SUBJECT OUTLINE: 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 topics 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 analysing 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 student with the opportunity to evaluate and critically analyses different types of functions and series. It contributes 10% of the total marks for the Subject.

AT2: Test 1 The test provides student with the opportunity to recall, interpret and solve problems involving functions and 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 student 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 student 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.

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 (NQF), Course Learning Outcomes (CLO), Unitech Graduate Attributes (GA) and Engineers Australia Stage 1 Competencies.

The Subject Learning Outcomes for this Subject combine with those of all Subjects within your course to collectively deliver the 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	Critical Thinker, Life Long Learner	AT1, AT2, AT7	1.2
2	Knowledge and skills	1	Critical Thinker, Life Long Learner	AT1, AT2, AT7	1.2
3	Knowledge and skills Application	1	Critical Thinker, Life Long Learner	AT3, AT4, AT7	1.2
4	Knowledge and skills Application	1	Critical Thinker, Life Long Learner	AT3, AT4, AT7	1.2
5	Knowledge and skills	1	Critical Thinker, Life Long Learner	AT5, AT6, AT7	1.2
6	Knowledge and skills	1	Critical Thinker, Life Long Learner	AT5, AT6, AT7	1.2

Engineering Graduate 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 Courses Learning Outcomes - 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 details for all SLOs to Engineers Australia Stage 1 Competencies for each course provides finer detail.

Course Learning Outcome	Engineers Australia Stage 1 Competencies
1. Possession of a deep understanding of the sciences, math, information systems and engineering fundamentals that underpin the engineering disciplines.	1.1, 1.2
2. An in-depth understanding of the body of knowledge that forms the engineering disciplines.	1.2, 1.3
3. Collection, synthesis and application of information within the engineering disciplines.	1.4, 1.5, 2.1, 2.3, 2.4, 3.4
4. Undertaking research, analysis & evaluation of ideas and concepts within engineering.	1.3, 1.4, 1.6, 2.1, 2.3, 2.4, 3.2, 3.4
5. Applying problem solving skills to complex engineering systems and processes.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3
6. Undertake engineering design 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

***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 Reflected in Work	Sets Aspiration Goals for Personal Improvement and Career Growth	Takes responsibility for one's learning and development.
2. Critical Thinker	Use of Inference Rules in Analyzing and Finding Solutions for Complex Problems	Non-Emotional, Logic and Critical Thinking Abilities in all Situations.	Ability to find solutions to problems by using logical and imaginative thinking.
3. Effective Communicator	Abilities in Articulate Discussions	Skills in Delivering 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, 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.

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	2.2 Fluent application of engineering techniques,	3.2 Effective oral and written communication

analysis, statistics, and computer and information sciences which underpin the engineering discipline.	tools and resources.	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.

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: student to provide

Weekly Tutorial worksheets

Mathematical software

Relevant Unitech Policies

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