SUBJECT OUTLINE: ME311 MECHANICS OF MACHINES

Programs	Mechanical Engineering (NQF Level 8)
Subject Name	Mechanics of Machines
Subject Code	ME311
Duration	13 Teaching Weeks, 1 Examination Week, 1 Mid Semester Week
Contact Hours	6 Hours/Week (4 Lec/1 Tut/1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	ME222 – Solid Mechanics
Corequisites	Nil
Subject Coordinator	TBA

Synopsis

The subject introduces the students to the study of relative motion between the various parts of a machine and forces which act on them. The knowledge of this subject is essential for mechanical engineers in designing the various parts of machines. The included topics address various aspects of kinematics, dynamics, kinetics and statics in machinery.

Subject Topics

1. **Kinematics of Motion**: Rectilinear, Curvilinear and Plane Motions. Equations of Motion. Displacements, Velocities and Accelerations.
2. **Kinetics of Motion**: Newton's laws of motion. Mass, momentum, couple. Centripetal and centrifugal forces. Mass moment of inertia, angular momentum. Torque, work, energy and power in mechanical engineering systems. Conservation of energy. Elastic and plastic impacts.
3. **Harmonic Motion**: Displacements, velocities and accelerations in harmonic motion. Governing differential equations. Simple, compound and torsional pendulums. Centers of percussion.
4. **Mechanisms with Lower Pairs**: Pantographs, straight line mechanisms, steering gear mechanisms, Hook's joints. Friction in mechanisms. Solid, mixed and fluid friction. Clutches.
5. **Belts, Ropes, Chains, Gear Drives, Flywheels, Gyroscopes and their Design**: Geometry, materials and characteristics of mechanisms with belt, rope, chain and gear drives. Gear Trains. Energy storage in flywheels. Precessional angular motion and gyroscopic couples.
6. **Governors, Brakes, Dynamometers and Cams**: Hartnell, Proell and Porter governors. Sensitiveness and stability of governors. Types of Brakes. Absorption

and torsion dynamometers. Cam-follower mechanisms. Equation of motion, velocities and accelerations in cam-follower mechanisms.

Subject Learning Outcomes SLOs

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

1. Establish equations of motion for rectilinear, curvilinear and plane motions and evaluate displacements, velocities and acceleration by analytical and graphical methods in mechanism elements in plane motion.
2. Perform quantitative kinetic evaluations on mechanisms by using Newton's laws and principle of conservation of energy.
3. Establish governing differential equation for harmonic motion, evaluate solutions and variation of specific vibration parameters. Design pendulums and calculate centers of percussion.
4. Evaluate and design mechanisms with lower pairs. Evaluate effects of friction on mechanisms and calculate mechanism efficiencies.
5. Evaluate and design mechanisms with belt, rope, chains and gear trains. Evaluate energy storage capabilities of flywheels. Evaluate precessional angular motion, design gyroscopes and calculate their coupling capabilities.
6. Establish governing equations of motion in governors, brakes and mechanisms with cams. Study the velocity and acceleration distributions by analytical and graphical methods.
7. Undertake team laboratories and communicate team-based laboratory outcomes via well structured reports.

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 final examination. Students must also refer to the Subject Assessment Details.

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% 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 in the Academic Integrity Policy at:

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

Subject Mapping

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

SLO	SLO to NQF	SLO to CLO	SLO to GA	SLO to AT	SLO to EA Stage 1 Competencies
1	Knowledge and Skills	1, 2	1,2	2,3,4	1.1, 1.2, 1.3
2	Applications, Knowledge and Skills	1,2,3	1,2	2,3,4	1.1, 1.2, 1.3
3	Applications, Knowledge and Skills	1,2,5,6	1, 2	2,3,4	1.2, 1.3, 1.5
4	Applications, Knowledge and Skills	4,5,6	1, 2	2, 3, 4	1.3,1.5,
5	Applications, Knowledge and Skills	4,5,6	1, 2,6	2, 3, 4	1.3, 1.5,2.1,2.3
6	Applications, Knowledge and Skills	1,2	1,2,6	2,3,4	1.1,1.2,1.3
7	Applications, Knowledge and Skills	6,7,8	2,3,4,5	1	1.5, 2.1,2.2, 3.1, 3.2,3.3,3.6

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	2.3 Application of	3.3 Creative, innovative

specialist bodies of knowledge within the engineering discipline.	systematic engineering synthesis and design processes.	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 Statement

The mechanical engineering graduate will have the skills and ability to systematically apply the 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.

Mechanical Engineering Course Learning Outcomes

The following table is included to demonstrate to mechanical engineering students that their Course Learning Outcomes address all EA Stage 1 Competencies.

The mapping matrix for all subject learning outcomes within the Course, against EA Stage 1 Competencies, provides more detailed information. That matrix is provided separately to students.

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 mechanical engineering discipline.	1.1, 1.2
2. An in-depth understanding of the body of knowledge that forms the mechanical engineering discipline.	1.2, 1.3
3. Collection, synthesis and application of information within the mechanical and related engineering disciplines.	1.4, 1.5, 2.1, 2.3, 2.4, 3.4
4. Undertaking research, analysis & evaluation of ideas and concepts within mechanical engineering.	1.3, 1.4, 1.6, 2.1, 2.3, 2.4, 3.2, 3.4

5. Applying problem solving skills to complex mechanical engineering systems and processes.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3
6. Undertake mechanical 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

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

Subject Text

Norton, R. - Design of Machinery, McGraw Hill, Boston, 2004

References

Myszka, D. – *Theory of Machines and Mechanisms*, Prentice Hall, Boston, 2012

Readings and Resources

Vinogradov, O. – *Fundamentals of Machines and Mechanisms*, CRC Press, London, 2000

YouTube Clips

1. https://www.youtube.com/watch?v=MJeRFzs4oRU&list=PLBEA57F7E7560C8E8
2. https://www.youtube.com/watch?v=Co4YlavCpeQ
3. https://www.youtube.com/watch?v=0uQAPnaW5D4&list=PLWPirh4EWFpEECWjyAysIZ6WIkwHUy72R

Relevant Unitech Policies:

It is important that all students familiarize themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies can be viewed by visiting the PNGUOT website:

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