SUBJECT OUTLINE: EN123 INTRODUCTION TO CIRCUITS AND ELECTRONICS

Course	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 1
Co requisites	Nil
Subject Coordinator	TBA

Synopsis

Introduction to Circuits and Electronic 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 which lead to a practical system. It introduces the fundamentals of the lumped circuit abstraction, the basic components of electronics such as resistive elements, diodes, transistors, amplifier and op amps. It examines the different ways to design basic analogue 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 of 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 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 design of 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

Subject Mapping

Subject Learning Outcomes (SLO) are mapped to each of; PNG National Qualifications Framework Level 8 (NQF), Course Learning Outcomes (CLO), Unitech Graduate Attributes (GA), Assessment Tasks and Engineers Australia Stage 1 Competencies.

All Subject Learning Outcomes combine to collectively deliver the Course Learning Outcomes and Engineers Australia Stage 1 Competencies.

Subject Mapping Matrix

SLO	SLO to NQF	SLO to CLO	SLO to GA	SLO to AT	SLO to EA Stage 1 Competencies
1	Knowledge and skills	1 & 3	Critical Thinker	1, 2 & 3	1.1, 1.2, 1.3, 3.5, & 3.6
2	Knowledge and skills	1 & 3	Critical Thinker	1, 2, & 3	1.1, 1.2, 1.3, 3.5 & 3.6
3	Knowledge and skills	1, 3 & 4	Critical Thinker	1, 2, & 3	1.1, 1.2, 1.3, 3.5 & 3.6
4	Knowledge and skills	1, 3 & 4	Critical Thinker	1, 2, & 3	1.1, 1.2, 1.3, 3.5 & 3.6
5	Application	1, 3	Lifelong learner, Critical Thinker & Technologically Savvy	1, 2, & 3	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.2, 3.4, 3.5, & 3.6
6	Application	1, 2, 3, & 6	Lifelong learner, Critical Thinker & Technologically Savvy	1 & 2	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4, 3.5, & 3.6
7	Knowledge and skills Application	3, 6, 7	Lifelong learner, Critical Thinker, Technologically Savvy Effective Communicator	1 & 2	1.2, 2.3, 2.4, 3.2, 3.6

Engineers Australia Stage 1 Competencies

1. KNOWLEDGE AND SKILL BASE	2. ENGINEERING APPLICATION ABILITY	3. PROFESSIONAL AND PERSONAL ATTRIBUTES
1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.	2.1 Application of established engineering methods to complex engineering problem solving.	3.1 Ethical conduct and professional accountability.
1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.	2.2 Fluent application of engineering techniques, tools and resources.	3.2 Effective oral and written communication in professional and lay domains.
1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline.	2.3 Application of systematic engineering synthesis and design processes.	3.3 Creative, innovative and pro-active demeanour.
1.4 Discernment of knowledge development and research directions within the engineering discipline.	2.4 Application of systematic approaches to the conduct and management of engineering projects.	3.4 Professional use and management of information.
1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline.		3.5 Orderly management of self, and professional conduct.
1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline		3.6 Effective team membership and team leadership.

Graduate Capability Statement

This subject is common to all Bachelor of Engineering courses. Each engineering discipline will map subject learning outcome to its own CLOs and the graduate statement and capabilities that stem from those CLOs. Refer to each engineering discipline for the relevant graduate statement.

Engineering Course Learning Outcomes – Mapped to EA Stage 1 Competencies

This Subject is common to all engineering courses and its Learning Outcomes are mapped to the following broad engineering Course Learning Outcomes, which mesh with those of each engineering discipline.

The following table is included to demonstrate to students that overall, the Engineering CLOs address all Competencies. The combined mapping matrix for all SLOs to Engineers Australia Stage 1 Competencies for each course provides 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 cognizant of the importance of sustainability and the environmental impact of engineering.	1.5, 1.6, 3.1, 3.3, 3.4

***Note:** While the course learning outcomes will have minor differences for each engineering course the above mapping remains valid for use in all courses.

Unitech Graduate Attributes

Attribute	Academic dimension	Personal Dimension	Transferable Dimension
1. Lifelong learner	Sustained intellectual curiosity and use of feedback to reflect on their own work.	Sets aspirational goals for personal improvement and career growth.	Takes responsibility for one's learning and development.
2. Critical thinker	Uses rules of inference to analyse complex issues and find solutions.	Calmly uses logic and critical thinking, and not emotion, in all situations.	Ability to find solutions to problems by using logical and imaginative thinking.
3. Effective communicator	Ability to discuss and debate issues articulately and confidently and convincingly.	Character of producing high quality written essays and oral presentations.	Ability to communicate and negotiate with others and to listen to them.
4. Cultural modernist	Familiarity with international standards and world cultures and human rights.	Tolerance of the religions and cultures of others.	Ability to work in a multicultural setting and comprehension and tolerance of religious and cultural differences.
5. Moral uprightness	Understand and act upon the ethical responsibilities of their actions.	Character of acting in a morally upright way in all situations.	Professional behaviour at all times.
6. Technologically savvy	Familiarity and use of technologies appropriately.	Keeping up to date with innovations.	Character of accepting new technology and quickly adapting to it.

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

All university policies can be found at http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies