of the Excel VBA framework, Matlab scripts of the Matlab computational software, and the JMP programming language of SAS JMP - emphasis on the trade-off between efficiency and accuracy of computational methods versus algebraic analytical methods.

Subject Topics

1. Introduces Excel as a data handling tool in engineering
    1.1. Explores the use of formulae on data manipulation using the coordinate system of data cells
    1.2. Explores the use of charting functions in data collections
    1.3. Introduces the grammar of the VBA language and uses it to develop automation on data manipulation
    1.4. Data cleansing process of data importation and data message into a form that can be manipulated and analyzed
    1.5. Implement modeling methods using formulae and VBA including; Statistical Analysis, Time Series Analysis, Mathematical functions, Curve Fitting and Regression, and Solving Equations
    1.6. Numerically differentiating, integrating, and integration of differential equations for engineering applications.
2. Introduces Matlab as a computational tool for engineering applications
    2.1. Matlab fundamentals: Matlab interface, Matlab data types, Matlab script and function files.
    2.2. Matlab programming: Loop Commands, Logical Branching Statements, Combining Loops and Logic, elementary vectorization of algorithms
    2.3. Matlab Data Plotting
    2.4. Matlab Engineering Applications: Finding Roots of Equations, Matrix Mathematics, Solving Simultaneous Equations, Numerical Integration, Solving Ordinary Differential Equations, Solving Partial Differential Equations, Solving Nonlinear Algebraic Equations.
3. Introduces JMP SAS for engineering data analytics.
    3.1. Data: Importing Data into JMP, JMP Data Table, Cleaning and Formatting Data, Analyzing Row States.
    3.2. Index of Graphs: Basic Charts, Thematic Maps, Graphs of One, Two, and Multiple Columns.
    3.3. Graphing: Using Graph Builder to produce graphs of Data and Maps.
    3.4. Problem Solving with One, Two, and Multiple Columns.

Subject Learning Outcomes (SLOs):

On completion of this subject, the students will be able to:

1. Demonstrate qualitative and quantitative understanding of the use of Excel Spreadsheets.
2. Develop a working knowledge of the required mathematical solution procedures for engineering analysis.
3. Illustrate the use of spreadsheets to compute a variety of engineering problems.
4. Apply Excel built-in features and VBA, Matlab, and SAP JMP to compute engineering problems.
5. Apply necessary skills to design and implement an emerging engineering application.

Assessment Tasks and Weightings:

To obtain a pass grade in this subject a student must achieve 50% overall. There is no final examination for this subject. Students must also refer to the Subject Assessment Details as prescribed by the subject coordinator.

Computer Laboratory Reports and Quizzes are worth 40% of the overall marks for the subject. Assignments and Projects are worth 40% and Tests are worth 20%.

Subject Assessment Task (AT) Details

AT Item	Component	Marks	Weeks
1. Laboratory	1 - 10	30%	3 – 12
2. Quizzes	1 – 3	25%	5, 8 & 11
3. Assignments	1 – 3	20%	3-6, 7-9, 9- 12
4. Test	Mid & Final	15% and 10%	7 and 13

Student Workload:

The total workload for the subject for the 'average' student is a nominal 140 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Textbooks:

1. Ronald Larsen - Engineering with Excel, Pearson, 2012
2. Svein Linge & Hans Petter Langtangen - Programming for Computations – MATLAB/Octave, 2010
3. JMP ® Essentials An Illustrated Guide for New Users, 2nd Edition, 2012

References:

1. Bill Jelen - VBA and Macros Microsoft Excel 2010, Que Publishing, 2010
2. Joseph C. Musto, William E. Howard & Richard R. Williams – Engineering Computations: An Introduction Using Matlab and Excel, 2009.

Readings and resources:

1. https://www.youtube.com/watch?v=T_ekAD7U-wU
2. https://www.jmp.com/en_us/home.html
3. https://www.youtube.com/watch?v=AKsj0sxCtFA&list=PL3mwk0Db0keIwDJopA_rRD1aTXT92PLE6
4. https://www.youtube.com/watch?v=xge-f1KV_oc&list=PL411D719858B57C47

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN121 ENGINEERING MATHEMATICS II

Programs Common to all Bachelor of Engineering Courses

Subject Name Engineering Mathematics 2

Subject Code EN121

Duration 13 teaching weeks, 1 exam, and 1 mid-semester week break

Hours 6 (4 hours lectures, 2 hours tutorials)

Credit Points 22

Delivery Mode On-campus

Prerequisites EN112 Engineering Mathematics I

Co-requisites Nil

Coordinator TBA

Synopsis

This subject will continue to develop the fundamental mathematical concepts, principles, and analytical processes that underpin professional Engineering studies. The topic of vectors expands mathematics concepts into 2D and 3D space and matrices help to represent and solve systems of linear equations. The topics of Differential equations first and second-order helps to model dynamic systems and teaches techniques to solve related problems and Laplace Transform as an adequate mathematical tool in solving differential equations.

Subject Topics

1. Vectors: Dot product; Cross product; scalar triple product; parametric equations of a line; planes in 3-space.
2. Matrices: Addition and multiplication of matrices; Systems of linear equations; Gauss elimination; Determinants; Inverses; Cramer's Rule.
3. First Order ODE: Techniques of solving 1st ODE: Separation of variables, Homogeneous equations, Integrating factor, Transformation, Bernoulli Equations, Exact differential equations, Solutions by substitution. Applications of ODE – bacterial growth, half-life of radioactive matter, cooling and heating, current flow in a series circuit, and concentration of mixtures in tank reservoirs.
4. Second Order ODE: Formation, Solution of constant coefficient linear homogeneous and non-homogeneous equations, Method of undetermined coefficients, Applications.
5. Laplace Transform: Definition of Laplace Transforms, Transform of standard functions, Table of transforms, Properties of transforms, Laplace inverse transforms. Heavy side functions, Unit functions, Dirac functions, etc. Solving systems of ODEs.

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Solve problems involving the vector equations of lines and planes in 3-D space.
2. Use Cramer's rule and Gauss elimination to solve systems of linear equations, including those with infinitely many solutions, and geometric interpretation.
3. Formulate and solve various first-order differential equations,
4. Formulate and solve second-order linear differential equations with constant coefficients,
5. Use Laplace and inverse Laplace Transforms to solve O.D.E.

Assessment Tasks and Weightings

To obtain a pass grade in this Unit 50% overall must be achieved and at least 50% achieved in the final examination.

Unit Assessment consists of three assignments, three tests, and a final examination as summarized below. Students must also refer to the Assignments, Tests, and the Subject Assessment Guide for Engineering Mathematics 2. Detailed information is provided for each assignment.

1. **Assignment 1** The assignment provides students with the opportunity to construct and evaluate vector equations in 2 and 3 dimensions and matrices. It contributes 10% of the total marks for the Subject.
2. **Test 1** The test provides students with the opportunity to recall, interpret, and solve problems involving vectors and matrices. It contributes 10% of the total marks for the Subject.

3. **Assignment 2** This assignment provides students with the ability to formulate and solve first-order and second-order differential equations. The assignment is worth 10% of the total marks for the Subject.
4. **Test 2** The test provides students with the opportunity to recall, interpret, and solve problems involving first-order and second-order DE. It contributes 5% of the total marks for the Subject.
5. **Assignment 3** This assignment provides the students with the ability to apply Laplace transforms. The assignment is worth 10% of the total marks for the Subject.
6. **Test 3** The test provides students with the opportunity to recall, interpret, and solve problems involving Laplace Transforms. It contributes 5% of the total marks for the Subject.
7. **Final Examination**: The final examination is of 3 hours duration. The final exam is worth 50% of the total marks for the Subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Stroud K.A. 2000, Engineering Mathematics: Programs and Problems. 6th Edition (ELBS/Macmillan)
2. Anton H,1999, Calculus with Analytical Geometry, 6th Edition (Wiley)

References

1. Kreyszig E1999, Advanced Engineering Mathematics, 7th Edition (Wiley).

Readings and Resources

- Scientific Calculator: Students to provide
- Weekly Tutorial worksheets
- Mathematical software

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN122 ENGINEERING MECHANICS

Programs Common to all Bachelor of Engineering Courses

Subject Name Engineering Mechanics

Subject Code EN122

Duration 13 teaching weeks, 1 exam, and 1 break week

Contact Hours 6 Hours (3 Lect, + I Tut, + 2 lab)

Credit Points 18

Delivery Mode On-campus

Prerequisites EN112 Engineering Mathematics I

Co-requisites Nil

Coordinator TBA

Synopsis

The subject of engineering mechanics provides students with the opportunity to attain a knowledge of the fundamental engineering sciences that provide the foundation for all engineering disciplines. The subject incorporates topics from fundamental units of measurement, Rigid body static, Structures, Friction, Center of Gravity and Moment of Inertia, Kinematics of particles, Kinetics of particles, rigid body dynamics, and Waves.

Subject Topics

1. Rigid body static: Equivalent force system. Equations of equilibrium, Free body diagram, Reaction, Static indeterminacy, and partial constraints, Two and three-force systems.
2. Structures: 2D truss, Method of joints, Method of section. Frame, Beam, types of loading and supports, Shear Force and Bending Moment diagram, relation among load-shear force-bending moment.
3. Friction: Dry friction (static and kinematics), wedge friction, disk friction (thrust bearing), belt friction, square threaded screw, journal bearings (Axle friction), Wheel friction, Rolling resistance.
4. Centre of Gravity and Moment of Inertia: First and second moment of area and mass, radius of gyration, parallel axis theorem, product of inertia, rotation of axes and principal M. I., Thin plates, M.I. by direct method (integration), composite bodies.
5. Kinematics and Kinetics of Particles: Rectilinear motion, curvilinear motion rectangular, normal tangential, polar, cylindrical, spherical (coordinates), relative and constrained motion, space curvilinear motion, Force, mass and acceleration, work and energy, impulse and momentum, impact.
6. Kinetics of Rigid Bodies: Translation, fixed axis rotation, general planner motion, work energy, power, potential energy, impulse-momentum, and associated conservation principles, Euler equations of motion and its application.
7. Waves: Definitions of wave parameters, types of waves (sound waves, light waves, surface waves), traveling and standing waves and their equations, and wave interference.

Subject Learning Outcomes (SLOs)

On completion of this subject, students will be able to:

1. Explain the basic laws and principles of mechanics.
2. Analyze and solve simple problems in mechanics.
3. Identify the assumptions and limitations of approaches used in the calculation of mechanical problems.
4. Apply scalar and vector analytical techniques for analyzing forces in statically determinate structures.
5. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
6. Develop teamwork attributes and abilities.

Assessment Tasks and Weightings

To obtain a pass grade in this Unit 50% overall must be achieved and a minimum of 40% must be achieved in the final examination. Students must also refer to the Subject Assessment Task Details.

AT1. Assignments: Individual written assignments contribute 10% to the final marks.

AT2. Laboratories: Group Laboratories contribute 20% to the final marks.

AT3. Class Quizzes: Quizzes contribute 20% to the final marks.

AT4. Final Examination: The Final Exam contributes 50% to the final mark.

It is important that all students familiarize themselves with the PNG Unitech Assessment Guidelines including those on plagiarism. This can be viewed on the PNG Unitech website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I – Statics, Vol II – Dynamics, 6th Ed, John Wiley, 2008.
2. F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, 9th Ed, Tata McGraw Hill, 2011.
3. Hugh D.Young and Freeman, University Physics 12th Edition,(Pearson, Addison Wesley 2008).

References

1. H. Shames, Engineering Mechanics: Statics and Dynamics, 4th Ed, PHI, 2002.
2. R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press, 2006

Readings and Resources

Internet sources

The reading and resources for this subject will depend on the project that is selected for the students to do the design.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN123 INTRODUCTION TO CIRCUITS AND ELECTRONICS

Programs Common to all Bachelor of Engineering Courses

Subject Name Introduction to Circuits and Electronics

Subject Code EN123

Duration 13 teaching weeks, 1 examination week, and 1 mid-semester week

Contact Hours 6 hours per week (3 Lect, 2 Lab, 1 Proj.)

Credit Points 19

Delivery Mode On-campus

Prerequisites Engineering Mathematics I

Co-requisites Nil

Coordinator TBA

Synopsis

Introduction to Circuits and Electronics enables students to attain knowledge of circuits and the integration of electronic components to obtain these circuits. It will impart skills to identify various electronic components, verify their operational characteristics, and use them to design circuits that lead to a practical system. It introduces the fundamentals of lumped circuit abstraction, and the basic components of electronics such as resistive elements, diodes, transistors, amplifiers, and op-amps. It examines the different ways to design basic analog and digital electronic circuits for engineering applications.

Subject Topics

1. Basic Electronic Principles
    1.1. Ohm's Law
    1.2. Semiconductors and Types
    1.3. Diodes, Types, and Applications
    1.4. Transistors, Configuration and Biasing
    1.5. Operational Amplifiers
2. Electronic Instruments
    2.1. Importance and Application of General-Purpose Instruments
    2.2. Multi-meter
    2.3. Cathode-ray Oscilloscope
    2.4. Function Generators
    2.5. Switched Mode Power Supply (SMPS)
    2.6. Inverter and Uninterrupted Power Supply (UPS)
3. Analog Circuits and Their Applications
    3.1. Diode as Rectifier: Half wave and full wave
    3.2. Bridge Rectifier
    3.3. Capacitor Filter Circuit
    3.4. Zener Diode as Voltage Regulator
    3.5. Transistors as Amplifiers
    3.6. Inverting and Non-inverting Operational Amplifiers
    3.7. Operational Amplifier Applications: Addition, Subtraction, and Voltage Follower
4. Digital Circuits and Their Applications
    4.1. Number Systems and their Conversion
    4.2. Logic Gates: OR, NOT, NOR, AND, NAND
    4.3. De Morgan's Theorem
    4.4. Algebraic Simplification
    4.5. NAND and NOR Implementation
    4.6. Half-added and Full-adder Circuits
    4.7. Multiplexer and Demultiplexer
5. Introduction to Integrated Circuits
    5.1. Need for Integrated Circuits

5.2. Classifications of Integrated Circuits
5.3. Fabrication Process

Subject Learning Outcomes (SLOs)

On completion of this subject, students will be able to:

1. Analyze the fundamental principles of electronics
2. Employ simple lumped circuit models for resistors, sources, inductors, capacitors, and transistors in circuits.
3. Analyze circuits made up of linear lumped elements.
4. Employ Boolean algebra to describe the function of logic circuits.
5. Construct simple gates, amplifiers, or filters in the laboratory.
6. Design, build, and test basic circuits which include both analog and digital components.
7. Develop team skills and communicate experimental and project outcomes

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved.

The subject assessment consists of a mini project (30%), five laboratory assignments (30%), and a final examination (40%) as summarized below. Students must also refer to the Subject Assessment Guide for Introduction to Circuits and Electronics. Detailed information is provided for each assignment.

AT1. Mini Project The mini project provides students – working in groups - with the opportunity to undertake an industrial project to apply their knowledge acquired in the lectures and tutorials to develop a solution to an industrial problem. This assessment contributes 30 % to the total marks for this subject.

AT2. Laboratories There will be five laboratories to be conducted and assessed. Each laboratory will contribute 5% to the total assessment items mark of 30%. Before the start of each laboratory, there will be a 5-minute quiz worth 1% of the 5% mark for each laboratory. The laboratory activities allow the student to prepare a professional level of application design. It involves undertaking an analysis of various circuits and designing a minimum of 3 alternative circuits for specific applications.

AT3. Final Examination: The final examination is of 2 hours duration consisting of two parts. The examination consists of Part A which is to evaluate their knowledge and Part B consists of a choice of two questions out of three questions. The final exam is worth 40% of the total marks for the Subject.

It is important that all students familiarize themselves with the PNG Unitech Assessment Guidelines including those on plagiarism. This can be viewed on the PNG Unitech website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Sean Westcott & Jean Riescher Westcott, Basic Electronics: Theory and Practice, Mercury Learning and Information, 2nd Edition, 2018.
2. Anant Agaral & Jeffrey Lang, Foundations of Analog and Digital Circuits, Elsevier Morgan Kaufmann, 2005
3. Daniel M. Kaplan & Christopher G. White, Hands-On Electronics: A Practical Introduction to Analog and Digital Circuits, Cambridge University Press, 2003

References

1. Boylestad and Nashelsky, "Electronic Devices and Circuit Theory", 8th Ed., Pearson Education India, New Delhi, 2002.
2. Sedra A S and Smith K C, "Microelectronic Circuits" 4th Ed., New York, Oxford University Press, New York

Readings and Resources

1. NPTEL Lecture series on basic electronics available at https://nptel.ac.in/courses/117103063/
2. MIT Open courseware on basic electronics available at https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN124 INTRODUCTION TO ENGINEERING DESIGN

Programs Common to all Bachelor of Engineering Courses

Subject Name Introduction to Engineering Design

Subject Code EN124

Duration 13 teaching weeks, 1 exam, and 1 break week

Contact Hours 6 hours per week (2 Lect) + 1 Tut + 3 Proj/Lab)

Credit Points 15

Delivery Mode On-campus

Prerequisites Nil

Co-requisites Nil

Coordinator TBA

Synopsis

The subject provides students with the opportunity to develop their engineering design skills, underpinned through the utilization of a broad range of engineering drafting equipment, media, and reproduction methods including computer-aided design and drafting (CADD). Topics include design elements and components and the application of CADD in the design process. The importance of communication design through drawings, presentations, and writing as key steps in solving most engineering problems is stressed. A team-based design project is undertaken.

Subject Topics

1. Introduction to engineering design and design teams
2. Design elements and components including design drafting
3. Drafting and reproduction methodologies including sketching applications within engineering design
4. Introduction to Computer-Aided Design and Drafting (CADD) as part of the design process
5. Geometry, views, annotations, dimensioning and tolerancing
6. Producing working design drawing
7. Design specifications

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Identify and apply the various elements and components within an engineering design process.
2. List and describe the key terminology and tools within engineering design drawing.
3. Apply their skills to solve technical problems, and to develop a systematic methodology in engineering design drawing.
4. Outline systematic methodologies within the engineering design process
5. Apply creativity, problem-solving, and decision-making techniques in the design process.
6. Display communication, teamwork, and leadership skills through active participation within an engineering design team.

Assessment Tasks and Weightings

To obtain a pass grade in this Unit 50% overall must be achieved plus at least 40% in the Final Design Report. There is no final examination in this subject. Unit Assessment consists of reports, assignments, tests, and a presentation as summarized below. Students must also refer to the Assignments and the Subject Assessment Guide for detailed information on each assignment.

Assessment Task 1: Project Concept Report. The first assessment task is a Team-based report that outlines; team formation, the roles of team members, the process for design project selection, the team action plan, and future schedule for meetings. A Gantt chart or its equivalent is required. It is worth 10% of the total marks for the subject.

Assessment Task 2: Two individual written assignments that are each worth 5% and contribute 10% overall to the final marks.

Assessment Task 3: Two class tests/quizzes that are each worth 5% and contribute 10% overall to the final marks.

Assessment Task 4: Design Progress Report. The Team-based report outlines the team's progress in achieving design outcomes. The report will outline the progress against the schedule provided in assessment task 1 and identify the issues that may have impacted on progress. It is worth 15% of the total marks for the subject.

Assessment Task 5: Final Design Report. The assessment task is comprised of a combination of individual and team-based reports outlining the design processes, issues that may have impacts on design, design outcomes, and recommendations for future work. It is worth 40% of the total marks for the subject.

Assessment Task 6: Team Presentation. The task is a Team audio-visual presentation of the Final Design Report, which focuses on design outcomes. Marks will be awarded for Team members and the overall Team. It is worth 15% of the total marks for the subject.

It is important that all students familiarize themselves with the University of Technology Assessment Guidelines including those on plagiarism in the Academic Integrity Policy at: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Student Workload

The total workload for the subject is nominally 150 hours, based on a 15-week semester with 14 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Madsen D.A., Madsen D.P.-Engineering Drawing & Design, 5th Edition, Delmar, Cengage Learning, 2012.

References, Readings, and Resources

1. Engineering Design Process, available at https://www.youtube.com/watch?v=ZQF8iU7ygoM
2. Introduction to Engineering Design Course, available at https://www.youtube.com/watch?v=sCgGW5XBnGI
3. Introduction to Engineering Design Process and Stages of Designing, available at
4. https://www.youtube.com/watch?v=1JQBkU-DtYY
5. Summer Institute for Engineering and Technology Education, 2001. Introduction to Engineering Design and Problem Solving, available at https://webpages.uncc.edu/~jmconrad/hsed/intr_0in.pdf
6. Other readings and resources for this subject will depend on the design project selected for students to undertake.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN211 COMPUTER-AIDED DESIGN

Programs All Engineering (NQF Level 8)

Subject Name Computer-Aided Design

Subject Code EN211

Duration 13 Lecture Weeks, 1 Exam Week, 1 Mid-Semester Week

Contact Hours 6 Hours/Week

Credit Points 18

Delivery Mode On-campus

Prerequisites EN114 Engineering Computation

EN124 Introduction to Engineering Design

Corequisites Nil

Coordinator TBA

Synopsis

The subject introduces students to the modern approach of 3D Computer-Aided Design for generating and analyzing solid models and assemblies related to Civil, Electrical, Mechanical, and Mining Engineering systems and structures. The included topics address theoretical and practical aspects encountered in the creation, modification, analysis, and optimization of engineering design. Also included are topics dealing with the creation of technical drawings, generation of bills of materials, and basic elements of static, dynamic, and thermal analysis.

Subject Topics

1. Characteristics of Digital Engineering Documentation: Characteristics of feature-based, parametric solid modeler. Principal components of modern 3D CAD software user interfaces. Relationships between digitally created sketches, components, assemblies, and technical drawings.
2. Creation of Fully Defined Sketches: Characteristics of sketch geometry and relationships between geometrical features. Sketch tools. State of the sketch and the creation of fully defined sketches. Design intents function of dimensioning methodologies.
3. Basic 3D Component Modelling: Extrusions from sketches. Boss and cut extrusions. Hole wizard, fillets, basic drawings, dimension changes. Associativity between solid models and drawings. Feature parameter editing.
4. Advanced 3D Component Modelling: Revolved and sweep features. Shellings and ribs. Patterns. Part configurations, repairs, and design changes. Design tables, equations, and families of parts. Selection of materials and calculation of physical properties of solid models: mass, center of gravity, moment of inertia. 3D printing.
5. Creation of Assemblies: Bottom-up and top-down assemblies. Import of commercial parts. Geometrical, mechanical, and advanced mating relationships between parts in assembly. Mass properties and interferences. Creation of exploded views. Bills of materials.
6. Creation of Technical Drawings for 3D Parts and 3D Assembly Models: Templates, views, dimensions and tolerances. Sections and technical notes.

Subject Learning Outcomes SLOs

On completion of this subject, students will be able to:

1. Describe the characteristics and requirements of digitally created engineering documentation and the relationships between sketches, parts, assemblies, and technical drawings for engineering design.
2. Create fully defined design sketches
3. Execute basic 3D component modeling and understand design intent and associativity between 3D models and technical drawings.
4. Undertake advanced 3D component modeling, implement design changes, assign materials to models, and calculate the physical properties of models. Use design tables and equations and create families of parts.
5. Create 3D assemblies, add mating relationships between parts, evaluate mass properties, and implement changes for interference avoidance. Create exploded views and bills of materials for application in engineering design.

6. Create technical design drawings for parts and assemblies. Add dimensions, tolerances, technical notes, sections, and isometric views to created drawings. Prepare parts for 3D printing and 3D print them.

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved. There is no final examination for this subject.

Students must also refer to the Subject Assessment Details.

Assessment 1 - Test: Individual computer-based test on Fully Defined Sketch Creation. This test contributes 15% towards the final grade of this subject.

Assessment 2 - Test: Individual computer-based test on 3D Component Modelling. This test contributes 15% towards the final grade of this subject.

Assessment 3 - Assignment: Creation of a 3D Assembly with related Technical Drawings. This assignment contributes 30% towards the final grade of this subject.

Assessment 4 - Assignment: Creation of full Technical Documentation consisting of 3D Modelled Parts, 3D Assembly with Created and Imported Parts, Exploded Views, Bill of Materials and Technical Drawings. This assignment contributes 40% towards the final grade of this subject.

It is important that all students familiarize themselves with the University of Technology assessment guidelines including those on plagiarism. See the website of the University of Technology at http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies.

It is also important to note that any software or hardware-related damage to computers or other laboratory facilities attracts severe disciplinary measures.

Student Workload

The total subject workload for the average student is a nominal 150 hours, based on a 15-week semester with 13 weeks of lecturing and laboratories, one mid-semester week, and one examination week as per the PNG National Qualification Framework.

Subject Textbook

1. 3D CAD in SolidWorks – Tutorials

References

1. Dassault Systems – SolidWorks Fundamentals, Concord, Massachusetts, United States, 2012

Readings and Resources

1. Leondes, C., Systems Techniques and Computational Methods, CRC Press, Boca Raton, 2001

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN212 ENGINEERING MATHEMATICS III

Programs Common Second Year Engineering (NQF Level 8)

Subject Name Engineering Mathematics III

Subject Code EN212

Duration 13 Lecture Weeks, 1 Exam Week, 1 Mid-Semester Week

Contact Hours 6 Hours/Week (4 Lectures, 1 tutorial, 1 lab)

Credit Points 20

Delivery Mode On-campus

Prerequisites EN121 Engineering Mathematics II

Co-requisites Nil

Coordinator TBA

Synopsis

To enable students to acquire further basic mathematical concepts, principles, and analytical processes needed for degree studies in Engineering. On completion of this subject students should be able to use numerical methods for approximation of solutions, perform multiple integrals, use advanced mathematical methods such as Fourier transforms and Laplace transforms to solve ordinary and partial differential equations of the 1st and 2nd order, and work with line and surface integrals.

Subject Topics

1. Topic 1: Numerical Methods

   Solution of equations - bisection, Newton -Raphson. Numerical methods of integration using trapezoidal Rule and Simpson's Rule. Numerical solutions of differential equations using Euler, Heun, and Runge-Kutta technique.

2. Topic 2: Multivariable Calculus

   Partial differentiation: Applications including tangent planes, total derivatives, directional derivatives, gradient, maxima/minima. Introduction to partial differential equations. Multiple Integrals: Double integrals over rectangular and non-rectangular regions. Triple integrals: Applications including surface areas, centroids, and Centre of gravity.

3. Topic 3: Partial Differential Equations

   Fourier's series, integrals, and transforms. Solving PDEs, The One-Dimensional Wave Equation and The Heat Equations, The Two-Dimensional Wave and Heat equations, Higher Order PDE.

4. Topic 4: Vector Calculus

   a. Inverse square fields, Divergence, and curl, The del operator, The Laplacian operator. Evaluation of line integrals in 2D and in 3D space, Change of parameter, Applications to the evaluation of the mass of a wire, arc length, and work.

      The Fundamental theorem of work Integrals, Independence of path, Recognition of conservative vector fields in 2 and 3-dimensional spaces. Finding work using Green's Theorem, Greens Theorem for multiply connected regions.

   b. Evaluation of surface integrals, Applications to the evaluation of a mass of a curved lamina, surface area, and to vector fields associated with fluid flow and electrostatic forces. Oriented surfaces, using the Divergence Theorem to find flux, Sources, and sinks, Gauss's Law for inverse square fields.

   c. Relative orientation of curves and surfaces, using Stokes' Law to calculate work, Relationship between Green's Theorem and Stokes' Theorem, Curl viewed as circulation.

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Use numerical techniques to solve equations, calculate definite integrals, and solve differential equations.
2. Find the integral of a function of several variables,
3. Apply Fourier series to solve Ordinary Differential equations and Partial Differential equations.

4. Evaluate line integrals in two- and three-dimensional space.

Assessment Tasks and Weightings

To obtain a pass grade in this Unit 50% overall must be achieved and at least 50% achieved in the final examination.

Students must also refer to the Subject Assessment Details.

Unit Assessment consists of three assignments, three tests and a final examination summarised below.

AT1 Assignment1 The assignment provides student with the opportunity to use numerical techniques to solve equations, calculate definite integrals, and solve differential equations.

It contributes 3% of the total marks for the Subject.

AT2 Test1 the test provides student with the opportunity to recall, interpret and solve problems involving numerical techniques it contributes 13% of the total marks for the Subject.

AT3 Assignment2 This assignment provides students with the ability to find the integral of functions of several variables. The assignment is worth 3% of the total marks for the Subject.

AT4 Test2 the test provides student with the opportunity to recall, interpret and solve problems integral of functions of several variables. It contributes 13% of the total marks for the Subject.

AT5 Assignment3 This assignment provides the students with the ability to apply Fourier series to solve Ordinary Differential equations and Partial Differential equations. The assignment is worth 4% of the total marks for the Subject.

AT6 Test3 the test provides student with the opportunity to recall, interpret and solve problems involving Vector Calculus. It contributes 14% of the total marks for the Subject.

AT7 Final Examination: The final examination is of 3 hours duration. The final exam is worth 50%of the total marks for the Subject.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism at:

http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 14week semester with 13 weeks of lecturing and tutorials, 1 mid-semester week and 1 week of examination as per the PNG National Qualification Framework.

Subject Text

1. Kreyszig E. Advanced Engineering Mathematics, 7th ed. (Wiley, 1993).
2. Anton H, Calculus with Analytical Geometry, 6th Edition (Wiley 1999)

References

1. Stroud K.A . Engineering Mathematics: Programmes and Problems. 6th Edition (ELBS/Macmillan 2000)

Readings and Resources

Scientific Calculator: Students to provide

Weekly Tutorial worksheets

Mathematical software

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EE211 ELECTROMAGNETIC FIELDS THEORY

Program Electrical Engineering (NQF Level 8)

Subject Name Electromagnetic Fields Theory

Subject Code EE211

Duration 13 teaching weeks plus 1 examination week and 1 mid-semester week

Contact Hours 6 hours per week (3 Lect., 1 Tut. 2 Lab.)

Credit Points 17

Delivery Mode On-campus

Prerequisites EN112 Engineering Mathematics I

EN121 Engineering Mathematics II

Co-requisites None

Coordinator TBA

Synopsis

Electromagnetic Fields and Waves Theory introduces the student to the concepts and underpinning theories of electric and magnetic fields and the use of vectors to describe their behavior using Cartesian, Cylindrical, and Spherical Coordinate Systems. The subject provides the students with the opportunity to develop an insight into the behavior of waves and outlines a range of techniques to obtain key parameters such as Electric Fields, Electric Flux density, Electric potential, magnetic fields, and magneto-motive force. Students are introduced to Maxwell's equations that form the basis of describing fields and waves.

Subject Topics

1. Vector analysis:

   1.1 Vector algebra in Cartesian, cylindrical, and spherical coordinate systems
   1.2 Gradient of a scalar function
   1.3 Divergence and curl of a vector function
   1.4 Apply Divergence theorem and Stoke's theorem

2. Electrostatics field and electric potential:

   2.1 Evaluate the electric field and potential due to any distribution of electric charges
   2.2 Gauss's law
   2.3 Resistance & Capacitance
   2.4 Resistive and capacitive sensors

3. Magnetostatics:

   3.1 Magnetic fields and Ampere's law
   3.2 Magnetic forces of current-carrying conduct in a magnetic field
   3.3 Apply Biot-Savart Law to calculate magnetic field due to current carrying conductors
   3.4 Ampere's law application

4. Magnetic materials and energy:

   4.1 Explain magnetic hysteresis
   4.2 Calculate inductance
   4.3 Relate magnetic energy to magnetic field distribution

5. Maxwell's equations:

   5.1 Faraday's law and Lenz's law
   5.2 Displacement and conduction current, Charge-current continuity equation
   5.3 Stationary loop in a time-varying magnetic field, Moving conductor in a time-varying magnetic field
   5.4 Wave equation and wave properties
   5.5 Attenuation and phase delay
   5.6 Reflection of plane waves

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Explain and illustrate the nature of electromagnetism using vector calculus for field representation and analysis.
2. Evaluate the electric field and electric potential due to electric charges through the application of Gauss's law.
3. Evaluate the magnetic field using Ampere's law and the magnetic force, including the effect of magnetic materials.
4. Interpret Maxwell's equations and apply them in static and slowly time-varying fields to describe electric and magnetic fields.
5. Apply electromagnetic field theory and concepts in designing electromagnetic sensors, devices, and systems.
6. Demonstrate development of their professional and personal attributes of skills in teamwork, professional conduct, communication, and innovation through team-based laboratory exercises.

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved and at least 40% achieved in the final examination.

The subject assessment consists of two assignments (2x6%), a Class Test (20%), six laboratory assignments (18%), and a final examination (50%) as summarised below. Students must also refer to the Subject Assessment Guide for Electromagnetic Fields and Waves Theory. Detailed information is provided for each assessment.

Students must also refer to the Subject Assessment Details.

Assessment Task (AT)		
1	**Assignment 1**	The assignment provides the student with the opportunity to demonstrate their knowledge regarding vectors in different coordinate systems. It contributes 6% towards the total marks for the subject.
2	**Assignment 2**	This assignment requires students to demonstrate their skills regarding the applications of electromagnetic field theory in everyday life. The assignment contributes 6% towards the total marks for the subject.
3	**Class Test**	This assessment evaluates students' understanding and comprehension of all topics covered at the time. The Class Test contributes 20% towards the total marks for the subject.
4	**Laboratories**	There will be six laboratories to be conducted and assessed. Each laboratory contributes 3% towards a total of 18% of the total marks for the subject. The laboratory activities allow the student to prepare a professional level of mathematical modelling and simulations. It involves the use of different software such as Mathcad, PSpice, and MATLAB.
5	**Final Examination**	The final examination is of 3 hours duration consisting of two parts. Part A is compulsory. Part B consists of a selection. The final exam is worth 50% of the total marks for the subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Hayt W. H. and Buck. J, "Engineering Electromagnetics", 9th Ed, McGraw Hill, New York, 2018

References

1. Hoole, Pirapaharan and Hoole, "Electromagnetics Engineering Handbook", WIT-UK, 2013
2. J.A Edminister, "Shaum's Outlines on Electromagnetics", McGraw Hill
3. Kraus, J.D and Fleisch, D.A, "Electromagnetics with Applications", 5th Edition, McGraw Hill,1999.

Readings and Resources

1. https://www.academia.edu/32199510/Engineering_Electromagnetics_Hayt_Buck_8th_edition.pdf
2. https://nptel.ac.in/downloads/115101005/

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EE212 INTRODUCTION TO C PROGRAMMING

Program Electrical Engineering (NQF Level 8)

Subject Name Introduction to C Programming

Subject Code EE212

Duration 13 teaching weeks, +1 examination week +1 mid-semester week

Contact Hours 6 hours per week (2-Lecture, 2-Tutorial, 2 - Laboratory)

Credit Points 17

Delivery Mode On-campus

Prerequisites EN114

Co-requisites None

Coordinator TBA

Synopsis

This subject introduces programming fundamentals and the C language to students. The subject begins with an outline of the relation of logical thinking and programming concepts. The materials then use simple exercises to assist the students build a foundational understanding of program design and implementation of algorithms to solve simple to complex problems.

Subject Topics

1. Introduction to the C programming language covering the following topics:
   - Variables, Data Types, and Input/Output
   - Operators and Expressions.
   - Relation and Making Decisions
   - Loops for Repetition and Random Numbers
2. Intermediate Programming in C
   - Modular Programming using Functions
   - Arrays for Data Processing
3. Implementing simple applications using standard and third-party libraries. This includes
   - Memory management
   - Graphics Programming
   - File Processing
4. Introduction to implementing hardware control drivers using the Arduino platform

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Design, implement, compile, execute, and debug programs using fundamental C constructs to develop an understanding of programming in C.
2. Apply fundamental programming control structures, including conditional statements, iteration, and recursion to solve programming problems/ apply structural design principles, including modularisation and information hiding, to solve programming problems
3. Create C programs using pointers to demonstrate an understanding of efficient memory use and management.
4. Troubleshoot C program code using an Integrated Development Environment and its tools to identify problems in codes and to write effective and efficient programs.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall, and at least 40% for the internal assessment must be achieved.

Students must also refer to the Subject Assessment Details.

Assessment Task (AT)		
1	**Assignment 1**	The assignment provides the student with the opportunity to demonstrate their knowledge regarding the implementation of a console IO application. It contributes 10% towards the total marks for the subject.
2	**Assignment 2**	The assignment provides the student with the opportunity to demonstrate their knowledge regarding the implementation of real-time graphics applications It contributes 12% towards the total marks for the subject.
3	**Assignment 3**	The assignment provides the student with the opportunity to demonstrate their knowledge regarding the implementation of an Arduino platform for embedded software applications. It contributes 10% towards the total marks for the subject.
4	**Laboratories**	There will be nine laboratories to be conducted and assessed. Such each set of three focus on skill development to complete each of the 3 assignments. Each laboratory contributes 2% towards a total of 18% The laboratory activities allow the student to prepare a professional level of software development for mathematical modelling. It involves the use of different software such as GCC compiler, various third-party c libraries, and Visual Studio Code.
3	**Class Test**	This assessment evaluates students' understanding and comprehension of topics covered of week 1 to 6. The Class Test contributes 10% towards the total marks for the subject.
5	**Final Examination**	The final examination is of 3 hours duration consisting of two parts. Part A is compulsory. Part B consists of a selection. The final exam is worth 40% of the total marks for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. C Programming Pocket Primer-Mercury (2019)
2. Arduino in Action 2013

References

1. Brian W Kernighan,Dennis M Ritchie - The C Programming Language, Ansi C-Prentice-Hall
2. C Programming Pocket Primer-Mercury (2019)
3. Arduino in Action 2013, Manning Publications; 1 edition (June 10, 2013)

Readings and Resources

1. learn-c.org free interactive C tutorial, https://www.learn-c.org/
2. Arduino home-page, https://www.arduino.cc/

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN221 ENGINEERING MODELLING

Programs All Engineering (NQF Level 8)

Subject Name Engineering Modeling

Subject Code EN221

Duration 13 Lecturing Weeks, 1 Examination Week, 1 Mid-Semester Week

Contact Hours 6 Hours/Week

Credit Points 18

Delivery Mode On-campus

Prerequisites EN211 Computer-Aided Design

Corequisites Nil

Coordinator TBA

Synopsis

The subject introduces students to Engineering Modeling and Simulation and offers solutions for engineering analysis and design problems using physics-based computational models. The applications relate to Civil, Electrical, Mechanical, and Mining Engineering systems and structures. The included topics address theoretical and practical aspects encountered in model creation, analysis, and optimization of virtual prototypes, with significant cost reduction in the development cycle. Also included are topics dealing with advanced static, dynamic, fluid flow, and thermal analysis applied to all fields of engineering and verification problems.

Subject Topics

1. Specific Features of Engineering Modeling and Simulation: Engineering modeling and computer simulations as substitutes for prototyping and experiments in a design process. The benefits of evaluating the behaviour of engineering systems by virtual prototyping and simulation. The need for verification problems. Main components of software user interfaces for virtual prototyping and simulation. Steps in creating engineering design models from 3D geometric models.
2. Fundamental Concepts in Modeling and Simulation: Stress and strain matrices. Finite Element Method. Vibration modes and buckling of structures. Variational statement and equations of heat transfer. Solutions of transient heat conduction governing equations. Physical capabilities of flow simulations and governing partial differential equations for laminar and turbulent flows. Conjugate and radiation heat transfer. Multi-flows. Boundary conditions.
3. Static Simulations: Static analysis of parts, sheet metal, and assemblies. Displacement contacts, bolt connectors, remote loads, non-uniform pressure distributions, and shrink fits. Beam diagrams and static analysis of trusses. Analysis of systems under bearing loads. Composite shells.
4. Dynamic and Non-Linear Simulations: Modal and harmonic analysis. Buckling, drop test, and fatigue analysis. Modeling and optimization of systems under combined pressure, thermal, and earthquake loads. Non-linear analysis of contacts. Elasto-plasticity modeling and analysis. Random vibrations, thermal contact, and thermal stress analysis. Steady-state and transient thermal analysis of electronic components.
5. Engineering Modeling and Simulations for Thermo-Fluidic Applications: Structure and interface of flow simulation applied to ball valve design, flow in porous media, and conjugate heat transfer. Computational fluid dynamics with mesh optimization in the evaluation of hydraulic losses, drag coefficients, non-Newtonian flows, and heat exchanger efficiency. Building and electronic cooling simulations.
6. Validation Applications in Engineering Modeling: Static, buckling, and vibrations verification problems. Unsteady heat conduction and thermoelectric cooling verification problems. Laminar and turbulent flows in pipes.

Subject Learning Outcomes SLOs

On completion of this subject, students will be able to:

1. Describe the benefits of engineering modeling and simulation, the need for verification problems, the modeling software interfaces, and the steps in creating engineering models for use in design.

2. Explain the fundamental theoretical concepts in engineering modeling and computer simulation underpinning design related to the fields of statics, dynamics, fluid mechanics, and thermodynamics.
3. Perform modeling and static simulation for components and systems encountered in all fields of engineering design.
4. Apply advanced modeling and simulation for components and systems under dynamic and non-linear loading conditions. The gained skills and abilities should cover the large spectrum of all engineering fields.
5. Outline the structure and interface of computational thermo-fluidic applications and perform advanced simulations related to the fields of civil, electrical, mechanical, and mining engineering.
6. Undertake simulations for engineering models with known analytical solutions, compare the results, discuss the accuracy of computer modeling, and understand its limitations in design processes.

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved. There is no final examination for this subject.

Students must also refer to the Subject Assessment Details.

Assessment 1 - Test: Individual computer-based test on Static, Dynamic and Non-Linear Simulations. This test contributes 15% towards the final grade of this subject.

Assessment 2 - Test: Individual computer-based test on Thermo-Fluidic Simulations. This test contributes 15% towards the final grade of this subject.

Assessment 3 - Computer-Based Assignment: Advanced Thermo-Fluidics Simulation. This test contributes 20% towards the final grade of this subject.

Assessment 4 - Computer-Based Assignment: Static, dynamic, and non-linear simulation for engineering models with known analytical solutions. This assignment contributes 20% towards the final grade of this subject.

Assessment 5 - Computer-Based Assignment: Thermo-fluidics simulations for engineering models with known analytical solutions. This assignment contributes 30% towards the final grade of this subject.

It is important that all students familiarize themselves with the University of Technology assessment guidelines including those on plagiarism. See the website of the University of Technology at http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies. It is also important to note that any software or hardware-related damage to computers or other laboratory facilities attracts severe disciplinary measures.

Student Workload

The total subject workload for the average student is a nominal 150 hours, based on a 15-week semester with lecturing and laboratories, one mid-semester week, and one examination week as per PNG National Qualification Framework.

Subject Textbook

1. Engineering Modeling and Simulation in SolidWorks – Tutorials

References

1. Dassault Systems – SolidWorks Simulation, Concord, Massachusetts, United States, 2014
2. Dassault Systems – SolidWorks Flow Simulation, Concord, Massachusetts, United States, 2014

Readings and Resources

1. Cook, R. – Finite Element Modeling for Stress Analysis, John Wiley & Sons, New York, 1995

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EE221 DIGITAL LOGIC SYSTEMS

Program Engineering (NQF Level 8)

Subject Name Digital Logic Systems Design

Subject Code EE221

Duration 13 teaching weeks, +1 examination week +1 mid-semester week

Contact Hours 5.5 (3 Lect., 1 Tut., 1.5 Lab)

Credit Points 18

Delivery Mode On-campus

Prerequisites EE212 Introduction to Programming in C

Co-requisites EE222 Analog Electronics and Circuits

Coordinator TBA

Synopsis

EE221 provides the students the opportunity to develop a thorough insight into the fundamental principles, concepts, and operations that are common to all digital systems. The study begins with the simple logic gates to combinational and sequential logic circuits. The application of useful and practical logic circuits is also investigated through VHDL simulations with the aim of developing a better understanding of the fundamental principles. The understanding of digital components, the analytic processes, and logic circuit operations developed in this subject is mastered through a real-time practical problem group project that prepares the students for advanced digital systems subjects in the upper levels of study. To engage the students in the learning process, the subject is delivered utilizing lecture notes, tutorials, research assignments, laboratories for practical sessions, and major projects.

Subject Topics

The subject content is delivered in 6 topics they are as listed below.

1. DIGITAL SYSTEM OVERVIEW & VHDL PROGRAMMING

   1.1 Digital Computers and Digital Systems
   1.2 Binary, Octal, and Hexadecimal number systems
   1.3 Binary Coded Decimal Codes
   1.4 Binary Data Structure and Alphanumeric [ASCII] Codes
   1.5 Serial and Parallel Transmission and Error Detection for ASCII-Coded Data.
   1.6 Digital Arithmetic Operations [Binary, Hexadecimal and BCD)

2. BOOLEAN ALGEBRA & LOGIC GATES SIMPLIFICATIONS

   2.1 Logic Gates
   2.2 Boolean Algebra
   2.3 Simplification of Boolean Functions and Logic Gates Using Boolean Theorems
   2.4 Simplification of Boolean Algebraic Expressions and Logic Gates using K-Map

3. DESIGN AND ANALYSIS OF COMBINATIONAL LOGIC CIRCUITS

   3.1 Combinational Logic Circuits
   3.2 Design Procedures and Steps
   3.3 Logic Circuits Alternate Representation
   3.4 Combinational Logic Circuits ICs Integration
   3.5 Programmable Logic Devices

4. PRACTICAL COMBINATIONAL LOGIC CIRCUITS

   4.1 Importance of Practical Combinational Logic Circuits in Digital Systems
   4.2 Digital Decoder and Encoder
   4.3 Multiplexer and Demultiplexer
   4.4 Magnitude Comparator
   4.5 Code Converter
   4.6 Digital Arithmetic Logic Circuits (Adder & Subtractor)

5. DESIGN AND ANALYSIS OF SEQUENTIAL LOGIC CIRCUITS

- 5.1 Analysis of Synchronous sequential Circuits
- 5.2 Design of Sequential Circuits
- 5.3 Analysis of Asynchronous Sequential Circuits
- 5.4 Binary Counters and Registers

6. ALGORITHMIC STATE MACHINES (ASM) & MEMORY DEVICES

- 6.1 Algorithmic State Machines
- 6.2 Data Bus Operation
- 6.3 Memory Devices Circuits and Sequence of Operation

Subject Learning Outcomes (SLOs)

At the completion of the topics, students should be able to:

1. Form a general mental picture of digital system and be able to relate main functional units to each other, perform different binary arithmetic and describe different digital operations in digital systems.
2. Perform analysis on Boolean algebra and Boolean functions by applying Boolean theorems and the use of K-Map method in the simplification of logical circuits for an application using VHDL.
3. Design and analyze or Interpret Digital Logic Circuits comprising of logic gates, Combinational logic circuits, Practical MSI Logic Circuits, and Sequential Combinational logic circuits.
4. Apply structured design methodology in logic circuit design using finite-state machines (FSM), describe memory elements and write hardware description language to create model circuits and analyze them to know the principle of operations in VHDL.
5. Design a digital system to solve a practical problem that will interpretation requirements that may be encountered in senior level undergraduate subjects in the likes of computer architecture, microcontroller and interfacing, and embedded systems.

Assessment Tasks [AT] and Weightings

To obtain a pass grade in this subject one is required to obtain at least 50% overall. The subject weightings comprise of 100% continuous assessment. The internal assessment comprises of assessment items namely, Assignments, Quizzes, Laboratories, Tests and Major Project.

Note: Students must also refer to the Subject Assessment Details.

Subject Assessment Tasks Details

The assess-able components of the subject are, Assignments, Quizzes, Laboratory Activities, Tests and Major Project. The assessment component and weights are provided below.

Assessment Tasks		**MARK (% of Total)**
AT1	Assignment 1	6
	Assignment 2	6
AT2	Mini Quizzes (3, 5% each)	15
AT3	Laboratory Work (6, 3% each)	18
AT4	Class Test 1	10
	Class Test 2	10
AT5	Major Project	40
TOTAL		100

AT1 - The assessment is individual based to allow early assessment of progress. Students are required to undertake research to obtain relevant information around an assigned problem and to also apply the knowledge obtained from the Topics to propose and provide a solution to the problem.

AT2 – The three quizzes are given to test an individual student's knowledge of the subject learning outcomes. Students must solve a random problem that relates to the current topic of study. This may be in the form of solving an analytical question in a tutorial as closed book. Quizzes contributes 15% of the total assessment marks.

AT3 - There will be six laboratories to be conducted and assessed. Laboratory activities are performed in groups. A professional level report with individual and team components that outlines and communicates the design processes, rationale and experimental outcomes. The laboratory reports and laboratory assessable activities contributes 18% of the final grade for the subject. A laboratory report must be submitted as a group report and teams are required to submit their mark distributions to each member.

AT4 – Students are tested twice to determine their mastery of the topic being taught and to demonstrate attainment of learning outcomes. This is individual task and reflect student ability to apply the appropriate analytical processes to given problems.

AT5 – Student teams are each assigned a major electronic design project for the whole semester. The assessment task enables students to demonstrate their commitment to workings in a team by applying their combined knowledge and skill to solve a complex problem. The assessment item is worth 40 % of the total mark and reflects the application of the knowledge content acquired and understanding developed in studying the logic and design concepts in this subject. The progressive assessment details for the major project are given below.

AT5 Assessment Component	**Description**
Project Concept Report	A team-based report outlining team formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the final design outcome. The report contributes 5% towards the final grade for the subject
Progress Report	Team-based report outlining team progress in achieving design outcomes in line with the team schedule submitted in the Project Concept Report. Variations to the original schedule will be identified and justified. The Progress Report contributes 10% towards the final grade for the subject.
Final Report	A professional-level report with individual and team components that outlines and communicates the design processes, rationale, and outcomes. The Final Report contributes 15% towards the final grade for the subject.
Audio Visual Presentation	An audio-visual presentation of design outcomes that contains the salient feature of the Final Report. All team members will contribute. The presentation contributes 10% towards the final grade for the subject.

Note: It is important that all students familiarize themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/unitech/policies

Student Workload

The total workload for the subject for the average student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Ronald J. Tocci., Neal S. Widmer and Gregory L. Moss, Digital Systems Principles and Applications, 12th Edition, Pearson Education Inc., New Jersey 07458, April 2, 2018.

References

1. William Kleitz, Digital Electronics, A Practical Approach with VHDL, 9th Edition, Pearson, State University of New York—Tompkins Cortland, 2012

Readings and Resources

1. http://www.gatestudymaterial.com/study-material/digital%20ciruits/text%20books/Digital%20Systems%2010e%20Widmer%20Tocci.pdf

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EE222 ANALOGUE ELECTRONICS AND CIRCUITS

Program Electrical Engineering (NQF Level 8)

Subject Name Analogue Electronics and Circuits

Subject Code EE222

Duration 13 teaching weeks plus 1 examination week and 1 mid-semester week

Contact Hours 6 (3 Lect, + 1 Tut, +2 Lab.)

Credit Points 18

Delivery Mode On-campus

Prerequisites EN123 Introduction to Circuits and Electronics,

EE211 Electromagnetic Fields and Wave Theory

Co-requisites EE223 Circuit Theory

Coordinator TBA

Synopsis

Analog electronics is a branch of electronics that deals with a continuously variable signal. It is widely used in radio and audio equipment along with other applications where signals are derived from analog sensors before being converted into digital signals for subsequent storage and processing. Thus, in this course, students will gain good knowledge and skills in the design, construction, and analysis of analog electronic circuits. The main contents are the basic principles of operation, terminal characteristics, and equivalent circuit models for diodes, Bipolar Junction Transistors (BJT), and op-amps. The study operational amplifiers will include differential amplifiers, inverting amplifiers, and non-inverting. Concepts, design, and analysis of filters, oscillators, and feedback circuits, DAC, ADC, and 555 Timer ICs will also be covered. The theory will be followed by laboratories to enable students to gain good hands-on experiences in working with analog electronic circuits and devices.

Subject Topics

1. Electronic Theory of Covalent Bonding 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
   - P-N junction and Thermal Equilibrium
   - Junction capacitance

2. P-N Junction Diodes and Applications
   - P-N junction diode and its characteristic curve.
   - Types of diodes and respective applications.
   - Rectifier circuits: full and half wave rectifier circuits.
   - Voltage regulators
   - Trouble Shooting

3. 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
   - Trouble Shooting

4. 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 and analysis of Class AB.
- Class AB amplifier analysis

5. Operational amplifiers
   - Op amp operation
   - Differential amplifier
   - Inverting amplifier
   - Non-inverting amplifier

6. Analogue Devices
   - Filters
   - Oscillators
   - Feedback circuits
   - Comparators
   - DAC/ADC
   - Timers

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the formation of the p-n junction via energy level diagrams and physical structure
2. Analyse and solve diode circuits in series, parallel, and series-parallel configurations, and be able to determine voltage and current waveforms of diode rectifier circuits.
3. Describe the structure of BJT and the DC biasing circuits and be able to develop an ability to analyse the biasing circuit configurations.
4. Model BJT and specify small signal AC analysis of standard transistor network configurations and determine small-signal model parameters.
5. Perform quantitative analysis of ideal and non-ideal operational amplifiers and develop an ability to analyse operational amplifier circuits.
6. Identify and discuss the operating principles of the following analogue devices; filters, oscillators, feedback circuits, comparators, DAC, ADC, and 555 timer ICs.

Assessment Tasks and Weightings

Your final grade will be the result of 4 components:

Assessment Component	Weight (%)
Assignment 1	10
Assignment 2	10
Laboratories	20
Class Test	20
Final Exam (3 Hours)	40

Students must also refer to the Subject Assessment Details.

Assessment 1 – Assignment 1 Circuit Analysis: Analytical and critical thinking analysis applied in (i) understanding covalent bonding of n-type and p-type materials, and (ii) solving Diode circuits and applications. The Assignment contributes 10% towards the final grade for the subject.

Assessment 2 – Assignment 2 Circuit Analysis: Analytical and critical thinking analysis applied in understanding and solving Bipolar Junction Transistor circuits and applications. Analytical and critical thinking analysis applied in understanding and solving Operational Amplifier circuits. The Assignment contributes 10% towards the final grade for the subject.

Assessment 3 - Test – This will be a 2-hours test. The assessment will test the understanding and comprehension of the analogue electronics and circuits. It will include (i) analytical and critical thinking analysis applied in (ii) understanding covalent bonding of n-type and p-type materials, and (iii) solving diode circuits and applications, and (iv) analytical and critical thinking analysis applied in understanding and solving Bipolar Junction Transistor circuits and applications. The test will contribute 20% towards the final grade for the subject.

Assessment 4 - Laboratories - Laboratory sessions, where students will perform experimental verifications. Students will be required to perform four experiments and record the results and write the reports on the following topics;

1. To draw V-I characteristics of PN junction diode (Ge, Si, switching and signal).
2. To design half wave and full wave bridge rectifiers,
3. To study BJT characteristics in common base and common emitter configurations, and
4. To study the characteristics of different Op-amp configurations.

Apart from the 4 major laboratory work, the students will do a pre-lab study on 3-D crystal structures of silicon, germanium, and lattice structures of other compounds. This will comprise physical structures in lab (simple cubes), or via animations, and or through 3-D printing technology. The laboratories will contribute 20% towards the final grade for the subject.

Assessment 5 - Final Examination – The final examination is of 3 hours duration and will assess student's achievement of the all the learning outcomes. The final exam is worth 40% of the total mark for the subject.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. R. Boylestad and L. Nashelsky, Electronics Devices and Circuit Theory. 11th Edition, Prentice Hall, Columbus, Ohio. 2012

References

1. Thomas L. Floyd, David M. Buchla, Electronics Fundamentals: Circuits, Devices & Applications, 8th Edition, Pearson education, 2014
2. Paul Tobin, "PSpice for Circuit Theory and Electronic Devices," Morgan & Claypool, 2007.
3. Paynter, Robert, Introductory Electronic Devices and Circuits, Prentice Hall, 7th Ed, 2005.

Readings and Resources

Web-based tools for design:

1. http://www.fairchildsemi.com/support/design-tools/power-supply-webdesigner/
2. http://www.ti.com/lsds/ti/analog/webench/overview.page Circuit Lab:

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EE223 CIRCUIT THEORY

Program Electrical Engineering (NQF Level 8)

Subject Name Circuit Theory

Subject Code EE223

Duration 13 teaching weeks, +1 examination week +1 mid-semester week

Contact Hours 6 (3 Lect, 1 Tut, 2 Lab.)

Credit Points 19

Delivery Mode On-campus

Prerequisites EN123 Introduction to Circuits and Electronics

Co-requisites EE222 Analog Electronics and Circuits

Coordinator TBA

Synopsis

This unit enables students to build a firm foundation in AC and DC circuit analysis. The goals of this unit include developing an ability to solve engineering problems to design, implement, and test circuits to meet design specifications. Emphasis is upon the understanding and application of Ohm's law and Kirchhoff's voltage and current laws in resistive networks. Methods of linear systems analysis are introduced including Thevenin's and Norton's theorems and the superposition principle and transient analysis are carried out on the first and second-order RLC circuits. Further emphasis is on the analysis of the AC circuits and calculations of various AC power and analysis of two-port networks.

Subject Topics

1. Basic Circuit Theory

    1.1 Circuit parameters
    1.2 Ohm's and Kirchoff's Laws
    1.3 Voltage Sources, Current Sources
    1.4 Node and Loop Analysis
    1.5 Superposition
    1.6 Thevenin's and Norton's Theorems
    1.7 Maximum Power Transfer
    1.8 Energy Storage Elements in the Network

2. Transients

    2.1 First-order RC Series Circuits
    2.2 First-order RL Series Circuits
    2.3 Second-order series RLC Circuits
    2.4 Second-order Parallel RLC Circuits

3. AC Circuit Analysis

    3.1 Phasors and Phasor Diagrams
    3.2 Complex-number Notations
    3.3 AC Circuit Elements Reactance, Admittance, Conductance and Susceptance
    3.4 Analysis Techniques
    3.5 Power Calculations
    3.6 Using Fourier Techniques

4. Three-Phase Circuit Analysis

    4.1 Balance Three-phase Circuits
    4.2 Star-Delta and Delta-Star Transformation
    4.3 Power Relationships

5. Two-Port Networks

    5.1 Admittance and Impedance Parameters
    5.2 Hybrid Parameters
    5.3 Transmission Parameters
    5.4 Interconnection of Two-ports

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Identify the main circuit elements and apply Kirchoff's Laws to calculate currents, voltages and power in typical linear and non-linear electric circuits using a variety of analytical methods for DC, AC, transient, and non-linear analyses.
2. Reduce more complex circuits into Thevenin's and Norton's equivalent circuits for maximum power transfer analysis.
3. Identify transient responses of first-order and second-order RLC circuits by examining their signals and waveforms to improve the performance of the circuits.
4. Apply complex circuit analysis to solve steady-state current and voltage and calculate real and reactive powers in AC circuits to improve the performance of the circuits.
5. Apply three-phase circuit analysis to solve steady-state current and voltage in three-phase AC circuits to improve the performance of the circuits.
6. Simplify circuits into various two-port network parameter representations to determine the output and input relationships.

Assessment Tasks and Weightings

To obtain a passing grade in this Subject at least 50% overall, and at least 40% to be achieved in the Final Examination.

Students must also refer to the Subject Assessment Details.

The subject assessments consist of two assignments (20%), a Class Test (15%), four laboratory reports (15%), and a final examination (40%) as shown below.

1. **Assignment 1** - This assignment is given to students to assess their competence level of understanding, knowledge, comprehension, and analysis of the basic electrical components and their circuits and analysis of first and second-order RLC circuits. The assignment contributes 10% towards the final grade for the subject.
2. **Assignment 2** - This assignment is given to students to assess their competence level of understanding, knowledge, comprehension, and analysis of AC circuits and calculation of various AC power and analysis of two-port networks. The assignment contributes 10% towards the final grade for the subject.
3. **Class Test** – This assessment will test the understanding and comprehension of the basic electrical circuits. It will include the use of Ohm's, Kirchoff's laws, and various analysis methods in analysing the AC circuits, power calculations, and determining various parameters of two-port networks. The test will contribute 15% towards the final grade for the subject.
4. **Laboratories** - Laboratory sessions, where students will perform experimental verifications. Students will be required to perform four experiments and record the results and write the reports on the following topics;

   Laboratory 1. Basic circuit analysis to verify Ohm's law and Kirchoff's laws and various theorems (4%), using multimeters.

   Laboratory 2. Perform transient analysis on the first and second order RLC circuits (4%), using oscilloscope.

   Laboratory 3. Carry out analysis and various power calculations of the AC circuits (4%), using variacs, ac loads, wattmeters, voltmeters, ammeters and power factor meters.

   Laboratory 4. Determine the various parameters (Admittance, Impedance, Hybrid and Transmission) of two-port networks (3%), using operational amplifiers, voltmeters, ammeters and ohmmeters.

   The four laboratories will contribute a total of 15% towards the final grade for the subject.

5. **Final Examination** – The final examination is of 3 hours duration and will assess student's achievement of the all the learning outcomes. The final exam is worth 40% of the total mark for the subject.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EE311 SIGNALS AND SYSTEMS

Program Electrical Engineering (NQF Level 8)

Subject Name Signals and Systems

Subject Code EE311

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 hours per week (3 lectures + 1 Tutorial + 2 Laboratory)

Credit Points 19

Delivery Mode On campus

Prerequisites EN114 Engineering Computation and EN212 Engineering Maths III

Co-requisites None

Coordinator TBA

Synopsis

This subject introduces students to the fundamentals of continuous and discrete time signals and system analysis. The underpinning mathematical framework, including various properties of signals and system analysis and characterization will be explored. Mathematical framework such as Fourier representations, Laplace and Z transforms, sampling theorem and convolution will be covered. Characterization of linear, time-invariant systems including; difference and differential equation Modelling, block diagrams, system functions, poles and zeros, impulse and step responses, and frequency response will be covered.

Subject Topics

1. Introduction to Signals and Systems
   - 1.1 Signal Classification and Properties
   - 1.2 Signal Operations and Transformation of the Independent Variable
   - 1.3 Common Continuous Time (CT) Signals
   - 1.4 Common Discrete Time (DT) Signals
   - 1.5 Continuous and Discrete Time Impulse Functions
   - 1.6 Continuous and Discrete Time Complex Exponential
2. Time Domain Analysis of Continuous Time Systems
   - 2.1 Continuous Time System Classification
   - 2.2 Linear Constant Coefficient Differential Equation Model of CT Systems
   - 2.3 Solving Linear Constant Coefficient Differential Equations
   - 2.4 Continuous Time Impulse Response, Characterization of systems by their Response to Impulse and Unite-step Signals
   - 2.5 Continuous Time Convolution
   - 2.6 Properties of Continuous Time Convolution
3. Time Domain Analysis of Discrete Time Systems
   - 3.1 Discrete Time Systems Classifications
   - 3.2 Linear Constant Coefficient Difference Equations Model of DT Systems
   - 3.3 Solving Linear Constant Coefficient Difference Equations
   - 3.4 Discrete Time Impulse Response Characterization of systems by their Response to Impulse and Unite-step Signals
   - 3.5 Discrete Time Convolution
   - 3.6 Properties of Discrete Time Convolution

4. Fourier Series and Fourier Transform

    4.1 Continuous Time Fourier Series and Fourier Transform

    4.2 Discrete-Time Fourier Series and Fourier Transform

5. Sampling and Reconstruction

    5.1 Signal Sampling

    5.2 Sampling Theorem

    5.3 Signal Reconstruction, Discrete to Continuous Conversion

    5.4 Aliasing Phenomena

6. Laplace and z-Transforms

    6.1 Laplace Transform and Continuous Time Systems

    6.2 Inverse Laplace Transform

    6.3 Poles and Zero in the S-Plane

    6.4 z Transform and Discrete Time Systems

    6.5 Inverse z-Transform

    6.6 Poles and Zero in the z-Plane

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Explain the classification of signals and their basic properties and be able to mathematically characterize continuous and discrete time signals,
2. Identify and compare different classifications of systems
3. Analyse the time domain response characteristics of systems due to impulse and step functions
4. Demonstrate the process of continuous time to discrete time signal conversion and reconstruction
5. Explain the frequency response characteristic of systems
6. Apply Laplace and z Transforms to CT and DT systems respectively to analyse their response characteristics

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved and at least 40% achieved in the final examination.

The subject assessment consists of two assignments (10%), two tests (20%), five laboratory assignments (20%), and a final examination (50%) as summarised below. Students must also refer to the Subject Assessment Guide for Signals and Systems. Detailed information is provided for each assignment.

1. **Assignment 1** This assignment allows students to evaluate and reinforce their understanding and knowledge of signals and systems by developing differential and difference equation mathematical models of CT and DT systems. The students will also solve these equations to analyse the time domain response characteristics of these systems.
2. **Assignment 2** This assignment allows the students to evaluate and reinforce their understanding and knowledge in time and frequency domain response of system by performing Fourier, and inverse Laplace and z Transforms.
3. **Test 1** This test will evaluate the students' understanding and comprehension of the classification and properties of Signals and Systems in both Continuous and Discrete Time.
4. **Test 2** This test will evaluate the students' understanding and comprehension of sampling and reconstruction of signals, sampling theorem, and continuous and discrete time convolution.
5. **Laboratories** There will be five laboratories to be conducted and assessed. Each laboratory will contribute 4% to the total assessment items mark of 20%. The laboratory activities allow the student to prepare a professional level of application design. It involves undertaking an analysis of various circuits and design of a minimum of 3 alternative circuits for specific applications.
6. **Final Examination** The final examination is of 3 hours duration given at the end of the semester. The examination questions are derived from the course materials covered throughout the semester and are intended to evaluate, knowledge, comprehension, and applications skills.

Relevant Unitech Policies

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EE312 INSTRUMENTATIONS AND MEASUREMENTS

Program Electrical Engineering (NQF Level 8)

Subject Name Electrical Measurement and Instrumentation

Subject Code EE312

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 hours per week (2 Lect., 1 Tut, 3 Lab.)

Credit Points 19

Prerequisite EE211 Electromagnetic Theory

EE222 Analog Electronics and Circuits

EE223 Circuit Theory

Co-requisites None

Coordinator TBA

Synopsis

Electrical measurement and instrumentation give a general view of certain electrical measurement systems. These systems deal with the functionality of basic devices and instruments in the measurement system. This subject deals with the processes of measurements of electrical variables/parameters using standard instrumentation measurement techniques. It covers fundamental units, standards; recording, analysis, and stating of measurements with an acceptable degree of accuracy/errors: absolute, relative, systematic, random, and FSD error. Error of complex method. Error calculations. The subject also discusses the main categories of measurement instruments/systems: construction, principles of operation and applications of moving coil instruments, dynamometer instruments, induction instruments, energy meters, instrument transformers, single- and three-phase power and energy measurements, and DC and AC bridges.

Subject Topics

1. Measurement Units & Systems of Units

   - CGS
   - MKSA
   - SI
   - Metric System
   - Imperial System
   - Fundamental Units
   - Derived Units.

2. Measurement Standards

   - Classifications of standards: (International, Primary, Secondary)
   - Electrical Standards (Ampere, Volt, Ohm, Farad, Henry, Hertz)

3. Measurements & Errors Analysis

   - Categories/Classifications of Errors:
   - Error Calculations:
   - Measurement error; Mean, Standard Deviation – RMS, average deviation, etc.
   - Instrument error: Tolerance, accuracy, resolution, precision, etc.

4. Measurements system

   - Classification of the measurement system (sensing element, conversion elements, etc.)
   - Types of measuring instrument
   - Application of measurement system

5. Instrumentation Systems Overview

   - Analog Instruments
   - Digital Instruments
   - Sensors & Transducers

6. Analog Instruments

   - Moving Coil Instrument
   - Moving iron instrument
   - Dynamometer
   - Induction Instrument Constructions
   - Principles of Operation
   - specification & Limitation/ capabilities
   - application

7. Energy Measuring Instruments

   - Wattmeters
   - 1-phase measurement
   - 3- phase power and phase measurement
   - Balanced loads
   - Unbalanced loads

8. Instruments Transformers

   - Current transformers
   - Voltage transformers

9. Bridges: AC/DC

   - DC bridge- the Wheatstone Bridge
   - AC Bridge
   - Capacitance Bridge
   - Inductance Bridge

Subject Learning Outcomes (SLOs)

On completion of this subject, students will be able to:

1. Analyse the operation of a generalized measurement system use in a number of modern measurement applications.
2. Define, explain and calculate errors: absolute, relative, systematic, FSD and random errors in measurement of a typical measurement system.
3. Explain principle of operation and applications of moving coil, moving iron, dynamometer and induction instruments.
4. Measure power in single and three phase systems, for balanced and unbalanced load and for any wave shape, using dynamometer wattmeters.
5. Apply current and voltage transformers for three phase measurements and protection applications and using DC and AC bridges for RCL measurements.
6. Explain structures, principles of operation and applications of current transformer (CT) and voltage transformer (VT).

Assessment Tasks and Weightings

To pass this subject student must obtain a minimum of 50% overall and 50% in the final exam. Students must also refer to the Subject Assessment Details. The assessment tasks consist of assignments (15%), laboratories (20%), Tests (15), and final exam (50%).

1. Assessment Task 1: Assignments. There will be 3 short assignments that will reinforce and assess subject learning outcomes. They are outlined below and will be worth 15% in total. Assignment 1 - Measurement and errors. Select the appropriate units and standard of measurements. Develop the skill to interpret data from measurement system and perform error calculation on the recorded results. (5%). Assignment 2 - Measurement system. Identify and design generalized measurement system in terms of its functional element. (5%) and Assignment 3 - Instrumentation. This report contains the explanation of principle operation, structures and application of certain indicating measuring instrument, (i) Electromechanical Indicating Instruments, (ii) Power & Energy Measurement and Bridges for Measurement. (5%)

2. Assessment Task 2: Laboratory Work. There will be 4 laboratories that will provide hands on reinforcement of theory and be worth 20% of overall mark. A series of mini quizzes will be used to help evaluate student attainment of subject learning outcomes. Salient details are provided in the table below:
   Experiment # Title

2.1 This assessment consists of laboratory exercises for identifying measurement system using AM/FM radio frequency training kit (Anacoms)

2.2 This assessment consists of laboratory exercises for error calculation,

- measurement of resistor tolerance using color coded and DMM
- measurement errors in series and parallel resistor connection
- verification of ohm's law with its uncertainty

2.3 This assessment consists of laboratory exercises for measurement of different electrical quantities using multimeter

2.4 This assessment consists of laboratory exercise for measurement of AC/DC bridge circuit

3. Assessment Task 3: Mid-term Test. This assessment will test the understanding of consistency in the measurement standards of units and the importance of analysing errors in measurement, and indicating measuring instruments' principle of operations. The test contributes 15% towards the final marks for the subject.
4. Assessment Task 5: Final Examination. The final exam of 3 hours is worth 50% of the total mark for the subject.

Relevant Unitech Policies

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EE313 ELECTRIC MACHINES

Program Electrical Engineering (NQF Level 8)

Subject Name Electric Machines

Subject Code EE313

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Week Mid-Semester Week

Contact Hours 6 (3 Lect, + 1 Tut, + 2 Lab.)

Credit Points 19

Delivery Mode On-campus

Prerequisites EE211 Electromagnetic Theory

Co-requisites None

Coordinator TBA

Synopsis

This subject enables students to gain an understanding of the operation of DC machines and transformers. It begins by introducing the characteristics of magnetic circuits and how these characteristics are utilized in machine operations. Magnetic and electric models will be developed for both the transformers and the DC machines enabling the analysis of the individual machines' performances and circuit characteristics. In the study of DC machines, emphasis is placed on the performance characteristics of the machines in operation, especially, the speed and torque characteristic of motors and the load and voltage relationships of generators. Both the single-phase and the three-phase transformers operating characteristics will be studied, including, open-circuit and short-circuit tests, and parallel operations. Students will also be introduced to other special-purpose DC machines and transformers such as instrument transformers and stepper motors. Each of these topics will have laboratory exercises to give students a better understanding of the concepts and develop basic skills in operating machines.

Subject Topics

1.0 Basic Laws of Electromagnetism and Principles of Electromechanical Energy Conversion

1.1 Magnetic materials and their properties

1.2 Magnetic circuits

1.3 Self and mutual inductance

1.4 Magnetically coupled coils

1.5 Review of Maxwell's equation

1.6 Electric and magnetic field mediums

1.7 A coil of uniform magnetic field

1.8 A coil of Time-varying magnetic field

2.0 Transformers

2.1 Single phase transformer

2.11 Construction

2.12 Circuit analysis

2.13 Voltage regulation and maximum efficiency criterion

2.14 Determination of transformer parameters

2.2 Concept of operation of an Auto transformer

2.3 Three phase transformers

2.31 Construction

2.32 Connection configurations

2.33 Per phase equivalent circuit

3.0 Direct Current (DC) Machines

3.1 General

3.11 Constructions

3.12 winding configurations

3.13 Elementary dc generator

3.14 Elementary dc motor

3.15 Commutation and armature reaction compensations

3.2 DC generators

3.21 Excitation and EMF generation

3.22 Types of generators and load/voltage performance characteristics

3.23 Losses and maximum efficiency criterion

3.3 DC motors

3.31 Types of dc motors and their speed / torque performance characteristics

3.32 Losses, efficiency and speed regulation

3.33 Methods of speed control (Analogue)

3.34 Introduction electronic drives applications in dc motor operation

4.0 Special Purpose Electric Machines

4.1 Stepper motors

4.11 Permanent magnet type

4.12 Reluctance type

4.2 Instrument transformers

4.21 Current transformer

4.22 Voltage transformer

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Identify the existence of various electromagnetic energies and their effect on devices operations and apply magnetic properties to solve magnetic circuits.
2. Construct an equivalent electrical model of a single transformer magnetic circuit and solve its performance characteristics and apply the same principle to analyse auto transformer and single-phase equivalent circuits of the three-phase transformers.
3. Describe the main features of a DC machine
4. Identify various types of DC generators from their V/I performance characteristics and identify various types of DC motors from their speed/Torque performance characteristics.
5. Investigate the use of simple electronic scalar drives to control DC shunt motor speed and torque
6. Evaluate and Integrate instrument transformers and stepper motors in instrumentation system

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall, comprising 50% from continuous and 50% from Final Examination.

Students must also refer to the Subject Assessment Details.

The subject assessments consist of three assignments (15%), a Class Test (15%), five laboratory reports (20%) and a final examination (50%) as shown below:

1. Assignment 1 - This assignment is given to students to assess their competence level of understanding, knowledge, comprehension and analysis of the basic magnetic components and the electromechanical energy conversion. The assignment contributes 5% towards the final grade for the subject.
2. Assignment 2 – This assignment is given to students to assess their competence level of understanding, knowledge, comprehension and analysis applying electronic scalar drive on DC motor operation. The assignment contributes 5% towards the final grade for the subject.
3. Assignment 3 - This assignment is given to students to assess their competence level of understanding, knowledge, comprehension and analysis applying instrument transformer and stepper motors in instrumentation system. The assignment contributes 5% towards the final grade for the subject.
4. Class Test - This assessment will test the understanding and comprehension of the basic transformer operations and electrical circuits. It will include use of single-phase transformer voltage regulation and efficiency calculations, autotransformers equivalent circuit analysis, three phase transformer circuit analysis using single phase equivalent. The test will contribute 15% towards the final grade for the subject.
5. Laboratories - Laboratory sessions, where students will perform experimental verifications. Students will be required to perform five experiments and record the results and write the reports on the following topics;

   Laboratory 3.1 To determine transformer circuit parameter from open-circuit and short –circuit tests, using a 240-volt variac or triodac for either single phase or three transformer tests, heavy insulated leads and at least two (2) multimeters per group. This lab comprises 4% of the final grade for the subject.

   Laboratory 3.2 To determine how the auto transformer is applied in at least three (3) types of welding machine. This is a research laboratory. This lab comprises 4% of the total assessment.

   Laboratory 3.3 Testing and obtaining the saturation curve of a shunt, series and separately excited DC generators, using the laboratory machines set. This lab comprises 4% of the final grade for the subject.

   Laboratory 3.4 Carry out output characteristics tests on all shunt, series and compound type DC generators, using the laboratory machines set. This lab comprises 4% of the final grade for the subject.

   Laboratory 3.5 Carry out output characteristics tests on all shunt, series and compound type DC motors, using the laboratory machines set. This lab comprises 4% of the final grade for the subject.

6. Final Examination –The final examination is of 3 hours duration and will assess student's achievement of the all the learning outcomes. The final exam is worth 50% of the final grade for the subject.

Relevant Unitech Policies

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EE314 DATA COMMUNICATIONS

Program Electrical Engineering (NQF Level 8)

Subject Name Data Communications and Networking

Subject Code EE314

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 4 hours per week (3 Lect. + 1Tutorial)

Credit Points 16

Delivery Mode On-campus

Prerequisites EE221 Digital Logic Systems

Co-requisites Nil

Coordinator TBA

Synopsis

Data communications and networking may be the fastest-growing technologies in our culture today. One of the ramifications of that growth is a dramatic increase in the number of professions where an understanding of these technologies is essential for success and a proportionate increase in the number and types of students taking courses to learn about them. This course aims on learning of the key elements and their importance in data communication and networking. In this course, students get detailed knowledge acquisition about the communication technologies of wired, and wireless and their associated security concerns in data communication and networking. Furthermore, this course will explore various design approaches of a data communication model and students learn the implementation of the same.

Subject Topics

1. Physical Layer and Media
    - Data and Signals
    - Transmission Media
    - Bandwidth Utilization
    - Switching
2. Data Link Layer
    - Error Detection and Correction
    - Data Link Control
    - Multiple Access
    - Wired LANs and Wireless WANs
3. Network Layer
    - Logical Addressing
    - Internet Protocol
    - Error reporting
    - Delivery, Forwarding and Routing
4. Transport Layer
    - Process-to-Process Delivery
    - UDP, TCP, and SCT
    - Congestion Control and Quality of Service
5. Application Layer
    - Domain Name System
    - Electronic Mail, and File Transfer
    - WWW and HTTP
    - Multimedia
6. Security
    - Cryptography
    - Network Security

- IPSec
- Firewalls

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Apply the concept of data and signals, and to calculate the bandwidth utilization for channels.
2. Calculate the error detection and correction in data communication models.
3. Evaluate the logical addressing for designing of a computer networks.
4. Describe how to implement the concept of process-to-process delivery in data communication.
5. Investigate the real-world applications of Application Layer.
6. Analyse the basic security principles in data communication and networking.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject one is required to obtain at least 50% overall. The assessment weight comprises of 50% internal and 50% external exam. The internal assessment comprises of assessment items namely, Assignments, Quizzes and Tests.

Assessment Task #	Assessment Component	Weight (%)
1	Assignment 1	5
2	Assignment 2	5
3	Class Test 1	20
4	Class Test 2	20
5	Final Exam	50

Students must also refer to the Subject Assessment Details.

Assessment Task 1- Assignment 1: This assignment provides students the opportunity to demonstrate their knowledge on how to calculate the bandwidth utilization and error detection/ correction in data communication models and how to implement the logical addressing in the computer networking. The same will contributes 5 % towards the final grade for the subject.

Assessment Task 2- Assignment 2: This assignment provides students the opportunity to demonstrate their knowledge on how to implement the concept of process-to-process delivery in data communication and real-world applications of application layer. The same contributes 5% towards the final grade for the subject.

Assessment Task 3- Class Test 1: This assessment will test the students' understanding and comprehension on data and signals, and implementation challenges of logical addressing in the data communications. It will also include critical thinking and analysis applied by solving error detection and correction problems in networking.

Assessment Task 4- Class Test 2: This assessment will test the students' understanding and comprehension on the concept of process-to-process delivery in data communication and real-world applications of application layer and its associated security issues along with their possible solutions.

Assessment Task 5- Final Exam: The final examination is of 3 hours duration and will assess student's achievement of the all the learning outcomes. The final exam is worth 50% of the total mark for the subject.

Note: It is important that all students familiarize themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 14 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

- DATA COMMUNICATIONS AND NETWORKING, Fourth Edition, Behrouz A. Forouzan, Sophia Chung Fegan, Tata McGraw Hill
- Computer Networks, Fifth Edition, Andrew s. Tanenbaum, David J. Wetherall, Pearson

References

- Wireless Communications & Networks, William Stallings, 2nd, 2009, Pearson.

Readings and Resources

- http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/vk5/report.html
- www.nptel.ac.in/courses/106105080/pdf/M5L9.pdf
- www.cs.ccsu.edu/~stan/research/pervasive/pubs/icict2007.pdf

Relevant Unitech Policies

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EE315 Electric Power Systems 1

Program Electrical Engineering (NQF Level 8)

Subject Name Electrical Power Systems I

Subject Code EE315

Duration 13 Teaching Weeks + 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 hours per week (3 lectures + 1 Tutorial + 2 Laboratory)

Credit Points 19

Delivery Mode On campus

Prerequisites EN112, EN121, EN212,

Co-requisites EE311

Coordinator TBA

Synopsis

This is an introductory subject in power systems. It begins with an introductory discussion on the structure of power systems including; generation, transmission and distribution subsystems. The discussions include energy sources and common energy conversion technologies and interconnection of power systems as well as load characteristics. An overview on the trend in the development in power systems including interconnection of DERs, AC and DC Microgrids as well as network topology is presented. The subject also discusses the fundamentals of power systems, mathematical notations, balanced three-phase systems, and per unit system. Power system components including power transformers and transmission lines; line parameters (R, L and C) calculations, equivalent circuits of transmission lines and their steady-state characteristics and performance are discussed.

Subject Topics

1. THE STRUCTURE OF POWER SYSTEMS AND TREND IN POWER SYSTEM DEVELOPMENT

   1.1 Power Generation and Different Energy Sources
   1.2 Transmission system and Reasons for Interconnection
   1.3 Distribution system and Distribution Transformer Connections
   1.4 Loads, load characteristics, Load Factor and Loss Factor, Load Growth
   1.5 Distributed Energy Resources (DERs) and Reasons for Interconnection
   1.6 A General Introduction to AC and DC Microgrids
   1.7 Power System Network Topologies

2. POWER SYSTEM FUNDAMENTALS

   2.1 Complex Power and Phasors
   2.2 Load Power Factor and Power Factor Correction
   2.3 Y- and Δ-Connected Loads
   2.4 Δ - Y Transformation
   2.5 Power in Single- and Three-Phase AC Circuits
   2.6 Advantages of Balanced Three-Phase versus Single-Phase Systems

3. POWER TRANSFORMERS AND PER UNIT SYSTEM

   3.1 The Ideal Transformer

   3.2 Transformer Equivalent Circuit and Equivalent Circuit Parameters
   3.3 Three-Phase Transformer Connections and Per-Phase Model
   3.4 The Per Unit System
   3.5 Per-Unit Equivalent Circuit Representation of Balanced Three-Phase Two-Winding Transformers
   3.6 Three – Winding Transformers
   3.7 Autotransformers

4. TRANSMISSION LINES PARAMETERS

   4.1 Transmission Line Parameters and Design Considerations
   4.2 Line Resistance
   4.3 Inductance of Single Conductance Due to Internal and External Flux Linkages
   4.4 Inductance of Single-Phase Lines and Flux Linkages Due to Self- and Mutual Inductances
   4.5 Inductance of Three-Phase Lines with Symmetrical and Asymmetrical Spacing and Transpose Lines
   4.6 Inductance of Composite Conductors

4.7 Capacitance of Single- and Three-Phase Lines

5. CHARACTERISTICS AND PERFORMANCE OF TRANSMISSION LINES

5.1 Two-Port Networks
5.2 Transmission Line Models with A,B,C,D Parameters
5.3 Voltage Regulation
5.4 Lossless Lines
5.5 Maximum Power Flow
5.6 Line Compensation

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Explain the structure of the power system and define the characteristics of its components
2. Discuss the trend in the development of Power and change in the power system structure due to the introduction of DERs at the distribution subsystem
3. Apply the per unit method of representing a balanced three-phase power system and its components
4. Compute the R, L and C parameters of transmission Lines
5. Construct two-port models of transmission lines with A, B, C, B Parameters
6. Evaluate the steady state performance characteristics of transmission lines

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved and at least 40% achieved in the final examination.

The subject assessment consists of two assignments (10%), two tests (20%), five laboratory assignments (20%) and a final examination (50%) as summarized below. Students must also refer to the Subject Assessment Guide for Introduction to Circuits and Electronics. Detailed information is provided for each assignment.

Students must also refer to the Subject Assessment Details.

Assessment Task (AT)

1. Assignment 1 This assignment gives the opportunity to students to evaluate and reinforce their understanding and knowledge of the structure and the main subsystems of a power system as well as the trend in the development of the power system. The students will also evaluate the characteristics of different load types, load and loss factors and estimate the rate of load growth, etc.
2. Assignment 2 This assignment enables the students to model the transmission lines by calculating the line parameters and evaluate the steady-state performance of the lines.
3. Test 1 This test will evaluate the students' understanding and comprehension on fundamentals of power systems including the per-unit system and its application in modelling power system components such as power transformers.
4. Test 2 This test will evaluate the students' understanding and comprehension on the characteristics and steady-state performance of the transmission lines
5. Laboratories There will be five laboratories to be conducted and assessed. Each laboratory will contribute 4% to the total assessment items mark of 20%. The laboratory activities allow the student to prepare a professional level of application design. It involves undertaking an analysis of various circuits and design of minimum of 3 alternative circuits for specific applications.
6. Final Examination The final examination is of 3 hours duration given at the end of the semester. The examination questions are derived from the course materials covered throughout the semester, and are intended to evaluate, knowledge, comprehension, and applications skills.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. H. Saadat, Power System Analysis, 3rd Ed., PSA Publishing, 2011

2. J.D. Glover, T. Overbye and M.S. Sarma, Power System Analysis and Design, 6th Ed.,Cengage Learning, 2016
3. D.P Kothari and I.J Nagrath, Modern Power System Analysis, 3rd Ed., McGraw-Hill, 2009

References

1. M.E. El-Hawary, Electrical Power Systems Design and Analysis, IEEE Press
2. D. Das, Electrical Power Systems, New Age International

Readings and Resources

All Lecture Notes, Assessment Items and Projects will be accessed through Google Classroom

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN321 Project Management and Economics

Programs Engineering (NQF Level 8)

Subject Name Engineering Project Management and Economics

Subject Code EN 321

Duration One semester

Credit Points 18

Delivery Mode On-campus

Prerequisites Nil

Co-requisites Nil

Coordinator TBA

Synopsis

The subject provides the opportunity for students to attain knowledge of organizational structures and design and human resource management. Students will develop the skills and understanding of how to evaluate, plan, and scope projects, and manage risk and budgets. It enables students to learn about the project life cycle, contract negotiation, and project closure through a team-based practice approach.

Subject Topics

1. The planning process and the different types of organizational planning, the various forms of organizational structure, the principles of organizational design, and the role and functions of human resource management.
2. Major leadership styles and the characteristics and methods of effective leadership. Interacting professionally with team members and stakeholders to ensure a collaborative and successful project environment.
3. Project economic selection through the expression of interest, proposals, and rankings. Planning in alignment with the organization's strategic plans consultation with stakeholders, and business justification throughout its lifecycle.
4. Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements with the project's lifecycle.
5. Managing the scope, cost, timing, risk, and quality of the project throughout its lifecycle from the owners' and contractors' viewpoints.
6. Implement project management knowledge and processes to achieve project success including responding to issues that arise internally and externally.

Subject Learning Outcomes (SLOs)

After successful completion of the course students will be able to:

1. Understand organisational structures and planning and the synergisms and contributions that can be obtained through good team selection and leadership.
2. Evaluate project alternatives based on a triple bottom line approach through incorporating whole of life economic analysis, environmental and social impact.
3. Apply the management skills for different stages of a project, life cycle costing, project design concepts, structures and environments through reviewing contemporary case study projects.
4. Integrate systems engineering processes and project management practices to critically assess and evaluate project designs by using proposals/expressions of interest.
5. Identify project management tools and techniques to develop project proposals in response to client project briefing documents.
6. Apply a robust project risk identification, assessment and treatment process to ensure success of the project.

Assessment Tasks and Weightings

To obtain a pass grade in this subject a student must achieve 50% overall and at least 40% in the Project Plan assessment task. All assessment tasks are group-based, however, the awarded marks for the Project Plan and AV Presentation are composed 50/50 of group and individual group member marks.

Assessment Task 1: Team Formation Report. The report will provide details of preliminary team meetings and the roles of members. The group report is worth 10% of the marks for the Subject.

Assessment Task 2: Economic Evaluation. An economic evaluation will be undertaken by each team member for a provided project based on a triple bottom line approach considering all benefits and direct, indirect, social and environmental costs. The economic analysis contributes 15% towards the total marks for the subject.

Assessment Task 3: The Project Charter. The Charter is to be prepared within the project management context from the owner's viewpoint. In order to create the Project Charter students will need to consider the selection-initiation phase for a provided project. While the Charter does not need to be based on exhaustive and real data, realistic assumptions will be required to be made and the rationale for those assumptions must be provided. Marks will be distributed between team members based on allocation by the team. The Charter is worth 20% of the marks for the Subject.

Assessment Task 4: The Project Plan. This assessment task involves creating the Project Plan for the adopted project. The Plan is to be prepared within the project management context from the owner's viewpoint. In order to create the Project Plan students will need to consider the planning phase for the project. While the process does not need to be based on exhaustive and real data, realistic assumptions will be required to be made and the rationale for those assumptions must be provided. Marks will be distributed between team members based on allocation by the team. The Project Plan is worth 40% of the marks for the Subject.

Assessment Task 5: Audio Visual Presentation. A professional business standard Power Point presentation using appropriate graphics and communication skills, will be prepared and delivered to convince stakeholders who may not be professional engineers of the worthiness of the project. Marks will be allocated based on team and individual team member performance. The AV presentation is worth 15% of the marks for the Subject.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 14 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Albert Lester, Project Management, Planning and Control, Butterworth-Heinemann, 1st Ed. 2017, ISBN: 9780081020210
2. Abol Ardalan, Economic and Financial Analysis for Engineering and Project Management, Imprint CRC Press, 1st Ed, 2000

References

David Whitman; Ronald Terry, Fundamentals of Engineering Economics and Decision Analysis, Morgan & Claypool Publisher, 2012

Readings and Resources

Individual projects will require the use of a variety of resources - reference library, electronic resources, professional engineers, etc. Books and journal articles are available in the library. Electronic searching for articles (by author, title, keyword, etc) can be done either on Compendex or FirstSearch*. Searching the World Wide Web may also provide useful information for many projects . Journals can also be browsed in the journal reading room. *Students should remember that material published on the web is not necessarily reviewed or checked for accuracy.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EE321 Communications Systems I

Program Bachelor of Electrical Engineering (NQF Level 8)

Subject Name Communications Systems I

Subject Code EE321

Contact Hours 6 (3 Lect., 3 Labs)

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Credit Points 18

Delivery Mode On campus

Prerequisites EE311 Signals and Systems

EN221 Engineering Modelling (Including Statistics & Probability)

Co requisites None

Coordinator TBA

Synopsis

This introductory subject to modern communications systems focuses on digital data transmission. Digital transmission of data is more favorable over analog transmission in terms of the size of content being delivered, the quality of the transmission and the reduced size of physical infrastructure. However, all-natural signal exist in analog form and the subject commences with the study of conversion techniques in transforming the analog source signal into digital from that is processed, transmitted, retrieved and converted back to useful from for the end user. Digital modulation techniques involved in processing the digital for transmission is explored through theoretical and practical laboratory exercises. Ideal transmission medium is rare; thus, the unit concludes by discussing the different types of noise induced by the system and the propagation medium. Techniques to quantify the noise are developed through theoretical and analytical calculations with the help of mathematical tools.

Subject Topics

1. Topic 1: Pulse Modulation
    - Sampling Process
    - Pulse-Amplitude Modulation
    - Quantization Process
    - Modulation Techniques
    - Line Codes
2. Topic 2: Baseband Data Transmission
    - Baseband Transmission of Digital Data
    - Intersymbol Interference Problem
    - The Nyquist Channel
    - The Eye Pattern
    - Theme Example: Equalization
3. Topic 3: Digital Band-Pass Modulation and Demodulation Techniques and Circuits
    - Shift Keying Techniques
    - Noncoherent Digital Modulation Schemes
    - Demodulation Techniques
    - Receivers Circuits
4. Topic 4: Random Signal and Noise
    - Defining Probability and Random Variables
    - Determination of Expectation
    - Defining Random Process
    - Defining Gaussian Process
    - Defining and Calculating White Noise
5. Topic 5: Noise in Digital Communications
    - Bit Error Rate
    - Detection of a Single Pulse in Noise

- Error Detection and Correction
- Application in BPSK, QPSK and QAM Systems

6. Topic 6: System and Noise Calculations

- Electrical Noise
- Noise Figure
- Free-Space Link Calculations
- Terrestrial Mobile Radio

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Apply mathematical signals & systems theories to advanced communication systems
2. Evaluate and critique common communication systems in terms of their properties, advantages and disadvantages
3. Simulate the operation of communication systems to predict their performance
4. Design a communication system according to a given specification by using design calculations
5. Develop an appreciation of the benefits and problems associated with team-based engineering work

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved.

Subject assessment consists of two quizzes, two assignments, and a group project as summarised below. Students must also refer to the Assignments and the Subject Assessment Guide for Communication Systems I. Detailed information is provided for each assignment. Formative assessment in the form of online quizzes would be administrated every second week to aid learning.

Assessment 1 – **Laboratory Report**: This compilation of laboratory reports will measure the ability of the student to interpret the data collected from the experiment and make sense of the data. Collectively the laboratory report contributes 15% of the total marks for the subject.

Assessment 2 – Mid Term Exam: This assessment will test the theoretical understanding of the students of concepts learned in class under time and access to learning materials constraints. It will test their ability to remember the basic facts and be able to apply them in a given setting. The mid-term exam is worth 15% of the total marks for the subject.

Assessment 3 - Assignment 1 The assignment provides student with the opportunity to evaluate properties of common communications systems through simulation. The simulation assignment will evaluate the performance of digital modulation techniques, line codes and error detection. The analysis of the performance of each modulation techniques will be useful in the design of communications system for a given application. It contributes 15% of the total marks for the subject.

Assessment 4 - Assignment 2 The insight observed in assignment one is used in this assignment to design a communications system to satisfy a given set of operating parameters. The requirement of the assessment will bring together all the knowledge attained in this subject and extend that knowledge through a design challenge. The assignment is worth 15% of the total marks for the subject.

Assessment 5 – Final Examination: The final examination is aimed to test individual's knowledge and ability to apply the knowledge in designing of communications. The exam contributes 40% towards the total marks for the subject.

It is important that all students familiarise themselves with the University of Technology Assessment guidelines including those on plagiarism: http://www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Leon W. Couch, II, Digital and Analog Communication Systems, Prentice-Hall, 8th Ed., 2015
2. Simon S. Haykin & Michael Moher, An Introduction to Analog and Digital Communications, 5th Ed, 2006

References

1. Simon Haykin, Communication Systems, Wiley, 5th ed., 2009

Readings and Resources

1. An online course on Principles of Communications Systems https://onlinecourses.nptel.ac.in/noc19_ee08/preview
2. A fee online course on analogue communication that is briefly covered in this subject as introductory topic https://www.classcentral.com/course/swayam-principles-of-communication-systems-i-7963
3. An introductory course from MIT on Digital Communications that is similar in content to this subject: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EE322 Electrical Integrated Design

Program Bachelor of Electrical Engineering (NQF Level 8)

Subject Name Electrical Integrated Design

Subject Code EE322

Contact Hours 6 (2 Lect., 4 Project)

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Credit Points 14

Delivery Mode On campus

Prerequisites EE314, EE315 & EE321

Co requisites EN321

Coordinator TBA

Synopsis

This capstone electrical engineering integrated design subject enables students to work in teams to undertake a complex electrical engineering design project. The subject aims to develop students' abilities to design and build complex electrical engineering systems, understand the systemic implication of design decisions, understand design challenges and apply design theory. It covers design theory, designing for safety, risk, reliability and quality, designing to international and national standards and maintenance and life cycle costs. The subject includes designing for the integration of power, communication and computer systems as well as integrating mechanical systems and machines into electrical systems. Students will be able to apply classical design optimization methods such as linear programming, simplex algorithm and geometric programming for design optimization. In addition, students will consider newer design methodologies such as parametric design, robust design and axiomatic design.

Subject Topics

1. Understanding Design and Integrated Design
2. Communicating Design through drawings
3. Design tools: hardware and software
4. Design Phases

a. Design procedures

b. Objectives

c. Requirements

d. Functions and characteristics of design

e. Alternate solutions

f. Improving details

5. Managing Design

a. Design Strategies

b. Product Development

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Plan, manage and conceptualize an electrical engineering design project within requirements and constraints including electric loads, transmission and distribution requirements, time and resources using electrical power system knowledge, communications systems knowledge, programming knowledge and skills developed during the program.
2. Formulate a concept solution by applying, researching and synthesizing the knowledge gained throughout their course and apply problem-solving methodologies to generate, evaluate and justify proposed concept solutions.
3. Debate, negotiate, justify, clarify and respond to questions and statements concerning the proposed design concept in terms of:

a. integrating applicable power generation, transmission and distribution for each team member,
b. integrating power supply requirements, signal transmission networks, access techniques, routing strategies, network programming, data and network security for each team member.

4. Reflect on professional engineering practice and its impact on the design project, including safety, ethical, legal, social, cultural and sustainability considerations, along with standards and codes of practice.
5. Generate high quality documentation that incorporates a literature review, requirements analysis, project planning and a concept proposal.
6. Use design project management processes and tools, and self-management skills, communication skills, to plan and manage project work.

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved.

Assessment 1 – Design Project Concept Report: A team-based report outlining team formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the final design outcome. The report contributes 10% towards the final grade for the subject.

Assessment 2 – Design Progress Reports: Team based report outlining team progress in achieving design outcomes in line with the team schedule submitted in the Project Concept Report. Variations to the original schedule will be identified and justified. There will be three reports written by different members of the team. The Progress Reports contributes 15% towards the final grade for the subject.

Assessment 3 - Final Design Report: A professional level report with individual and team components that outlines and communicates the design processes, rationale and outcomes. The Final Report contributes 50% towards the final grade for the subject.

Assessment 4 - Audio Visual Presentation: An audio-visual presentation of design outcomes that contains the salient feature of the Final Report. All team members will contribute. The presentation contributes 25% towards the final grade for the subject.

It is important that all students familiarize themselves with the University of Technology Assessment guidelines including those on plagiarism: http://www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Nigel Cross, Engineering Design Methods: Strategies for Product Design, 5th Edition, 2021, Wiley & Sons
2. Stapelberg, Rudolph Frederick, Handbook of Reliability, Availability, Maintainability and Safety in Engineering Design, 2009, Springer

References

1. J. Duncan Glover, Thomas J. Overbye, Mulukutla S. Sarma, Power System Analysis and Design, 2017, 6th Edition, Cengage Learning
2. Haesik Kim, Wireless Communications Systems Design, 2015, John Wiley & Sons, Ltd.
3. Tony Kenyon, High Performance Data Network Design: Design Techniques and Tools, 2002, 1st Edition, Digital Press

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EE323 Mobile Communications

Program Electrical Engineering (NQF Level 8)

Subject Name Mobile Communications

Subject Code EE323

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 4 hours per week (3 Lect. + 1Tutorial)

Credit Points 16

Delivery Mode On campus

Prerequisites EE321 Communication Systems 1

Co-requisites

Coordinator TBA

Synopsis

Mobile Communication is the use of technology that allows us to communicate with others in different locations without the use of any physical connection (wires or cables). Mobile communication makes our life easier, and it saves time and effort. This course aims on learning of the key factors driving the telecommunications revolution and the characteristics of the mobile computing environment and their implications. In this course, students get the detailed knowledge acquisition about the communication technologies of wired, wireless and cellular WANs and fading in Mobile communication. Furthermore, this course will explore various approaches of security and students learn the implementation of security in WAN.

Subject Topics

1. Transmission Fundamentals
    a. The cellular revolution
    b. Global Cellular network
    c. Channel Capacity
    d. Multiplexing
2. Issues in Mobile Computing
    a. Adaptability, the key to mobile computing
    b. How to develop or incorporate adaptations in applications?
    c. Mobility management
    d. location management
3. Mobile Communication Technology
    a. Antennas
    b. propagation modes
    c. line-of-sight transmission
    d. fading in the mobile environment
4. Multiple Access in Mobile Communication
    a. The concept of spread spectrum
    b. Frequency Hopping spread spectrum
    c. Direct sequence spread spectrum
    d. Bluetooth
5. Pervasive Computing
    a. Introduction to ad hoc and sensor networks
    b. Unique features of sensor networks
    c. Challenges
    d. Routing Protocol LEACH, PEGASIS
6. Mobile Communication Security
    a. Basic Idea, CDMA, GSM,
    b. GSM authentication,
    c. GSM encryption
    d. Problems with GSM Security
    e. Limitations

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Abstract the reasons of cellular revolution and able to calculate the channel capacity for given mobile communication scenario.
2. Hypothesise how the mobile roaming concept is implemented in real world.
3. Evaluate the distance between two antennas for good mobile communication.
4. Theorise how to implement the multiple access concept in mobile communication.
5. Compare the real-world applications of sensor networks.
6. Analyse the basic security principles in GSM.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject one is required to obtain at least 50% overall. The assessment weight comprises of 50% internal and 50% external exam. The internal assessment comprises of assessment items namely, Assignments, Quizzes and Tests.

Students must also refer to the Subject Assessment Details.

Assessment Task 1- Assignment 1: This assignment provides students the opportunity to demonstrate their knowledge on how to calculate the channel capacity and the implementation of roaming concept in mobile communication system. The students are able to calculate the distance between two antennas for better mobile communication. The same will contributes 5 % towards the final grade for the subject.

Assessment Task 2- Assignment 2: This assignment provides students the opportunity to demonstrate their knowledge on multiple access in mobile communication on the routing protocols used in mobile communication and their associated applications. The students will also analyse the basic security principles in mobile communication. The same contributes 5% towards the final grade for the subject.

Assessment Task 3- Class Test 1: There will be two class tests for this subject. This assessment will test the students' understanding and comprehension on cellular revolution, issues in the mobile communications. It will also include critical thinking and analysis applied by solving channel capacity and implementation problems in mobile communication.

Assessment Task 4- Class Test 2: This assessment will test the students' understanding and comprehension on various multiple access methods and routing protocols for mobile communication and its associated security issues along with their possible solutions.

Assessment Task 5- Final Exam: The final examination is of 3 hours duration and will assess student's achievement of the all the learning outcomes. The final exam is worth 50% of the total mark for the subject.

Note: It is important that all students familiarize themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 weeks semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

- Fundamentals Of Mobile and Pervasive Computing, Adelstein Frank, Sandeep K. S. Gupta, Golden G. Richard Iii, Loren Schwiebert, 1st 2005 Mcgraw Hill Education
- Wireless Communications & Networks, William Stallings, 2nd, 2009,Pearson.

References

- Mobile Computing, Asoke K. Talukdar, Hasan Ahmed, Roopa R Yavagal, 2nd 2010 Mcgraw Hill Education

Readings and Resources

- http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/vk5/report.html
- www.nptel.ac.in/courses/106105080/pdf/M5L9.pdf
- www.cs.ccsu.edu/~stan/research/pervasive/pubs/icict2007.pdf

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EE324 Electric Machines and Drives

Program Electrical Engineering (NQF Level 8)

Subject Name Electrical machines and Drives

Subject Code EE324

Duration 13 teaching weeks plus 1 examination week and 1 mid-semester week

Contact Hours 6 (3 Lect, + 1 Tut, +2 Lab.)

Credit Points 19

Delivery Mode On campus

Prerequisites EE313 Electric Machines

EE211 Electromagnetic Fields and Wave Theory

Co-requisites

Coordinator TBA

Synopsis

This course covers the steady-state theory of electric machines. It will enable students to attain adequate knowledge in understanding the operating principles and characteristics of AC electrical machines which are used in many industrial applications such as utility power system, wind power generation, fossil fuel power plants, and many industrial processes. Practical mathematical models for most types of AC motors, generators, and their drive systems commonly used in industry will be discussed, and the models will be used to analyse power requirements, power capability, efficiency, operating characteristics, speed control requirements.

Subject Topics

1. Review of Electromagnetic Principles
   a. Review of Faraday's Law of Electromagnetic Induction
   b. Ampere-Biot-Savart's Law of Electromagnetic Induced Forces
   c. Lenz's Law of Action and Reaction
   d. Electromechanical Energy Conversion
2. Three-phase Synchronous Generators
   a. Construction of a Synchronous Machine
   b. Armature Windings
   c. Pitch Factor
   d. Distribution Factor
   e. Winding Connections
   f. Induced EMF Equation
   g. The Equivalent Circuit
   h. Power Relationships
   i. Synchronous Generator Tests
   j. The External Characteristic
   k. Salient-Pole Synchronous Generator
   l. Drive Systems of Synchronous Generators
3. Synchronous Motors
   a. Construction and Operation of a Synchronous Motor
   b. Equivalent Circuit of a Synchronous Motor
   c. Power Expressions
   d. Exact Condition for Maximum Power
   e. Effect of Excitation
   f. Power Factor Correction
   g. Drive System for Synchronous Motors
4. Polyphase Induction Motors
   a. Construction
   b. Principle of Operation
   c. Development of an Equivalent Circuit
   d. An Approximate Equivalent Circuit

e. Maximum Power Criterion
f. Maximum Torque Criterion
g. Maximum Efficiency Criterion
h. Equivalent Circuit Parameters
i. Starting of Induction Motors
j. Rotor Impedance Transformation
k. Speed Control of Induction Motors
l. Types of Induction Motors
m. Variable Speed Drive using Cycloconveters

5. Single-phase Motors
   b. Single-Phase Induction Motor
   c. Analysis of a Single-Phase Induction Motor
   d. Types of Single-Phase Induction Motors
   e. Analysis of a Single-Phase Motor Using Both Windings
   f. Testing Single-Phase Motors
   g. Shaded-Pole Motor
   h. Universal Motor
6. Special Purpose Electric Machines
   a. Permanent-Magnet Motors
   b. Step Motors
   c. Switched-Reluctance Motors
   d. Brushless DC Motors
   e. Hysteresis Motors
   f. Linear Induction Motors

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the fundamental parts of electrical drives including converters, electrical machines and loads.
2. Explain the operating principles of, synchronous machines, induction machines, and their drive requirements.
3. Identify and model magnetic and electric circuit parameters in modelling of electrical machines
4. Use equivalent circuits to analyze electrical machines in steady state, and construct phasor diagrams for various loads and to use the vector method for analysis of AC machines.
5. Explain the operation principles of special purposes electric machines such as permanent magnet motors, step motors, switched reluctance motors, brushless DC motors, hysteresis motors, and linear induction motors.

Assessment Tasks and Weightings

Your final grade will be the result of 5 components: Assignments 1 (10%, Assignments 2 (10%), Laboratories (20%), Class Test (20%) and Final Exam (40%).

Assessment 1 – Assignment 1 Three-phase Synchronous Machines: Analytical and critical thinking analysis applied in (i) electromagnetics principles, and (ii) solving machines equations for synchronous machines using equivalent circuits, power relationships and relevant mathematical equations for both wound rotor, and salient pole synchronous generators and motors. The Assignment contributes 10% towards the final grade for the subject.

Assessment 2 – Assignment 2 Three-phase Asynchronous Machines: Analytical and critical thinking analysis applied in solving machines equations for three-phase asynchronous machines using equivalent circuits, power relationships and relevant mathematical equations. The Assignment contributes 10% towards the final grade for the subject.

Assessment 3 - Test – This assessment will test the understanding and comprehension of the physics of electromagnetic principles, and synchronous machines. It will include (i) solving machines equations for synchronous machines using equivalent circuits, power relationships and relevant mathematical equations for both wound rotor, and salient pole synchronous generator and motors. This assessment will require, analytical and critical thinking analysis applied in solving machines equations for three-phase asynchronous machines using equivalent circuits, power relationships and relevant mathematical equations. Further, the test will include analytical and critical thinking analysis applied in solving machines equations for single-phase induction motors using equivalent circuits, power relationships and relevant mathematical equations. The test will contribute 20% towards the final grade for the subject.

Assessment 4 - Laboratories - Laboratory sessions, where students will perform experimental verifications. Students will be required to perform four experiments and record the results and write the reports on the following topics; 1. To perform synchronous generator tests to determine circuit parameters. 2. A field trip to a power house to learn about the working

principle different power generators and turbines types and observe the synchronizations of generators. 3. To perform asynchronous machines tests to determine circuit parameters, and 4. To study the following methods in starting three-phase induction motor (i) Autotransformer starter, (ii) Direct-online starter, and (iii) star-delta starting. The laboratory will require field trips as well as laboratory work which will comprise of both hardware and software based modelling. The laboratories will contribute 20% towards the final grade for the subject.

Assessment 5 - Final Examination – The final examination is of 3 hours duration and will assess student's achievement of the all the learning outcomes. The final exam is worth 40% of the total mark for the subject.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

B. S. Guru and M.R. Hiziroglu, Electric Machinery & Transformers 3rd Edition, Oxford University Press, 2003.

References

1. George McPherson and Robert D. Lueamore , "An Introduction to Electrical Machines and Transformers," 2nd Edition,., John Wiley & Sons, Inc. 1990

2. J. Chapman, "Electric Machinery Fundamentals", 4e, McGraw-Hill.

3. A.E. Fitzerald, Jr. Stephen D. Umans, "Electric Machinery", Sixth Edition, McGraw Hill

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Readings and Resources

Web-based tools for design:

Saadat, H. (2012). MATLAB Graphical User Interface for EE Students. Date of access: March 31, 2012, Available from <http://people.msoe.edu/~saadat/matlabgui.htm

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at **www.unitech.ac.pg/AssessmentGuide/** and **www.unitech.ac.pg/Plagiarism/**

EN411 Research Project A

Programs Bachelor of Mechanical Engineering (NQF Level 8)

Subject Name Research Project A

Subject Code EN411

Duration 13 teaching weeks, plus 1 examination week and 1 mid-semester week

Contact Hours 6 hours per week (1 hour lecture, 5 hours project directed, 5 hours self-study)

Credit Points 20

Delivery Mode On campus

Prerequisites All Year 3 Subjects

Co-requisites Nil

Coordinator TBA

Synopsis

This subject outlines the commencement of undertaking of research that will augment professional work in the student's engineering discipline and form a foundation for future learning and professional development. It is intended to help students develop the cognitive skills for to think critically about research methods and literature reviews. The subject covers the introduction to research investigation through the creation of a research hypothesis, critical review and interpretation of literature on an approved topic and communication of those outcomes. The research provides an opportunity for the practical application and integration of the student's professional background and skills, and previous studies in the discipline's supporting subjects. The subject is student focused with students progressing at their own pace to meet assessment tasks, supported by their academic supervisor.

Subject Topics

Topic 1 concerns developing a research proposal and outlines the various types of research that may be undertaken by engineers and suggests that most engineers typically undertake research in the applied research space, using a quantitative approach.

Topic 2 stresses the importance of developing the research hypothesis/question for the topic is stressed along with the need to ensure that the proposed research can be completed within the time allocated to the project.

Topic 3 outlines definitions, structures and the role of the literature review in a research report. It stresses how one of the most important roles of the literature review is to show where the proposed research fits within, and augments, the existing international contemporary literature.

Topic 4 involves the provision of guidance on structuring and writing the Literature Review Report and communication the outcomes via an audio-visual presentation.

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Explain the various types of research that may be undertaken by engineers and the use of quantitative and qualitative research methodologies.
2. Develop and justify a research question/hypothesis and proposal supported by an appropriate quantity and quality of references.
3. Source and critically evaluate and synthesize research literature to determine the level of contemporary knowledge in a specialist area.
4. Construct a literature survey that places a research hypothesis/question within the national and international contemporary space and justifies the research hypothesis.
5. Create audio visual presentations that communicates the outcomes of the research, including the literature survey to a diverse audience.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the Research Project a Final Report.

Students must also refer to the individual Subject Assessment Details.

Assessment Task 1 requires the development of the Research Proposal, the research proposal/question and outlining the proposed research background and methodology to ensure that the proposed research is achievable. The approved proposal will be presented to the student cohort, academic staff and the wider profession. It is worth 10% of the total marks for the Subject.

Assessment Task 2 helps to facilitate the structured development of the research project and its literature review by requiring two Research Project A Progress Reports, which must include mapping against the semester's plan and a summary of the international literature reviewed to date and other outcomes. The progress reports will be presented to the student cohort, academic staff and the wider profession. They are worth 10% each and 20% overall of the total marks for the Subject.

Assessment Task 3 requires the production of the Research Project A Final Report that will largely be a critical review of the international literature and include ethical and sustainability aspects. Details of any other research outcomes will be included. The final report will be presented in a form that will integrate well into the Research Project Thesis that is the culmination of Research Project. It is worth 50% of the total marks for the Subject.

Assessment Task 4 provides an opportunity for the Audio-visual Presentation of the Research Literature Review Outcomes. The presentation must reflect and summarise the Research Project A Final Report. It will be at a professional level and include both visual and audio and must be delivered to the student cohort for the Subject, academic staff and the wider profession. It is worth 20% of the total marks for the Unit.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism at:

http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework. The subject is student focused and the amount of time spent by student will vary significantly.

Subject Text

Theil, D.V 2014, Research Methods for Engineers, Cambridge University Press, Cambridge

References and Readings

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism and other relevant policies via the link: http://www.unitech.ac.pg/unitech/policies

EE411 Control Systems

Program Electrical Engineering (NQF Level 8)

Subject Name Control Systems

Subject Code EE411

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 (3 Lect, + 1 Tut, +2 Lab.)

Credit Points 17

Delivery Mode On campus

Prerequisites EE222 Analog Electronic and Circuits & EE311 Signals and Systems

Co-requisites None

Coordinator TBA

Synopsis

Control Systems is the study of the analysis and regulation of the output behaviour of dynamic systems subject to input signals. This subject addresses the mathematical modelling of electrical circuits, servo-motors, position and speed control systems and the transient response analysis of first and second order control systems. This subject provides the students with the essential knowledge of the principles of mathematical modelling and analysis of system performances in the time domain and frequency domain. The mathematical modelling involves analytical solution using Laplace Transform of transfer functions of various electrical and mechanical control systems. In the design and analysis of the control systems, the MATLAB and SIMULINK control toolboxes are used. The use of PID controllers and velocity feedback control are taught and the stability and error analysis in the time domain involving s-plane and Routh criterion are carried out. Control system design and analysis in the frequency domain involving Nyquist, Bode and compensation techniques are carried out and digital control system is compared with classical control system.

Subject Topics

1. Introduction to Control Systems
   - 1.1 Control Systems History, Theory and Definitions.
   - 1.2 Open and closed-Loop Control systems.
2. Mathematical Modelling and Transfer Function of Control Systems
   - 2.1 Ordinary differential Equations.
   - 2.2 Laplace Transform Method.
   - 2.3Transfer functions of Electrical RLC Circuits, Mechanical Translational and Rotational Systems.
   - 2.4 Transfer Functions of DC Generators, Servo-motors and Servomechanism.
   - 2.5 Block Diagrams and Signal-Flow Graph Models
3. Time Domain Analysis and Design of Control Systems
   - 3.1 Routh-Hurwitz Stability Criterion Method
   - 3.2 Proportional, Integral and Derivative (PID) Methods
   - 3.3 Root Locus Method
4. Frequency Domain Analysis and Design of Control Systems
   - 4.1 Nyquist diagram and Bode Plot Methods.
5. Design and Compensation Techniques of Control Systems
   - 5.1 Phase Lead and Phase Lag and their Applications.
6. Digital Control Systems
   - 6.1 Digital computer control Systems Applications.
   - 6.2 Sampled-Data Systems

6.3 The z-Transform

6.4 Closed-Loop Feedback Sampled-Data Systems

Subject Learning Outcomes (SLOs)

On completion of this subject, students will be able to:

1. Explain and compare the Fundamentals and Operation of Open and Closed-loop Control Systems.
2. Apply Ordinary Differential Equations and Laplace Transform Techniques to Model Dynamic Systems and Examine their Output/Input Behaviour.
3. Analytically Quantify the Time Domain and Frequency Domain Behaviour of Dynamic Control Systems to Improve the System Performance.
4. Synthesise Feedback Controllers using Routh-Hurwitz, PIDs, Root Locus, Nyquist, Bode, and Compensation techniques to improve the System Performance.
5. Compare Digital Control Systems to Classical Control Systems
6. Employ MATLAB and SIMULINK Toolboxes to Simulate and Synthesise Dynamic Control Systems and Experimentally Characterise the Behaviour of Elementary Feedback Control Systems.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall, and at least 50% for the achieved in the Final Examination.

Students must also refer to the Subject Assessment Details.

The subject assessments consist of two assignments (20%), a class test (15%), four laboratory reports (15%) and a final examination (50%) as shown below.

1. **Assignment 1** - This assignment is given to students to assess their competence level of understanding, knowledge, comprehension and analysis of the open and closed-loop control systems and applying the ordinary differential equations and Laplace Transform techniques to model the dynamic control systems. The assignment contributes 10% towards the final grade for the subject.
2. **Assignment 2** - This assignment is given to students to assess their competence level of understanding, knowledge, comprehension and analysis of the time domain and frequency domain behaviour of dynamic control systems and use of the various techniques to improve the performance of the control systems. The assignment contributes 10% towards the final grade for the subject.
3. **Class Test** – This assessment will test the understanding and comprehension of the basic control systems. It will include use of various analytical methods and analysis techniques to analyse the performance of the control systems. The test will contribute 15% towards the final grade for the subject.
4. **Laboratories** - Laboratory sessions, where students will perform experimental verifications. Students will be required to perform four experiments and record the results and write the reports on the following topics;

   Laboratory 1. Carry out basic RLC circuit analysis (4%) to verify the output/input relationships of open and closed-loop control systems.

   Laboratory 2. Perform mathematical analysis (4%) using the ordinary differential equations and Laplace Transform techniques and verify the system behaviour using MATLAB simulation control toolbox.

   Laboratory 3. Carry out time-domain and frequency-domain analysis (4%) using MATLAB and Simulink simulation control toolbox.

   Laboratory 4. Design and analyse system dynamic behaviour (3%) using MATLAB and SIMULINK simulation toolboxes.

   The four laboratories will contribute a total of 15% towards the final grade for the subject.

5. 5.**Final Examination** – The final examination is of 3 hours duration and will assess student's achievement of the all the learning outcomes. The final exam is worth 50% of the total mark for the subject.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Richard C. Dorf, Robert H. Bishop, Modern Control Systems, 13th Edition, Prentice Hall, 2016.

References

1 Katsuhiko Ogata, Modern control Engineering, 4th Edition, Prentice Hall 2010.

2 Norman S. Nise, Modern control Engineering, 6th Edition, John Wiley & Sons, Inc.

3. Naresh K. Sinha, Control System, HRW International Editions

Readings and Resources

1. https://nptel.ac.in/courses/108101037/

2. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-30-feedback-control-systems-fall-2010/lecture-notes/

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism and other relevant policies via the link below:

http://www.unitech.ac.pg/?q=unitech/policies

EE412 Information Theory

Program Electrical Engineering (NQF Level 8)

Subject Name: Information Theory

Subject Code: EE412

Duration: 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours: 5 [3 Lect. + 2 Tut.]

Credit Points: 16

Delivery Mode: On campus

Prerequisites: EN221 Engineering Modeling, EE311 Signals and Systems & EE321 Communications Systems I

Co-requisites: None

Coordinator(s): TBA

Synopsis

Information Theory is concerned with the fundamental limits of communication and coding theory and with practical techniques to realize the limits specified by information Theory. The subject introduces the principles and applications of Information Theory in communications systems. Students will study how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies for both discrete and continuous random variables; how these are used to calculate the channel capacity of a communication channel, with or without noise; coding schemes, including error correcting codes; how discrete channels and measures of information generalize to their continuous form.

Subject Topics

1. Entropy

   - Entropy, Joint Entropy & Conditional Entropy
   - Relative Entropy and Mutual Information
   - Chain Rules
   - Data-Processing Inequality, Fano's Inequality

2. Channel Capacity

   - Symmetric Channels
   - Properties of Channel Capacity
   - Jointly Typical Sequences
   - Channel Coding Theorem
   - Fano's Inequality and converse to the coding Theorem

3. Differential Entropy and Gaussian Channel

   - Differential Entropy
   - AEP for continuous random variables
   - Properties of Differential Entropy
   - Relative entropy & Mutual Information

4. Linear Binary Block Codes

   - Introduction, Generator & Parity- Check Matrices
   - Repetition & Single- Parity Check codes
   - Binary Hamming Codes, Error detection with Linear Block codes
   - Hard-Decision and Soft-Decision decoding of Linear block codes

- Cyclic Codes
- Parameters of BCH and RS codes, interleaved and concatenated Codes

5. Convolution Codes

- Encoder Realization & Classification
- Minimum Encoders
- Trellis representation, MLSD and the Viterbi Algorithm
- Bit-wise MAP Decoding and BCJR Algorithm
- Huffman Codes, Optimality of Huffman codes

Subject Learning Outcomes (SLOs)

At the completion of the topics, students should be able to:

1. Investigate the trade-offs in real systems between signal-to-noise ratio, bandwidth and rate of information transfer.
2. Simulate and compare the concept of various channel coding schemes with operating parameters
3. Evaluate error control coding.
4. Investigate linear and cyclist block codes.
5. Analyze the basic principles underlying cryptography

Assessment Tasks [AT] and Weightings

To obtain a pass grade in this Subject one is required to obtain at least 50% overall. The assessment weight comprises of 50% internal and 50% external exam. The continuous assessment comprises of assessment items namely, Assignments, and Tests.

Assessment Task #	Assessment Component	Weight (%)
1	Assignment 1	10
2	Assignment 2	10
3	Class Tests	30
4	Final Exam	50

Note: Students must also refer to the Subject Assessment Details.

Subject Assessment Tasks Details

Assessment Task 1- Assignment 1: The assignment provides students the opportunity to demonstrate their knowledge on how to calculate signal-to-noise ratio and their associated bandwidth and how to implement the concept of channel coding. This assignment contributes 10 % towards the final grade for the subject.

Assessment Task 2- Assignment 2: The assignment provides students the opportunity to demonstrate their knowledge on how to calculate error control coding, investigate the cyclic codes and their associated security concern. This assignment contributes 10% towards the final grade for the subject.

Assessment Task 3- Class Tests: There will be two tests. They will evaluate the student attainment of the subject learning outcomes. Test 1 considers the trade-offs in real systems and the concept of channel coding. Test 2 involves linear block codes and convolution codes. The student will evaluate the error channel coding, calculate the cyclic block codes and their security principle associated with them. The tests are worth 15 % each and overall contribute 30% towards the final marks for the subject.

Assessment Task 4- Final Exam: The final examination is of 3 hours duration and will assess student's achievement of the all the learning outcomes. The final exam is worth 50% of the total mark for the subject.

Note: It is important that all students familiarize themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the average student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

a. Orhan Gazi, Information Theory for Electrical Engineers, Springer, 2018
b. Thomas Cover & Joy Thomas, Elements of Information Theory, 2nd Edition, Wiley, 2006

References

William Ryan & Shu Lin, Channel Codes: Classical and Modern, Cambridge University Press, 2009

Readings and Resources

1. Information Theory and Coding course online by National Program on Technology Enhanced Learning at https://nptel.ac.in/courses/117101053/

Relevant Unitech Policies

It is important that all students familiarize themselves with the University of Technology policies on teaching and learning including assessment via the link below:

http://www.unitech.ac.pg/?q=unitech/policies

EE413 Embedded Systems Design and Interfacing

Program Electrical Engineering (NQF Level 8)

Subject Name Embedded Systems Design and Interfacing

Subject Code EE413

Contact Hours 6 (3 Lect., 1 Lab., 2 Proj.)

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week Break

Credit Points 17

Delivery Mode On campus

Prerequisites EE221 Digital Logic Systems, & EE222 Analog Electronics and Circuits

Co requisites EE321 Communications Systems I

Coordinator TBA

Synopsis

This subject enables student to attain sound knowledge and skills in the design of embedded solutions to solve engineering challenges. It will assist students to develop cognitive skills to think critically about the techniques of interfacing microcontrollers in circuits. The subject examines the different ways in current microcontrollers are interfaced with the peripheral components in selected applications.

Subject Topics

1. Topic 1: Introduction to Embedded Systems Design
    - Define embedded systems design principles and select a problem for the major project
    - Compare and contrast microprocessors and microcontrollers in terms of structure, features and application
    - Principles of Building large projects with microcontrollers
2. Topic 2: Microcontrollers
    - Hardware Structures and Features in relation to practical application examples
    - Instruction Sets and Instruction Cycle
    - Chose a microcontroller for the project
    - Evaluate the systems bus characteristics of the chosen microcontroller
3. Topic 3: Programming in Assembly Language and C
    - Code the routine functions for the project in Assemble language and C
    - Socket programming in Assembling and C language
4. Topic 4: Introduction to Interfacing Techniques
    - Describe the standards of interfacing in small to medium embedded system
    - Design the necessary circuits for the project
    - Implement the code in either C or Assembly Language
5. Topic 5: Interfacing the real world
    - Sensors and actuators
    - Data communications
    - PCB hatching and Soldering techniques

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Compare and contrast the design of microprocessors and microcontrollers with reference to problem requirements and provide viable solutions;
2. Critically appraise and apply interfacing techniques to interconnect microcontrollers with a variety of peripheral devices;
3. Analyse and assess viable interfacing solutions to specific problems to ensure the solution is safe and technically sound;

4. Design automated electronic solutions to a problem for standalone and non-standalone systems.

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved and at least 60% in the final project. There is no final exam for this subject.

Subject assessment consists of three assignments and a group project as summarised below. Students must also refer to the Assignments and the Subject Assessment Guide for Embedded Systems Design and Interfacing. Detailed information is provided for each assignment.

1. **Assignment 1** The assignment provides student with the opportunity to develop in-depth knowledge of microprocessors and microcontrollers. The research assignment will evaluate the available microprocessors and microcontrollers in terms of their internal structures, processing speeds, instruction sets, instruction cycle and implementation of packaging choice. The theory will guide the students in deciding on the appropriate microcontroller for the project. 10%
2. **Assignment 2** This assignment involves the development of interfacing routines based in either Assemble language or C programming language in interfacing a simple standalone system. 15%
3. **Assignment 3** This assignment involves the development of interfacing routines based on Assembly language or C programming language in providing interconnectivity of simple standalone system. 15%
4. **Project Report:** A professional level report with individual and team components that outlines and communicates the design processes, rationale and outcomes. The major design allows the student to prepare a professional level microcontroller-based system design report. It involves undertaking an analysis of problem and proposing a minimum of 3 alternative design options. A whole of life cycle cost analyses is undertaken for the selection of the optimal alternative. The major design contributes 40% towards the total marks for the subject. 40 %
5. **Major Project Presentation**: An audio-visual presentation of design outcomes that contains the salient feature of the Final Report. All team members will contribute. 20%

It is important that all students familiarise themselves with the University of Technology Assessment guidelines including those on plagiarism: www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 teaching week as per the PNG National Qualification Framework.

Subject Text

1. Jonathan W. Valvano, Embedded Systems: Real-Time Interfacing to the Arm® Cortex(TM)-M3, 5th Edition, 2014
2. Peter Marwedel, Embedded System Design: Embedded Systems, Foundations of Cyber-Physical Systems, and the Internet of Things, 3rd Edition, 2017, Springer

References

1. Jivan Parab, Santosh A. Shinde, Vinod G Shelake, Rajanish K. Kamat, Gourish M. Naik, Practical Aspects of Embedded System Design using Microcontrollers, 2008, Springer
2. Mazidi and Mazidi: The 8051 Microcontroller and Embedded Systems, Pearson Education.

Readings and Resources

1. Online course on Embedded Systems Design that is similar to this subject - https://www.classcentral.com/course/nptel-embedded-system-design-with-arm-12936
2. A. V. Deshmukh: Microcontroller (Theory and Application), TMH.
3. Raj Kamal: Embedded Systems- Architecture, Programming and Design, TMH.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism and other relevant policies via the link below:

http://www.unitech.ac.pg/?q=unitech/policies

EE414 Electrical Power Systems II

Program Electrical Engineering (NQF Level 8)

Subject Name Electrical Power Systems II

Subject Code EE414

Duration 13 Teaching Weeks + 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 hours per week (3 lectures + 1 Tutorial + 2 Laboratory)

Credit Points 17

Delivery Mode On campus

Prerequisites EE315 Electrical Power Systems I

Co-requisites

Coordinator TBA

Synopsis

This subject progresses from EE315. It deals with the fundamentals of power system controls. The subject begins with optimal generation control and dispatch for economic operation observing generation constraints as well as system losses. The subject extends to modelling of power system components including; prime mover systems, generators, loads and governor systems for power-frequency control. It also presents an overview of automatic generation control (AGC) for 1 and 2 area systems and the tie-line bias control. Furthermore, the subject discusses voltage and reactive power control including excitation systems, automatic voltage regulator (AVR) and tap changing transformers.

Subject Topics

1. OPTIMAL DISPATCH OF GENERATION

   1.1 Formulation of the Economic Dispatch Problem
   1.2 Operating Cost of a Thermal Power Plant
   1.3 Economic Dispatch Neglecting Losses and No Generator Limits
   1.4 Economic Dispatch Neglecting Losses and Including Generator Limits
   1.5 Economic Dispatch Including Losses
   1.6 Derivation of Transmission Loss Formula

2. LOAD FREQUENCY CONTROL

   2.1 Fundamentals of LFC and Power - Frequency Relation
   2.2 Basic Generator Control Loops
   2.3 Generator Model
   2.4 Load Model
   2.5 Prime Mover Model
   2.6 Governor Model
   2.7 Transfer Function Model for Control

3. AUTOMATIC GENERATION CONTROL

   3.1 Fundamentals of Automatic Generation Control (AGC)
   3.2 Concept of Control Area
   3.3 AGC in Single Area System
   3.4 AGC in Two Area System
   3.5 Tie-Line Bias Control
   3.6 AGC with Optimal Dispatch of Generation

4. VOLTAGE AND REACTIVE POWER CONTROL

   4.1 System Voltage and Reactive Power
   4.2 Reactive Power Generation by Synchronous Machines
   4.3 Effect of Excitation Control
   4.4 Voltage Regulation and Power Transfer
   4.5 Exciter and Automatic Voltage Regulator
   4.6 Tap Changing Transformers

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Define the optimal power flow problem and select appropriate generator operating parameters for economic generation scheduling
2. Explain power-frequency relationship and demonstrate this relation through transfer function model of system components
3. Analyse variation of frequency with time for single-and two-area systems for step load increases for both controlled and uncontrolled cases.
4. Explain the tie-line bias control
5. Evaluate the methods of controlling the voltage and reactive power in a power system.
6. Analyse the method of voltage control through tap changing transformers

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved and at least 40% achieved in the final examination.

The subject assessment consists of two assignments (10%), two tests (20%), five laboratory assignments (20%) and a final examination (50%) as summarised below. Students must also refer to the Subject Assessment Guide for Introduction to Circuits and Electronics. Detailed information is provided for each assignment.

Assessment Task (AT)

1. **Assignment 1** This assignment gives the opportunity to students to evaluate and reinforce their understanding and knowledge the fundamentals of optimal dispatch of generation for economic operation. The Students will calculate the generator unit load sharing based on economic scheduling considering generator constraints and line losses.
2. **Assignment 2** This assignment gives the opportunity to the students to evaluate and reinforce their understanding of the students on Load-Frequency Control, Automatic Generation Control and Tie-Line Bias Control.
3. **Test 1** This test will evaluate the students' understanding and comprehension Reactive Power Generation and Effect of Excitation Control in Synchronous Generators.
4. **Test 2** This test will evaluate the students' understanding and comprehension on the fundamentals of Voltage and Reactive Power Control and Voltage Control using Tap-Changing Transformers.
5. **Laboratories** There will be five laboratories to be conducted and assessed. Each laboratory will contribute 4% to the total assessment items mark of 20%. The laboratory activities allow the student to prepare a professional level of application design. It involves undertaking an analysis of various circuits and design of minimum of 3 alternative circuits for specific applications.
6. **Final Examination** The final examination is of 3 hours duration given at the end of the semester. The examination questions are derived from the course materials covered throughout the semester, and are intended to evaluate, knowledge, comprehension, and applications skills.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. H. Saadat, Power System Analysis, 3rd Ed., PSA Publishing, 2011
2. J.D. Glover, T. Overbye and M.S. Sarma, Power System Analysis and Design, 6th Ed.,Cengage Learning, 2016
3. D.P Kothari and I.J Nagrath, Modern Power System Analysis, 3rd Ed., McGraw-Hill, 2009

References

4. 1.M.E. El-Hawary, Electrical Power Systes Design and Analysis, IEEE Press
5. 2.P.S.R Murty Operation and Control in Power Systems, B S Publications

Readings and Resources

All Lecture Notes, Assessment Items and Projects will be accessed through Google Classroom

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology policies on teaching and learning including assessment via the link below:

http://www.unitech.ac.pg/?q=unitech/policies

EE415 Power Electronics I

Program Electrical Engineering (NQF Level 8)

Subject Name Power Electronics I

Subject Code EE415

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 (3 Lect + 1 Tut + 2 Lab)

Credit Points 17

Delivery Mode On Campus

Prerequisites None

Co-requisites EE313 Electric Machines

Coordinator TBA

Synopsis

This Subject introduces Power Electronic fundamentals and their application to students. The subject covers the theory and operation of power semiconductor devices, uncontrolled/controlled rectifiers, ac voltage controllers, dc-dc converters (choppers), voltage source converters and ac motor drives.

Subject topics

1 Introduction to Power Electronics covers the following topics:

- 1.1 Power electronic switching devices which fall under diode, Thyristor and Transistors.
- 1.2 Voltage and Current ratings of the devices
- 1.3 IV characteristics
- 1.4 Control and its applications

2 Uncontrolled and controlled rectifiers

- 2.1 Analysing half-wave rectifier with resistive load
- 2.2 Analysing half-wave rectifier with resistive-Inductive Load
- 2.3 Analysing full-wave rectifier with resistive load
- 2.4 Analysing full wave rectifier with resistive-inductive load

3 AC voltage controllers and cyclo-converters

- 3.1 single-phase AC voltage controller
- 3.2 three-phase AC voltage controllers
- 3.3 Cycloconvertor principle
- 3.4 Cycloconvertor circuits
- 3.5 Single phase and three phase cycloconverrter

4 Types of Converters

- 4.1 DC –DC converters
- 4.2 Buck converters
- 4.3 Boost converters
- 4.4 Buck-converters
- 4.5 SEPIC converters
- 4.6 Flyback converters
- 4.7 Bridge converter
- 4.8 Forward converters
- 4.9 Push-Pull converters

5 Voltage source converters and control

- 5.1 Electromechanical converters
- 5.2 Two-level converter
- 5.3 Three-level converter
- 5.4 Modular Multi-Level Converter (MMC)

5.5 Rectifier
5.6 Inverter.

6 Power electronic applications in power systems

6.1 application of power electronic devices in industries
6.2 automotive applications of power electronics systems

7 Waveform analysis, harmonic minimization, PWM AC motor drives

7.1 Fourier series analysis
7.2 Harmonics parameter calculations

Subject Learning Outcomes (SLOs)

At the completion of this unit, students should be able to:

1. Describe the characteristics of power semiconductor devices and identify suitable switch choices for a given application
2. Analyse controlled and uncontrolled single- and three-phase rectifiers, and cycloconverters.
3. Analyse dc-ac converters, and use pulse-width modulation techniques.
4. Analyse dc-dc converters.
5. Explain power electronic applications in power systems and motor drives, and evaluate suitable converter types of a given application.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall, and at least 40% for the achieved in the Final Examination.

Students must also refer to the Subject Assessment Details.

Assessment 1 – Assignment 1: analytical and critical thinking analysis applied in (1) electronic switching devices with their IV characteristics during switching operations and (ii) solving electronic equivalent circuits using Fourier series to achieve final design output. The assessment contributes 10% towards the final grade for the subject.

Assessment 2 - Assignment 2: analytical and critical thinking analysis applied in solving (i)controlled and uncontrolled devices and (ii) applying electronic switching characteristics in terms of current and voltage to design a equivalent circuit s for single phase and three phase applications. The assessment contributes 10% towards the final grade for the subject.

Assessment 3 - Test 1: this assessment will test the understanding and comprehension of power electronic switching devices with controlled and uncontrolled converters. The level of solving furrier series which will enable them to analyses the equivalent circuits. The assessment contributes 20% towards the final grade for the subject.

Assessment 4 – Laboratories: laboratory sessions, where students will perform experimental verifications. Students will be required to perform 5 experiments and record the results and write the reports on the following topics; (i) Static V-I characteristics of SCR and IGBT (ii) Industrial Power Control by Integral Cycle Switching without Generating Harmonics (iii Single-phase full wave fully controlled rectifier 3 phase fully controlled bridge rectifier (iV) Single-phase AC voltage controller (vi) SCR series inverter and SCR parallel inverter (Vii) TRIAC & AC phase control with R, DIAC & UJT trigger circuit. Overall, the labs contribute 20% towards the final marks for the subject.

Assessment 5 – Final examination: the final examination is of 3 hours duration and will assess student's achievement of the learning outcomes. The final exam is worth 40% of the total mark for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Jon Erickson, Fundamentals of Power Electronics, Springer US, 2013

References (Text Book)

1. N. Mohan, T.M. Undeland, W.P. Robbins, Power Electronics: Converters, Applications and Control, Wiley, 2003
2. Newman, M., Industrial Electronics and Controls, John Wiley & Sons, New York, 1986

Readings and Resources

NPTEL Lecture series on basic electronics available at https://nptel.ac.in/courses/117103063/

Relevant Unitech Policies

All university policies can be found at http://www.unitech.ac.pg/unitech/policies/

EE416 Microwave and Optical Systems

Program Electrical Engineering (NQF Level 8)

Subject Name Microwave and Optical Systems

Subject Code EE416

Duration 13 teaching weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 hours per week (3 Lect., 1 Tut., 2 Lab)

Credit Points 17

Delivery Mode On campus

Prerequisites

Co-requisites None

Coordinator TBA

Synopsis

This subject introduces the principles of operation, concepts, design techniques, performance evaluation and analysis of microwave passive and active and optical devices in microwave and optical communications systems. Analytical and numerical methods would be used in the design and analysis of the device and sub-system operation. Modern CAD software packages will also be used to demonstrate the microwave and optical network configurations.

Subject Topics

1. Microwave
    a. Waveguides and Couplers
    b. Transmission Lines
    c. Passive reciprocal components
    d. Detectors and Mixers
    e. Transistor Amplifiers
2. Photonics
    a. Wave Nature of Light
    b. Waveguides and Couplers
    c. Nonlinear Photonics
    d. Lasers, Amplifiers and Oscillators
    e. Semiconductor Optoelectronics

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Demonstrate principles of operation, analysis and design of microwave passive and sub-systems and photonic devices.
2. Analyse and simulate active and passive microwave and optical circuits using specialized CAD software tools
3. Apply critical reasoning to microwave analysis and design problems to obtain meaningful solutions
4. Model the photonic devices using analytical and numerical methods and reflect on the results
5. Evaluate the performance of microwave and photonic device in microwave and optoelectronic system

Assessment Tasks and Weightings

To obtain a pass grade in this subject at least 50% overall.

Students must also refer to the Subject Assessment Details.

Assessment 1 – 6 Laboratory Experiments: 6 individual laboratory experiments will be given, three would be for microwave and the other three for optical systems. Each experiment is worth 5% of the total mark. Collectively, laboratory marks would contribute 30% of the total marks in this subject. Each laboratory session will run for 3 hours; thus, laboratory should be scheduled for alternating weeks.

Assessment 2 – Performance Evaluation Assignment: This assessment is will assess the skills and ability in performing analysis and evaluation of active and passive circuits in a number of applications ranging from communications systems, health systems, transport systems and smart grid system. It is worth 10% of total subject marks in this subject.

Assessment 3 – Design Assignment: This assessment grades the design techniques and their performance in the microwave or optical system or both in a practical problem as applied in one specific application. This assessment is worth 15% of the total subject marks in this subject.

Assessment 4 – Mid Term Test: This 2-hour class test would test the knowledge and ability of the student to apply that skill within some constraints as is applicable in the real world. The materials being examined in this assessment is the content covered in the first half of the semester. This assessment would contribute 15% of the total subject marks in this subject.

Assessment 5 – Final Examination: This 2-hour final examination would grade the knowledge and ability of the student to apply that skill within some constraints as is applicable in the real world. The materials being examined in this assessment is the content covered in the last half of the semester. This assessment would contribute 30% of the total subject marks in this subject.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. D. M. Pozar, Microwave Engineering - 3rd ed, John Wiley & Sons, 2005.
2. S. O. Kasap, Optoelectronics and photonics : principles and practices, Boston: Pearson, 2013, 2nd Ed.

References

1. D. M. Pozar. Microwave and RF Design of Wireless Systems, John Wily & Sons, 2017
2. Jia-ming Liu, Photonic Devices, Cambridge University Press, 2005

Readings and Resources

1. A microwave encyclopedia online at
2. The Information Source for the Photonics Industry, https://www.photonicsonline.com/
3. A monthly magazine for engineers, researchers, scientists, and technical professionals - provides comprehensive global coverage of optoelectronic technologies, applications, and markets, https://www.laserfocusworld.com/

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism and other relevant policies via the link below:

http://www.unitech.ac.pg/unitech/policies

EE417 Digital Signal Processing

Program Bachelor of Electrical Engineering (NQF Level 8)

Subject Name Digital Signal Processing

Subject Code EE417

Contact Hours 6 (3 Lect., 3 Labs)

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Credit Points 16

Delivery Mode On campus

Prerequisites EE311 Signals and Systems

Co requisites None

Coordinator TBA

Synopsis

This introductory subject to modern communications systems focuses on digital data transmission. Digital transmission of data is more favourable over analog transmission in terms of the size of content being delivered, the quality of the transmission and the reduced size of physical infrastructure. However, all-natural signal exist in analog form and the subject commences with the study of conversion techniques in transforming the analog source signal into digital from that is processed, transmitted, retrieved and converted back to useful from for the end user. Digital modulation techniques involved in processing the digital for transmission is explored through theoretical and practical laboratory exercises. Ideal transmission medium is rare; thus, the unit concludes by discussing the different types of noise induced by the system and the propagation medium. Techniques to quantify the noise are developed through theoretical and analytical calculations with the help of mathematical tools.

Subject Topics

1. Discrete Time Signals:
   - Signal classifications,
   - frequency domain representation,
   - time domain representation,
   - discrete time random signals,
   - energy and power theorems.
2. Discrete Time Systems:
   - Classification and properties
   - time invariant system
   - finite impulse Response (FIR) system
   - infinite impulse response (IIR) system
3. Sampling of Time Signals:
   - Sampling theorem and its application,
   - Frequency domain representation of sampling
   - Reconstruction of band limited signal from its samples
   - Introduction to multi-rate digital signal processing
   - Sampling rate conversion,
   - Filter structures,
   - Multistage decimator and interpolators,
   - Digital filter banks.
4. Fourier transform:
   - Definition
   - Properties of Fourier transform
   - Inverse Fourier Transform
   - Applications Fourier Transform

5. Z-Transform:
    - Definition
    - Region of convergence and its properties
    - Properties of Z-transform
    - Inverse Z-transform

Subject Learning Outcomes (SLOs)

After completing this subject, students will be able to:

1. Analyse the properties of LTI systems in terms of z-transforms.
2. Evaluate the spectra of random signals being processed by a discrete time filter.
3. Design of digital filter (FIR/IIR filters) using practical experiments on the important design techniques.
4. Designing of new digital signal processing systems using the Fourier and Z transform.
5. Design and simulate DSP systems for real life applications such as digital audio recording, radar systems, electrical power stations, bio-medical or image recognition.

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved.

Continuous assessment consists of two assignments, laboratory reports, and a midterm exam as summarised below. Students must also refer to the Assignments and the Subject Assessment Guide for Digital Signal Processing. Detailed information is provided for each assignment. Formative assessment in the form of online quizzes would be administrated every second week to aid learning.

Assessment 1 – Laboratory Report This compilation of laboratory reports will measure the ability of the student to interpret the data collected from the experiment and make sense of the data. Collectively the laboratory report contributes 20% of the total marks for the subject.

Assessment 2 - Assignment 1 The assignment provides student with the opportunity to evaluate properties of common communications systems through simulation. The simulation assignment will evaluate the performance of digital modulation techniques, line codes and error detection. The analysis of the performance of each modulation techniques will be useful in the design of communications system for a given application. It contributes 10% of the total marks for the subject.

Assessment 3 – Mid Term Exam This assessment will test the theoretical understanding of the students of concepts learned in class. It will test their ability to remember the basic facts and be able to apply them in a given scenario. The mid-term exam is worth 15% of the total marks for the subject.

Assessment 4 - Assignment 2 The insight observed in assignment one is used in this assignment to design a communications system to satisfy a given set of operating parameters. The requirement of the assessment will bring together all the knowledge attained in this subject and extend that knowledge through a design challenge. The assignment is worth 15% of the total marks for the subject.

Assessment 5 – Final Examination: The final examination is aimed to test individual's knowledge and ability to apply the knowledge in theory and application of digital signal processing. The exam contributes 40% towards the total marks for the subject.

It is important that all students familiarise themselves with the University of Technology Assessment guidelines including those on plagiarism: http://www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Proakis and Manolakis, Digital Signal Processing, Pearson, 4th Ed., 2013
2. Schafer & Yoder, Digital Signal Processing First, Global Edition, McClellan, 2nd Edition, 2017

References

1. Alan V. Oppenheim, Ronald W. Schafer, Digital Signal Processing, 3rd Edition, 2013

Readings and Resources

1. The MOOC list website with a list of current course on signal processing from around the world at https://www.mooc-list.com/tags/digital-signal-processing, accesses on the 6th October 2020
2. A graduate course but closely related with solve problems to add self-learning at https://ocw.mit.edu/courses/mechanical-engineering/2-161-signal-processing-continuous-and-discrete-fall-2008/index.htm, accessed on the 7th October 2020.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism and other relevant policies via the link below:

http://www.unitech.ac.pg/?q=unitech/policies

EN421 Research Project B

Programs Bachelor of Engineering (NQF Level 8)

Subject Name Research Project B

Subject Code EN421

Duration 13 teaching weeks, plus 1 examination week and 1 mid-semester week

Contact Hours 6 hours per week (1 hour lecture, 5 hours project directed, 5 hours self-study)

Credit Points 20

Delivery Mode On campus

Prerequisites EN411 Research Project A

Co-requisites Nil

Coordinator TBA

Synopsis

This subject continues the undertaking of research that was commenced in Research Project A. It is intended to continue to augment the professional work in the students engineering discipline to form a foundation for future learning and professional development and assist to develop cognitive skills. The subject covers research methods, literature reviews, plans, analysis and presentation. The subject provides an introduction to planning a research investigation, developing testing regimes, and data analysis, interpretation and presentation. The final outcomes of the subject will be creation of a Research Project Thesis and an accompanying audio-visual presentation. The subject is student focused with students progressing at their own pace to meet assessment tasks, supported by their academic supervisor.

Subject Topics

Topic 1 provides an overarching framework to planning a research program, outlining the need to develop a schedule for the entire project and to identify the breadth and depth of testing required to generate adequate and reliable data.

Topic 2 outlines the importance of accurate analysis, interpretation and presentation of experimental results and explores the use of regression and correlation as tools to help explain trends in data. The role of hypothesis testing in engineering is introduced.

Topic 3 involves the provision of guidance on structuring and writing the Research Project Thesis and preparing the accompanying audio-visual presentation.

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Develop and justify an integrated research plan and select and apply appropriate research methodologies
2. Source and critically evaluate and synthesise research literature to determine the level of contemporary knowledge in a specialist area.
3. Undertake experimentation, data collection through laboratory and/or field studies and/or critical analysis of the literature.
4. Judge the degree to which research outcomes are supported by the research data and form appropriate conclusions and recommendations based on the research.
5. Apply established theories and techniques to present the significance of their research findings and make informed recommendations for future research directions.
6. Create a research report and audio-visual presentation that communicates the outcomes of the research to a diverse audience.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the Research Project Thesis.

Students must also refer to the Subject Assessment Details.

Assessment Task 1 requires the development of the Research Plan, outlining the proposed research schedule to ensure that the proposed research is achievable. It is worth 10% of the total marks for the Subject. The approved research plan will be presented to the student cohort, academic staff and the wider profession.

Assessment Task 2 helps to facilitate the structured development of the research project and its outcomes by requiring two Research Project B Progress Reports, which must include mapping against the Research Plan and a summary of all research outcomes to date. The progress reports will be presented to the student cohort, academic staff and the wider profession. They are worth 10% each and 20% overall of the total marks for the Subject.

Assessment Task 3 requires the production of the Research Project Thesis. The thesis is the capstone of the degree and be around 6000 words excluding tables, graphs and appendices. It will include ethical and sustainability aspects. It is noted that some theses may vary significantly in length due to the research topic. It is worth 60% of the total marks for the Subject.

Assessment Task 4 provides an opportunity for the Audio-visual Presentation of the Research Outcomes. The professional presentation must reflect and summarise Research Project Thesis and include both visual and audio and must be delivered to the student cohort for the Subject. It is worth 10% of the total marks for the Subject.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism at:

http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework. The subject is student focused and the amount of time spent by student will vary significantly.

Subject Text

Theil, D.V 2014 Research Methods for Engineers, Cambridge University Press, Cambridge

References and Readings

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism and other relevant policies via the link: http://www.unitech.ac.pg/unitech/policies

EE421 Instrumentation & Process Control

Program Electrical Engineering (NQF Level 8)

Subject Name Instrumentation Systems and Process Control

Subject Code EE421

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 (3 Lect, + 1 Tut, +2 Lab.)

Credit Points 17

Delivery Mode On campus

Prerequisites EE411 Control Systems

Co-requisites

Coordinator TBA

Synopsis

The design and operation of instrumentation systems and process control systems in industries require the knowledge of the principles and performance of their components. This unit provides students with knowledge of basic theories and understanding of electronic instruments and instrumentation systems in carrying various measurements in industrial process controls. The unit introduces students to fundamentals of electronic measurements, the instrumentation systems, the programmable logic controllers (PLCs), the international standard graphical symbols used in instrumentation, and process control engineering and the programmable logic control applications in industries. It builds on the engineering knowledge and principles gained in years two and three.

Subject Topics

1. Electronic Instruments an Instrumentation Systems
   - 1.1 Analogue Electronic measuring Instruments
   - 1.2 Digital electronic Measuring Instruments
   - 1.3 Instrumentation Block diagrams
   - 1.4 Types of Analogue/Digital Conversion
   - 1.5 DC DVM, True AC/DC Conversion
   - 1.6 AC DVM, Digital Ammeters and Multimeters, Watt meters

2. Transducers
   - 2.1 Electromechanical Transducers, CRO, Hall Effect
   - 2.2 Optical Transducers
   - 2.3 Temperature and Pressure Transducers
   - 2.4 Strain Gauges
   - 2.5 Displacement Transducers

3. Instrumentation Systems
   - 3.1 Data Recording from Digital Instruments
   - 3.2 Automatic Data Acquisition Systems
   - 3.3 Computer Control Instrumentation Systems
   - 3.4 Virtual Instrumentation Systems (VIS)

4. Industrial Process Control
   - 4.1 Sequential Control
   - 4.2 Relay control
   - 4.3 Programmable Logic Controllers (PLC)

5. PLC Programming and Applications in Industries
   - 5.1 Introduction to Relay Control
   - 5.2 Theory of Operation, Constructions, Inputs, outputs and Programming devices
   - 5.3 Programming Languages (Boolean Statements, Static Logic, etc.)
   - 5.4 Relay ladder Programs, Mnemonic Code, Machine Code
   - 5.5 Wiring Diagrams and Ladder Diagrams

Subject Learning Outcomes (SLOs)

On completion of this subject, students will be able to:

1. Explain the principles of operation of electronic analogue and digital instrumentation and their applications in instrumentation systems.
2. Explain the operations of Programmable Logic Controller (PLC) based instrumentation systems.
3. Explain the construction, logic and operation of Programmable Logic Controllers (PLCs).
4. Identify and apply the PLCs for control of various industrial processes in mining, manufacturing industries and traffic control.
5. Design flow charts, PLC wiring diagrams and PLC ladder diagram programs for various process control systems.
6. Analyse and execute the developed PLC programs and monitor on-line process in the laboratory.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall, and at least 50% for the achieved in the class tests.

Students must also refer to the Subject Assessment Details.

The subject assessments consist of two assignments (20%), two class tests (50%), four laboratory reports (30%) as shown below.

1. Assignment 1 - This assignment is given to students to assess their competence level of understanding, knowledge, comprehension and analysis of the operation of the analogue and digital instrumentation and their applications in instrumentation systems. The assignment contributes 10% towards the final grade for the subject.
2. Assignment 2 - This assignment is given to students to assess their competence level of understanding, knowledge, comprehension and analysis of PLC. The assignment contributes 10% towards the final grade for the subject.
3. Class Test 1 – This assessment will test the understanding and comprehension of the instrumentation systems and their applications in industrial process control. It will include applications of electronic instruments, transducers and instrumentation systems. The test will contribute 25% towards the final grade for the subject.
4. Class Test 2 – This assessment will test the understanding and comprehension of the instrumentation systems and their applications in industrial process control. It will include industrial process control and PLCs programming. The test will contribute 25% towards the final grade for the subject.
5. Laboratories – For the laboratory sessions, students will be given four PLC projects to do based on various industrial process control applications. Students will be required to analyse the problem and define the inputs and the outputs, develop the flow chart of the industrial process, develop the wring diagram and the PLC ladder diagram programme, enter into the PLC and execute it and record the results and write the reports on the following topics; PLC Project 1. Traffic Light control, (8%), PLC Project 2. Automatic Filling up of a Tank, (6%), PLC Project 3. Mining Operation, (8%) and PLC Project 4. Chemical Operation, (8%). The four PLC projects will contribute a total of 30% towards the final grade for the subject.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/unitech/policies

Student Workload

The total workload for the subject for the ‘average’ student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. McMillian Gregory K., Process Industrial Instruments and Controls, 6th Edition, McGraw-Hill Book Co, 2019.
2. L. A. Bryani, E. A. Bryani, Programmable Controllers, Theory and Implementation, 2nd Edition, Industrial Text Company, 1997

References

1 William Bolton, Instrumentation and Control System, 2nd Edition, Elsevier Science & technology, Newnes, 2015

2 Alan S. Morris, Reza Langari, Measurements and Instrumentation, Theory and Application, 2nd Edition, Academic Press, 2012

Readings and Resources

1. http://thelearningpit.com/
2. http://www.pacontrol.com/

Relevant Unitech Policies

All PNG University of Technology policies can be found at; http://www.unitech.ac.pg/unitech/polocies/

EE422 Computer Networks Design

Program Electrical Engineering (NQF Level 8)

Subject Name Advanced Computer Networks

Subject Code EE422

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 5.5 hours per week (3 Lect., 1 Tut., 1.5 Lab.)

Credit Points 16

Delivery Mode On campus

Prerequisites EE221 Digital Logic System and EE416 Data Communications and Networking

Co-requisites EE423 Network Security

Coordinator TBA

Synopsis

This subject introduces the students to advance data networks using a variety of access device with the emphasis on wireless data networks. The subject will discuss the requirements in design, building, testing and benchmarking a wireless enterprise data network utilizing a variety of physical layer mediums, experimenting with popular protocols at the application, transport and network layer of the TCP/IP protocol stack. Also, the concept of managing the data network is explored in this subject. The concepts will be used to solve a data network problem. The major team project aims to guide the student to master the content and skills required to develop and deploy a secure, reliable and cost effective data network for a varied access devices.

Subject Topics

1. Wireless Network Design

   Examine modern wireless protocols and design enterprise wireless LAN:

   - 802.11 wireless LANs, physical topology and security
   - Design considerations for a specific application
   - Site plan, design, testing and commissioning

2. Voice over IP:

   Examines the basics of building Voice over IP (VoIP) networks, including:

   - the technologies,
   - data transport,
   - quality of service issues

3. Managing the network infrastructure:

   Examines the issue of configuring and managing the network infrastructure in the following areas such as:

   - Procedure used to obtain a domain name for a network and the steps required to get IP addresses assigned to it.
   - IP management with DHCP.
   - Techniques for scaling the network with NAT and PAT
   - Domain Name Service configuration and management
   - Managing the network using the SNMP protocol

4. Analyzing network data traffic using Wireshark:

   Perform data packet analysis using the Wireshark protocol analyser. The focus is on introducing the concept of protocol forensics and network data traffic analysis.

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Evaluate the modern wireless protocols and standards for a given propagation environment
2. Design and implement an enterprise wireless local area network.

3. Design and implement additional enterprise data services such as VoIP, IP TV or Streaming on a wireless local area network
4. Manage the network infrastructure using free and proprietor SNMP based network management tools.
5. Analyse network data traffic using Wireshark to evaluate the network performance and reliability.

Assessment Tasks and Weightings

To obtain a pass grade in this subject at least 50% overall, and at least 60% for the final project report must be achieved. There is not final examination in this subject.

Students must also refer to the Subject Assessment Details.

Assessment 1 – Assignment 1 Project Concept Plan: A team-based report outlining team formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the final design outcome. The report contributes 10% towards the final grade for the subject.

Assessment 2 – Assignment 2 Progress Report on Protocols and Services: Team based report outlining team progress in achieving design outcomes in line with the team schedule submitted in the Project Concept Plan on the application, transport and network layer. Variations to the original schedule will be identified and justified. The Progress Report contributes 15% towards the final grade for the subject.

Assessment 3 – Assignment 3 Progress Report on Security Implementation & Performance Evaluation: Team based report outlining team progress in achieving design outcomes in line with the team schedule submitted in the Project Concept Plan relating to the security implementation for a secure and reliable data protection plan. Variations to the original schedule will be identified and justified. The Progress Report contributes 15% towards the final grade for the subject.

Assessment 4 – Assignment 4 Final Report: A professional level report with individual and team components that outlines and communicates the design processes, rationale and outcomes. The Final Report contributes 40% towards the final grade for the subject.

Assessment 5 – Assignment 5 Audio Visual Presentation: An audio-visual presentation of design outcomes that contains the salient feature of the Final Report. All team members will contribute. The presentation contributes 20% towards the final grade for the subject.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Jeffrey S. Beasley, Piyasat Nilkaew, A Practical Guide to Advanced Networking, 2015, Pearson IT Certification
2. Roshan Pejman, Leary Jonathan, 802.11 Wireless LAN fundamentals: a practical guide to understanding, designing, and operating 802.11 WLANs, 2004, Cisco Press

References

1. James Kurose& Keith Ross, Computer Networking: A Top-Down Approach, 7th Edition, 2017, Pearson Education
2. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, 5th Edition, 2011, Pearson Education
3. William Stallings, Data and Computer Communications, 9th Edition, 2010, Pearson Education

Readings and Resources

1. Learning resources that will be posted in Google Classroom.
2. Complete self-phased tutorial and quizzes through Google Classroom.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology policies on teaching and learning including assessment via the link below:

http://www.unitech.ac.pg/?q=unitech/policies

EE423 Network Security Concepts

Program Electrical Engineering (NQF Level 8)

Subject Name Network Security

Subject Code EE432

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Break Week

Contact Hours 6 hours per week (3 Lect., 1 Tut., 2 Lab.)

Credit Points 17

Delivery Mode On campus

Prerequisites EE314 Data Communications

Co-requisites EE212 C Programming

Coordinator TBA

Synopsis

This subject introduces the students the theoretical and software tools required to implement secured network systems for a diverse range of applications.

Subject Topics

The following topics will be covered in this subject:

1. Symmetric key cryptography: secure data exchange:
    a. Symmetric Block Algorithms
    b. Random number generators and their applications
    c. Stream ciphers
    d. Cipher block modes of operations
2. Asymmetric key cryptography: secure key exchange.
    a. Approaches to Message Authentication
    b. Secure Hash functions
    c. Message Authentication Codes
    d. Digital signatures
    e. Authentication and secured data exchange protocols: Implementation and applications.
3. Secure hash functions: Implementation and applications.
    a. Key distribution and User Authentication
    b. Network Access Control and Cloud Security
    c. Transport Level Security
    d. Wireless Network Security
4. Key Management & Public Key Infrastructure (PKI).
    a. Malicious Software
    b. Intruders
    c. Firewalls
5. Application study case.

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Implement a cryptographic algorithm using the c programming language;
2. Evaluate and selectively apply secure data exchange protocols in solution design.
3. Evaluate and selectively apply the type of secure authentication mechanism and data cryptographic system in solution design;
4. Solution design and implementation using a existing data security framework.

Assessment Tasks and Weightings

To obtain a pass grade in this subject at least 50% overall, and at least 60% for the final project report must be achieved. There is not final examination in this subject.

Students will be given a network application-based project, for which it shall be broken down into the following assessment items:

Assessment 1 – Assignment 1 20%: Assuming the students has formed theirs teams (group of 2 to 4 people), each team will submit their implement a cryptographic or Hashing algorithm using C to be used in the project.

Assessment 2 – Quiz+lab 10%: Test the student understanding of the theory and concepts being applied in the assessment 1.

Assessment 3 – Assignment 2 20%: Implement encrypted data stream system for a client and server application using C.

Assessment 4 – Quiz+lab 10%: Test the student understanding of the theory and concepts being applied in the assessment 2.

Assessment 5 – Assignment 3 20%: Implement entity authentication system for a client and server application using C.

Assessment 6 – Quiz+lab 10%: Test the student understanding of the theory and concepts being applied in the assessment 3.

Assessment 7 – Project Audio Visual Presentation 10%: An audio-visual presentation of design outcomes that contains the salient feature of the Final Report. All team members will contribute.

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. William Stallings, Network Security Essentials: Applications and Standards 2017, Pearson

References

1. James Kurose& Keith Ross, Computer Networking: A Top-Down Approach, 7th Edition, 2017, Pearson Education
2. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, 5th Edition, 2011, Pearson Education
3. William Stallings, Data and Computer Communications, 9th Edition, 2010, Pearson Education

Readings and Resources

1. Learning resources that will be posted in Google Classroom.
2. Complete self-phased tutorial and quizzes through Google Classroom.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology policies on teaching and learning including assessment via the link below:

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EE424 Electrical Power Systems III

Program Electrical Engineering (NQF Level 8)

Subject Name Electrical Power Systems III

Subject Code EE424

Duration 13 Teaching Weeks + 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 hours per week (3 lectures + 1 Tutorial + 2 Laboratory)

Credit Points 17

Delivery Mode On campus

Prerequisites EE315, EE414

Co-requisites

Coordinator TBA

Synopsis

This subject deals with the fundamentals of Power System Protection and Transient Stability Analysis. The subject begins with load flow problem formulation and solution techniques. Then follows with short circuit calculations for balanced and unbalanced faults where the fundamentals of sequence components and sequence networks are introduced. Basic components of Protection Systems are defined, with particular emphasis on the operating principles and constructional features of overcurrent (OC) protection relays, their operating mechanism and control circuits. Radial system protection including Protection of transmission lines, transformers, generators and busses are introduced and the concept of zones of protection is discussed. The subject concludes with the fundamentals and techniques on power system stability analysis.

Subject Topics

1. LOAD FLOW CALCULATIONS
   - 1.1 Bus Classification
   - 1.2 Bus Admittance Matrix
   - 1.3 Load Flow Problem Formulation
   - 1.4 Computation for Line Flows and Line Losses
   - 1.5 Solution of Nonlinear Algebraic Equations – Gauss-Seidel Method
   - 1.6 Load Flow Using Newton-Raphson Method
   - 1.7 Fast Decoupled Power Flow Solution

2. SHORT-CIRCUIT CALCULATIONS
   - 2.1 Balanced Three-Phase Fault
   - 2.2 Bus Impedance Matrix
   - 2.3 Rated MVA Interrupting Capacity of Circuit Breaker and Fuse
   - 2.4 Unbalanced Faults
   - 2.5 Fundamentals of Sequence Components and Sequence Networks
   - 2.6 Single Line-to-Ground Fault, Line-to-line Fault, Double Line-to-Ground Fault
   - 2.7 Sequence Bus Impedance Matrices

3. POWER SYSTEM PROTECTION
   - 3.1 Protection System Components
   - 3.2 Overcurrent Relays
   - 3.3 Radial System Protection
   - 3.4 Directional Relays
   - 3.5 Zones of Protection
   - 3.6 Line Protection with Distance Relays
   - 3.7 Generator, Transformer and Bus Protection with Differential Relays

4. POWER SYSTEM TRANSIENT STABILITY ANALYSIS
   - 4.1 The Swing Equation
   - 4.2 Synchronous Machine Models for Stability Analysis
   - 4.3 Steady-State Stability
   - 4.4 Transient Stability – Equal Area Criterion

4.5 Multimachine Transient Stability

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Define the power flow problem and apply static power flow solution techniques such as Gauss-Seidel and Newton-Raphson to calculate voltage and current magnitudes and power angle at selected network nodes
2. Analyse balanced faults as well as unbalanced faults using symmetrical components and sequence networks, and determine maximum fault levels for selection of fuse rating and relay setting
3. Identify appropriate protective devices and design appropriate protection schemes for generators, transformers and radial feeders
4. Define zones of protection and protection system coordination
5. Characterise the system behaviour for large disturbances through formulation of the swing equation
6. Apply analytical methods to determine the steady-state and transient stability limits

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved and at least 40% achieved in the final examination.

The subject assessment consists of two assignments (10%), two tests (20%), five laboratory assignments (20%) and a final examination (50%) as summarised below. Students must also refer to the Subject Assessment Guide for Introduction to Circuits and Electronics. Detailed information is provided for each assignment.

1. Assignment 1 This assignment gives the opportunity to students to evaluate and reinforce their understanding and knowledge the fundamentals of load flow calculations. The students will classify different nodes and perform calculation to determine, voltage (V), power (P), reactive power (Q) magnitudes and the power angle (δ) at these nodes using nonlinear iterative solutions such as Gauss-Seidel and Newton-Raphson techniques as well as Line losses and Line Flows.
2. Assignment 2 This assignment gives the opportunity for the students to evaluate and reinforce their understanding of the Protection System Function, its components and various Protection Schemes for the Protection of Power System Components.
3. Test 1 This test will evaluate the students' understanding and comprehension of short-circuit calculations, Selection of Fuse, Relay and Circuit-Breakers based on the maximum MVA level
4. Test 2 This test will evaluate the students' understanding and comprehension on the fundamentals of the Steady-State and Transient Stability Limits of the Synchronous Generator.
5. Laboratories There will be five laboratories to be conducted and assessed. Each laboratory will contribute 4% to the total assessment items mark of 20%. The laboratory activities allow the student to prepare a professional level of application design. It involves undertaking an analysis of various circuits and design of minimum of 3 alternative circuits for specific applications.
6. Final Examination The final examination is of 3 hours duration given at the end of the semester. The examination questions are derived from the course materials covered throughout the semester, and are intended to evaluate, knowledge, comprehension, and applications skills.

Students must also refer to the Subject Assessment Details

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. H. Saadat, Power System Analysis, 3rd Ed., PSA Publishing, 2011
2. J.D. Glover, T. Overbye and M.S. Sarma, Power System Analysis and Design, 6th Ed.,Cengage Learning, 2016
3. D.P Kothari and I.J Nagrath, Modern Power System Analysis, 3rd Ed., McGraw-Hill, 2009

References

1. M.E. El-Hawary, Electrical Power Systes Design and Analysis, IEEE Press

2. Y.G Pathankar and S.R Bhide, Fundamentals of Power System Protection, Prentice-Hall
3. S.H Horowitz and A.G Phadke, Power System Relaying, Wiley
4. N. D Tleis, Power System Modelling and Fault Analysis, Newnes

Readings and Resources

All Lecture Notes, Assessment Items and Projects will be accessed through Google Classroom

Relevant Unitech Policies

All university policies can be found at http://www.unitech.ac.pg/unitech/policies/

EE425 Renewable Energy

Program Electrical Engineering (NQF Level 8)

Subject Name Renewable Energy Systems

Subject Code EE425

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 hours per week (3 Lect., 1 Tut. 2 Lab.)

Credit Points 17 [4.2*3+2.1*1+1.4*2]

Delivery Mode On campus

Prerequisites EE315 Power Systems I

Co-requisites

Coordinator TBA

Synopsis

The Renewable Energy Systems subject provides an undergraduate level coverage of the conversion principles and technology behind various renewable energy sources. It also examines the issues involved in the integration of various renewable energy sources and their economics for heat, power and other needs. Based on the technical and sustainability challenges, the future outlook for each of the renewable energy sources and systems is discussed.

Subject Topics

1. Introduction to Renewable Energy Technology:
   1.1 Climate change effect of renewable energies.
   1.2 Technological Innovations in renewable energies
2. Solar Energy:
   2.1 Introduction to photovoltaic (PV) systems
   2.2 Historical development of PV and overview of PV usage in the world,
   2.3 Solar energy potential for PV, irradiance, solar radiation and spectrum of sun, geometric and atmospheric effects on sunlight.
   2.4 Solar panels and photovoltaic system,
   2.5 Conversion of solar energy into electrical energy,
   2.6 Behaviour of solar cells (panels) and its applications
3. Wind Energy:
   3.1 Overview of global wind power, wind types and classes, and its physical characteristics
   3.2 Wind resource assessment: Anemometry and site prospecting
   3.3 Introduction to basic statistics: Weibull and Rayleigh distributions
   3.4 Wind and power density calculations
   3.5 Components and basic operation of WEC (Wind Energy Conversion) systems and types
   3.6 Horizontal and vertical axis turbines
   3.7 Conversion of wind power to electrical power
   3.8 Factors affecting turbine performance and efficiency
4. Biomass Energy:
   4.1 Introduction to biomass and biomass energy basics
   4.2 Biomass energy sources and energy conversion process
   4.3 Biomass energy to electrical energy conversion
5. Hydropower:
   5.1 Hydrologic (water) cycle, global hydro power, and hydro resource assessment.
   5.2 Analysis of power losses in pipes Moody diagrams, and the operating principles and the characteristics of selected turbines
   5.3 Criteria for selection of a particular turbine
   5.4 Concepts of gross head, net head, energy line, hydraulic grade line and available head
   5.5 Conversion of hydro- power to electrical power: Shaft torque and shaft power.
   5.6 Energy storage: pumped storage facilities.
6. Wave Energy:
   6.1 Introduction to wave energy
   6.2 Ocean wave energy and types

6.3 Wave energy generation, potential energy and kinetic energy
6.4 Wave energy conversion
6.5 Reservoir wave machine

7. Tidal Energy:
   7.1 Introduction to tidal energy
   7.2 The causes of tides
   7.3 Enhancement of tides
   7.4 Tidal current/stream power and range power
   7.5 Tidal wave energy application
8. Geothermal Energy:
   8.1 Introduction to geothermal energy and overview of geothermal energy
   8.2 Heat transfer in rocks
   8.3 Fluid flow in rock
   8.4 Reservoir geomechanics
   8.5 Enhanced geothermal system (EGS)
9. Renewable Hydrogen Energy:
   9.1 Introduction to hydrogen energy
   9.2 Hydrogen production method
   9.3 Hydrogen storage method
   9.4 Hydrogen transportation method
   9.5 Utilization of hydrogen gas

Subject Learning Outcomes (SLOs)

On completion of this subject, students will be able to:

1. Describe the principles of operation of the broad spectrum of renewable energy technologies
2. Conduct preliminary resource assessments for a variety of renewable energy technologies.
3. Articulate the technical challenges for each of the renewable energy sources;
4. Discuss economic, technical, and sustainability issues involved in the standalone and integrated renewable energy systems.

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved and at least 50% achieved in the final examination.

The subject assessment consists of two assignments (10%), two tests (30%), five laboratory assignments (10%) and a final examination (50%) as summarised below. Students must also refer to the Subject Assessment Guide for Renewable Energy Systems. Detailed information is provided for each assessment.

Students must also refer to the Subject Assessment Details.

Assessment Task (AT)

1. **Assignment 1** The assignment provides student with the opportunity to demonstrate their knowledge regarding solar, wind, biomass and hydropower systems. It contributes 5% towards the total marks for the subject.
2. **Assignment 2** This assignment involves demonstrating the knowledge regarding the applications of hydropower, wave, tidal and geothermal energy. The assignment contributes 5% towards the total marks for the subject.
3. **Tests** This assessment will test the understanding and comprehension of the basic concepts in renewable energy systems. Test 1 contributes 15% towards the total marks for the subject.
   Test2 will test the understanding and comprehension of the economics, design and viability of renewable energy systems. Test 2 contributes 15% towards the total marks for the subject.
4. **Laboratories** There will be six laboratories to be conducted and assessed. Each laboratory contributes towards 10% of the total marks for the subject. The laboratory activities allow the student to prepare a professional level of mathematical modelling and simulations. Laboratories involves the use of different software such as MathCAD and MATLAB as well as hardware. Where a lab is not feasible, it may be substituted with a project.
5. **Final Examination** The final examination is of 3 hours duration and ALL questions must be answered. The final exam is worth 50% of the total marks for the subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism http://www.unitech.ac.pg/unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Peake. S, "Renewable Energy: Power for a Sustainable Future", 4th Edition, Oxford University Press, 2018

References

1. John Twidell and Toney Weir, "Renewable Energy resources", 2nd Edition, 2006, Talor & Francis Group, London and New York.

Readings and Resources

1. "2011 Renewable Energy Data Book", US Department of energy, energy Efficiency & Renewable Energy.

Relevant Unitech Policies

All university policies can be found at http://www.unitech.ac.pg/unitech/policies/

EE426 Power Electronics II

Program Electrical Engineering (NQF Level 8)

Subject Name Power Electronics II

Subject Code EE421

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Contact Hours 6 (3 Lect + 1Tut + 2Lab)

Credit Points 17

Delivery Mode On Campus

Prerequisites None

Co-requisites EE415 Power Electronics I

Coordinator TBA

Synopsis

Power electronics is a critical enabling technology that covers a truly wide spectrum of applications including power supplies for all electronic equipment ranging from cell phones to mainframe computers, motion control, interface of renewable energy resources such as solar and wind, automotive applications and efficient lighting. The major focus of this course is on design-oriented analysis of topologies and control methods for various power electronic converters used for dc-dc, dc-ac and ac-dc power conversions in important and current applications.

Subject topics

1. DC-DC converters
   - Design of buck, boost, buck-boost, Cuk and SEPIC converters
   - Design of isolated dc-dc converters including forward, flyback, push-pull, full bridge and dual-active bridge topologies
   - DC-DC converters in continuous and discontinuous current modes of operation
   - Linearized, small-signal average models of dc-dc converters
   - Voltage mode and current mode control design methods
   - Modelling and control of dc-dc converters

2. AC-DC PWM rectifiers
   - Power quality issues
   - Boost and flyback converter-based power factor correction circuits (PFC)
   - Models, design and control of PFC
   - Full bridge bi-directional PWM rectifiers, applications in front end of motor drives

3. DC-AC PWM inverters
   - Voltage source inverters - topology and PWM techniques
   - Single phase and three phase inverters and control methods
   - Three-phase PWM techniques

4. Soft switching and resonant converters
   - ZVS and ZCS
   - Zero voltage transition converters
   - Resonant converters and applications in lighting

5. Power conditioners and UPS
   - Power supply disturbances
   - Power conditioners
   - UPS technologies
   - Case study and applications

6. Grid interface of renewable energy resources
   - Power converters and control for interfacing solar and wind energy to grid
   - Distributed generation and impact on power distribution systems

- Micro-grids and smart grid technologies using power electronic converters

7. FACTS devices:
   - TCR (Thyristor controlled reactor),
   - TSC (Thyristor switched capacitors).
   - STATCOM (Static synchronous compensator)
   - SSSC (Static series synchronous compensator)
   - UPFC (Unified power flow controller)
   - IPFC (Interline power flow controller)
   - Case study of FACTS devices applications

8. Electric Motor Controllers and Drives
   - Solid state controllers for motor drives
   - Vector control and direct torque control of induction, synchronous, permanent magnet sine fed, synchronous reluctance motors.

Subject Learning Outcomes (SLOs)

At the completion of this unit, students should be able to:

1. Analyse the operations and control of DC-DC converters
2. Analyse controlled and uncontrolled single- and three-phase rectifiers, and cyclo-converters.
3. Analyse dc-ac converters, and use pulse-width modulation techniques.
4. Analyse soft switching and resonant converters.
5. Explain power electronic applications in power systems especially in grid interface of renewable energy sources, flexible AC transmission systems, and other applications.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall, and at least 40% for the achieved in the Final Examination.

Assessment 1 – Assignment 1: analytical modelling of linearized small-signal average model of DC-DC converters in continuous and discontinuous current modes operations. The assessment contributes 10% towards the final grade for the subject.

Assessment 2 - Assignment 2: analytical and critical thinking analysis applied in solving in modelling and analyzing AC-DC, DC-AC converters, and soft switching and resonant converters. The assessment contributes 10% towards the final grade for the subject.

Assessment 3 - Test 1: This assessment will test the level of understanding and comprehensions of the skills and design applications of DC-DC, AC-DC, DC-AC circuit topologies as well as soft switching and resonant converters. The assessment **contributes 20% towards the final grade for the subject.**

Assessment 4 – Laboratory sessions, where students will perform experimental verifications. Students will be required to perform four experiments and record the results and write the reports on the following topics; (i) Software design and linearized small-signal average modelling of buck and boost converters (ii) Software design and modelling of zero voltage switching converter (iii) A field trip to a renewable power generation site to learn about the principles of design and operation of renewable energy sources in power generation, and (iv) Project design on micro-grid technology comprising wind and solar energy for a remote township in the country. Students will demonstrate their understanding of data collections on these energy sources and applied in design of the micro-grid project. Computer simulation will also be required. Overall, the labs contribute 20% towards the final marks for the subject.

Assessment 5 – Final examination: the final examination is of 3 hours duration and will assess student's achievement of the learning outcomes. The final exam is worth 40% of the total mark for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. M. H. Rashid, Power Electronics, Circuits, Design, and Applications, 4th Edition, Pearson/Prentice Hall, 2014

References (Text Book)

1. N. Mohan, T.M. Undeland, W.P. Robbins, Power Electronics: Converters, Applications and Control, Wiley, 2003
2. Newman, M., Industrial Electronics and Controls, John Wiley & Sons, New York, 1986

Readings and Resources

NPTEL Lecture series on basic electronics available at https://nptel.ac.in/courses/117103063/

Relevant Unitech Policies

All university policies can be found at http://www.unitech.ac.pg/unitech/policies/

EE427 Antennas and Radars

Program Electrical Engineering (NQF Level 8)

Subject Name Antennas and Radars

Subject Code EE427

Contact Hours 6 (3 Lect., 1 Tut & 2 Labs)

Duration 13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week

Credit Points 17

Delivery Mode On campus

Prerequisites EE311 Signals and Systems and EE321 Communications Systems

Co requisites None

Coordinator TBA

Synopsis

This subject introduces students to the air interface in wireless systems. Any wireless devices depend on the antenna to be connected to the other devices via the air medium. The subject begins with enough theory for the student to be able to design and analyse the performance of four antenna types. These include the wire antenna, the travelling wave, aperture and array antennas. The theory will enhance the student's understanding by the design process from simulation to synthesis of simple antenna structures with the appropriate measurements system. As an application of antennas, the principles of radar systems are discussed.

Subject Topics

1. Antenna Theory:
    - Basic characteristics, parameters, function, analysis and applications of communication
    - 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
    - Analyse the radiated electric and magnetic fields are derived from the integral form of Maxwell's equations describing the basic parameters and sketching the radiation patterns 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.
2. Antenna Design
    - Practical issues such as impedance matching, antenna installation
    - Pattern and gain measurements are also described and performed.
3. Wave Propagation
    - Propagation mechanism
    - Deriving the Friis equation
    - Applying the Friis equation to antenna design for certain applications
4. Principles of Radar: Introduction
    - The simple form of Radar Equation
    - Radar Block diagram and Operation
    - Radar Frequencies
    - millimetre and submillimeter waves
    - Applications of Radar.
5. Radar Equation
    - Prediction of Range Performance,
    - Minimum Detectable Signal
    - Receiver Noise
    - Signal to Noise Ratio
    - Matched filter impulse response

6. Continuous Wave (CW) and Frequency Modulated (FM) Radar
    - The Doppler effects
    - CW radar
    - FMCW radar
    - Airborne Doppler Navigation
    - Multiple Frequency CW radar
7. Radar Antennas
    - Antenna characteristics
    - Phased Array Antennas
    - Transmitter
    - Receiver

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Analyse the principle of antenna and the different principles on which antennas operate: wire, travelling wave, aperture and array antennas.
2. Analyse the performance of short dipole antenna, deriving radiation fields and all antenna parameters.
3. Evaluate the characteristics and performance of a radar system
4. Compare the radar equation in terms of range performance, receiver noise and Signal to Noise Ratio.
5. Design antenna systems using Friis and Radar equations

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved.

Subject assessment consists of two assignments, 4 laboratory reports and a group project as summarised below. Students must also refer to the Assignments and the Subject Assessment Guide for Antennas and Radars. Detailed information is provided for each assignment. Formative assessment in the form of online quizzes would be administrated every second week to aid learning.

Assessment 1 – Laboratory Report This compilation of laboratory reports will measure the ability of the student to interpret the data collected from the experiment and make sense of the data. Collectively the laboratory report contributes 15% of the total marks for the subject.

Assessment 2 - Assignment 1 The assignment provides student with the opportunity to evaluate properties of common antenna types in use on campus. The students will evaluate the performance of each antenna types through simulation and measurements. The analysis of the performance of at least three antenna types will offer some insights into choosing the appropriate antenna to match an application. It contributes 10% of the total marks for the subject.

Assessment 3 - Assignment 2 The assignment provides student with the opportunity to evaluate their understanding about radar and its operation, able to calculate the SNR and receiver noise for a radar system. The assignment is worth 10% of the total marks for the subject.

Assessment 4 – Design Project This assessment will test the theoretical and practical understanding of the students of concepts learned in class and access their teamwork dynamics. This will enable for the student to synthesis their knowledge and understanding in assignment one and two to a larger problem that may include a wireless communications system problem. The project will be assessed with a report worth 15% and a presentation worth 10%.

Assessment 5 – Final Examination: The final examination is aimed to test individual's knowledge and ability to apply the antenna theory and design skills to a design problem. The exam contributes 40% towards the total marks for the subject.

It is important that all students familiarise themselves with the University of Technology Assessment guidelines including those on plagiarism: http://www.unitech.ac.pg/?q=unitech/policies

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 14-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Textbooks

1. Warren L. Stutzman, Gary A. Thiele, Antenna Theory and Design, 3rd Edition, 2013
2. G. S. N. Raju, Radar Engineering, I. K. International Pvt Ltd, Oct 2008

References

1. Constantine A. Balanis, Antenna Theory: Analysis and Design, Wiley, 4th ed., 2016
2. K. K. Sharma, Fundamental of Microwave and Radar Engineering, S. Chand Publishing, 2011

Readings and Resources

1. IEEE Journal on Antennas and Propagation, accessible at https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8, accessed on 6th October 2020
2. Free Satellate Course on Coursea at https://www.coursera.org/lecture/satellite-communications/free-space-propagation-FA41e, accesded on the 6th October 2020.
3. NPTEL :: Electrical Engineering - NOC:Principles and Techniques of Modern Radar Systems
4. A site dedicated to Radar Systems including antennas https://www.radartutorial.eu/index.en.html

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism and other relevant policies via the link below:

http://www.unitech.ac.pg/?q=unitech/policies