FOUN040 Physics – Mechanics, Materials and Electricity

Section 1: General Information

1.1 Administrative Details

Subject:	Physics: Mechanics, Materials and Electricity
Code:	FOUN040
Stream	Science
Points	12
Pre-requisite	Nil

1.2 Subject Workload

Number of timetabled hours per week	Number of Personal study hours per week	Total workload hours per week
4	4	8

1.3 Pre-requisites

Students are not required to have undertaken a pre-requisite subject.

1.4 Other resource requirements

List specialist facilities and/or equipment required for the delivery of this subject:

Calculator: Casio fx 82 is recommended but there is no restriction.

Section 2: Academic Details

2.1 Subject Overview

This paper prepares students for 1st year University study and places an emphasis on the acquisition of:

- Background knowledge
- Computational skills
- English language skills
- Science laboratory skills

2.2 Learning Objectives and Outcomes

Lecture/Tutorial 1: Introduction Units and Measures

Students should be able to

- State and use the SI system of units
- Learn the prefixes
- Understand experimental methodology

Lecture/Tutorial 2: Graphs

Students should be able to

- Draw a straight line graph.
- Find the gradient of the straight line graph.
- Write the equation of the line for the straight line graph.
- Convert non linear graphs to linear graphs.

Lecture/Tutorial 3: Vectors

Students should be able to

- Represent a vector geometrically or numerically
- Combine two or more vectors
- Resolve a vector into perpendicular components
- State the difference between scalar and vector quantities

Lecture/Tutorial 4: Linear Motion and Kinematic Equations

Students should be able to

- Plot a distance vs. time graph and use it to find the speed of an object.
- Plot a velocity vs. time graph and use it to find the acceleration and displacement of an object.
- Explain what is meant by uniform speed and uniform acceleration.
- Carry out calculations using equations for uniform acceleration.
- Carry out calculations to find the vertical and horizontal distances travelled in parabolic motion.

Lecture/Tutorial 5: Forces

Students should be able to

- Explain what a force is
- Draw a free body diagram of the forces acting on the body.
- Find resultant forces.
- Calculate the motion of a body acted upon by a resultant force.
- Explain the link between mass and weight.
- Know Newton's 3 laws of motion.

Lecture/Tutorial 6: Uniform Circular Motion and Gravitation

Students should be able to

- State and use Newton’s law of gravitation to calculate the force between two masses.
- Define gravitational field strength and state its units.
- Relate acceleration due to gravity, g, to gravitational field strength.
- Explain why an object in uniform circular motion experiences a centripetal acceleration.
- Calculate the centripetal acceleration of an object in uniform circular motion from its speed and the radius of rotation.
- Analyse the motion of an object in circular motion in terms of the forces acting on the object.

Lecture/Tutorial 7: Revision of Lectures 3-6

Lecture/Tutorial 8: Equilibrium

Students should be able to

- Understand and use the concept of centre of gravity
- State and apply the principle of torque to a body in equilibrium
- Describe the conditions for an object to be in equilibrium

Lecture/Tutorial 9: Work, Energy and Power

Students should be able to

- Calculate the work done when a force is moved.
- Describe different forms of energy.
- Calculate potential energy.
- Calculate kinetic energy.
- Use the principle of energy conservation.
- Define power and carry out power calculations.
- Relate the power of an engine to force and speed.

Lecture/Tutorial 10: Momentum

Students should be able to

- Use the principle of the conservation of momentum to analyse collisions and explosions.
- Be able to explain the differences between elastic and inelastic collisions.
- Be able to calculate impulse.

Lecture/Tutorial 11: Simple Harmonic Motion

Students should be able to

- Calculate the angular frequency and the angular speed of an object.
- Define simple harmonic motion and give examples of SHM.
- Define amplitude and the time period of SHM.
- Describe, without calculations, how the acceleration, velocity and the displacement of an oscillating system change with time.
- Relate SHM to circular motion.
- Use formulae for the time period of a mass oscillating on a spring and a simple pendulum
- Describe what is meant by resonance.

Lecture 13 Elasticity and Young's Modulus

Students should be able to

- Use a spring to measure force
- Describe the effect of forces on different materials
- Be familiar with the meaning of strength, stiffness and elasticity
- Measure and carry out calculations on stress and strain
- Carry out calculations on Young's Modulus of a material.
- Distinguish between tension, compression and shear stress.
- Explain the meaning of fracture.

Lecture/Tutorial 14 Pressure

Students should be able to

- Be able to calculate density.
- Describe what pressure is.
- Explain the nature of pressure in fluids and carry out calculations on it.
- Understand atmospheric pressure.

- Explain Pascal's Principle.

Lecture/Tutorial 15 Buoyancy and Surface Tension

Students should be able to

- Explain the principle of flotation in terms of upthrust.
- Describe Archimedes Principle.
- Explain how a hydrometer works.
- State the connection between surface tension and capillarity.

Lecture/Tutorial 16 Fluids in Motion and Bernoulli's Equation

Students should be able to

- Explain what flow rate is.
- State and carry out calculations on the equation of continuity.
- Distinguish between lamina and turbulent flow.
- Explain the principle behind Bernoulli's Equation

Lecture 17 DC Electricity

Students should be able to

- Measure an electric current and relate charge and current.
- Describe the characteristics of common electrical components.
- Define resistance and calculate the resistance of a combination of resistances.
- Be able to use the following equations
- P=IV V=IR I=Q/t E=QV

Lecture 18 Static Electricity

Students should be able to

- Explain the nature and cause of static electricity
- Use Coulomb's Law to calculate the force between two point charges
- Sketch the pattern of lines of force and equipotentials in a uniform field, a radial field and near two point charges
- Define electrical field strength and electric potential
- Calculate the electric field strength of a uniform field created by two oppositely charged parallel plates
- Calculate the electric field strength at a given distance from a point charge.

Lecture 19 Magnetism

Students should be able to

- Sketch the magnetic field pattern for different shaped magnets and current carrying conductors
- Use a plotting compass to plot magnetic lines of force
- Describe the operation of an electromagnet
- Describe the motor effect and use it to explain the operation of an electric motor.

Lecture 20 Induction and Transformers

Students should be able to

- Describe and calculate the effect of a uniform magnetic field on a beam of charged particles.
- State and use Farady's Law and Lenz's Law
- Describe and explain the operation of a transformer
- Use the transformer rule and relate the input power and the output power to the efficiency
- Describe the main causes of inefficiency in a transformer

2.3 Subject Content

Week	Lectures
Week 1	Lecture 1 : Introduction Lecture 2: Graphs
Week 2	Lecture 3: Vectors Lecture 4: Linear Motion and Kinematic Equations
Week 3	Lecture 5: Forces Lecture 6: Gravitational Force and Centripetal Motion
Week 4	Lecture 7: Mechanics Revision Lecture 1 Lecture 8: Equilibrium
Week 5	Lecture 9: Energy Lecture 10: Momentum
Week 6	Lecture 11:Simple Harmonic Motion Lecture 12: Mechanics Revision Lecture 2
Week 7	Lecture 13: Midterm Test Lecture 14: Elasticity and Young's Modulus
Week 8	Lecture 15: Pressure Lecture 16: Buoyancy and Surface Tension
Week 9	Lecture 17: Bernoulli's Theorem Lecture 18: DC Electricity
Week 10	Lecture 19: Electric Fields Lecture 20: Magnetism
Week 11	Lecture 21: Induction and Transformers Lecture 22: Revision Lecture : Bulk Materials
Week 12	Lecture 23: Revision Lecture : Mechanics Lecture 24: Revision Lecture : Electricity and Magnetism
Week 13	Study Leave and Exams

2.4 Teaching Method/Strategies

Lectures are face to face instruction. Tutorials start with a recap of the last lecture and then students work through some problems. Lab work is completed in groups, with each person submitting a report.

2.5 Assessment

Assessment Type	**When**	**Weighting**	**Learning Outcomes Assessed**
Internal Test	Week 7	20%	Outcomes 1-10
Labs	Throughout term	10%	Outcomes 1-20
Final Examination	Week	70%	Outcomes 1-20

2.5.1 Assessment Strategy

Assessment is via timed tests and practical reports.

2.5.2 Hurdle Requirement

In order to pass this paper, students must obtain an overall mark of 50% (C-) or better.

2.5.3 Assessment Details

Assessment	Content/ Format	Time	Details
Internal Assessment Task 1 20%	45 minute written test. A data sheet is provided.	Week 7	This test covers all material from the first book. It has both calculation questions and short answers questions.
Internal Assessment Task 2	Labs. Students will attend 3 labs of 2 hours each.	Throughout the term.	A written report is required. Students will be given a lab book that they need to complete and hand in at the end of the class.
Final Examination		2 hours	This test covers all material from both of the books. It has both calculation questions and short answers questions.

3. Subject Details

3.1 Weekly Schedule

Week	Lectures
Week 1	Lecture 1 : Introduction Lecture 2: Graphs
Week 2	Lecture 3: Vectors Lecture 4: Linear Motion and Kinematic Equations
Week 3	Lecture 5: Forces Lecture 6: Gravitational Force and Centripetal Motion
Week 4	Lecture 7: Mechanics Revision Lecture 1 Lecture 8: Equilibrium
Week 5	Lecture 9: Energy Lecture 10: Momentum
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Week 13	Study Leave and Exams