SUBJECT OUTLINE: 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

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), travelling and standing waves and their equations, 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 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 team work 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: Tests(s) contributes 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

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 (EAS1C). 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 EAS1C
1	Knowledge and skills	1,2	Critical Thinker	1, 2, 3, 4	1.1, 1.2, 3.2, 3.6
2	Application	1,2	Life Long Learner	1, 2, 3, 4	1.1, 1.2, 3.2, 3.6
3	Application	1,2	Life Long Learner	1, 2, 3, 4	1.1, 1.2, 3.2, 3.6
4	Knowledge and skills	1,2	Critical Thinker	1, 2, 3, 4	1.1, 1.2, 3.2, 3.6
5	Application	1,2	Life Long Learner	1, 2, 3, 4	1.1, 1.2, 3.2, 3.6
6	Knowledge and skills	1,2	Critical Thinker	4	1.1, 1.2, 3.2, 3.6

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 matrix 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.

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.

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	Character of acting	Professional behaviour at all

	upon the ethical responsibilities of their actions.	in a morally upright way in all situations.	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

J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I – Statics, Vol II – Dynamics, 6th Ed, John Wiley, 2008.

F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, 9th Ed, Tata McGraw Hill, 2011.

Hugh D.Young and Freeman, University Physics 12th Edition,(Pearson, Addison Wesley 2008).

References

I. H. Shames, Engineering Mechanics: Statics and dynamics, 4th Ed, PHI, 2002.

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 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