SUBJECT OUTLINE: EN 121 ENGINEERING MATHEMATICS 2

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

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 helps 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 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, 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 student 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 student 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 student 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 student 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.

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	Life Long Learner, Critical Thinker	1, 2	1.2
2	Knowledge and skills Application	1	Life Long Learner, Critical Thinker	1, 2	1.2
3	Knowledge and skills, Application	1	Life Long Learner, Critical Thinker	3, 4	1.2
4	Knowledge and skills, Application	1	Life Long Learner, Critical Thinker	3, 4	1.2
5	Knowledge and skills	1	Life Long Learner, Critical Thinker	5	1.2

Graduate Capability Statement

This subject is common to all Bachelor of Engineering courses. Student should refer to their own engineering discipline for the Graduate Capability Statement that applies to their course/discipline.

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 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	2.4 Application of systematic	3.4 Professional use and

development and research directions within the engineering discipline.	approaches to the conduct and management of engineering projects.	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. 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: student to provide
- Weekly Tutorial worksheets
- Mathematical software

Relevant Unitech Policies

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