FOUN041 Physics – Thermodynamics and Modern Physics

Section 1: General Information

1.1 Administrative Details

Subject:	Physics: Thermodynamics, Waves and Nuclear Physics.
Code:	FOUN041
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

Student Learning Objectives

Lecture 2 Thermal Expansion

Students should be able to

- Convert temperatures in Celsius to Kelvin and vice versa.
- Calculate the thermal expansion of a solid for a given temperature rise.
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Lecture 3 Kinetic Theory and Gas Laws

Students should be able to

- Differentiate between temperature and heat energy
- Describe Brownian motion.
- Explain the cause of gas pressure.
- Outline the assumptions that form the basis of the kinetic theory model of a gas.

- State and use Boyle's Law and Charles' Law.
- Explain what is meant by an ideal gas.
- State and use the ideal gas equation, and the molar gas constant, R.

Lecture 4 Specific heat Capacity

Students should be able to

- Measure the specific heat capacity of different substances.
- Measure the specific latent heat of fusion of ice.
- Carry out specific heat calculations and specific latent heat calculations.

Lecture 5 Heat Transfer

Students should be able to

- Describe conduction, convection and radiation as heat transfer mechanisms.
- Carry out thermal conduction and radiation calculations

Lecture 6 Thermodynamics

Students should be able to

- State and use the Zeroth and First Laws of Thermodynamics.
- Explain what a heat engine is and calculate its maximum possible efficiency.

Lecture 7 Waves

Students should be able to

- Describe different types of waves and their uses.
- State the meaning of amplitude, frequency and speed of a wave.
- Relate the speed to the frequency and wavelength of a wave.
- Explain the properties of light waves.
- State the rules for reflection in a plane mirror.

Lecture 8 Refraction

Students should be able to

- Explain with a diagram what the refraction of light is and state how it happens.
- Identify the normal, angle of incidence and the angle of refraction in an example of refraction.
- Be able to use Snell's law.
- State and apply the rules for refraction.
- Explain with a diagram what total internal reflection is.
- State the conditions needed for total internal reflection.

Lecture 9 Lenses

Students should be able to

- Explain, using ray diagrams, what the focal point is
- Sketch ray diagrams for the convex lens with the object in a variety of positions and state the nature of the image in each case
- Explain, using a diagram, why a concave lens has a virtual focus and a virtual image
- Use formulae to solve problems

Lecture 10 Mirrors

Students should be able to

- Explain, using ray diagrams, what the focal point is
- Sketch ray diagrams for a concave mirror with the object in a variety of positions and state the nature of the images produced
- Explain, using a diagram, why a convex mirror has a virtual focus and a virtual image
- Use formulae to solve problems on mirrors

Lecture 11 Interference

Students should be able to

- Explain with diagrams what diffraction is
- State what condition must be met for diffraction to occur
- Be able to identify nodes and antinodes, explaining what they are and how they are formed
- Explain why interference of light would support a wave model for light
- Solve numerical problems involving the interference of light waves.

Lecture 14 Doppler Effect

Students should be able to

- Explain what a sound wave is.
- Be able to explain the parts and functions of the ear.
- Be able to describe the Doppler Effect.
- Be able to use the Doppler equation.

Lecture 15 Harmonics

Students should be able to

Be able to explain what a standing wave is.

- Identify nodes and antinodes
- Calculate fundamental frequencies.
- Calculate harmonics for open and closed pipes.
- State what resonance means.
- Be able to work out a beat frequency.

Lecture 16: Alpha, Beta, Gamma

Students should be able to

- Describe the structure of the atom in terms of electrons, protons and neutrons.
- Explain what is meant by atomic number and atomic mass.
- Explain what the term “isotope” means.
- Explain what a radioactive substance is and describe the main properties of the radiation from radioactive substances.
- Describe the changes that occur when an unstable nucleus emits radiation.
- Uses of alpha, beta, gamma.
- Writing decay equations.

Lecture 17: Rutherford Model and Half Life

Students should be able to

- Be able to describe Rutherford's gold leaf experiment
- Be able to define half lives
- Be able to calculate half lives
- Understand the difference between fusion and fission.

Lecture 18: Binding Energy

Students should be able to

- Identify the forces in the atom.
- Explain what is meant by binding energy and mass defect.
- Calculate the binding energy of a nucleus.
- Calculate the binding energy per nucleon.
- Explain why some atoms are more stable than others

Lecture 19: Bohr Model

Students should be able to

- Explain Bohr's modification to the Rutherford model of the hydrogen atom
- Use Bohr's modification to the Rydberg formula
- Interpret energy level diagrams for the Bohr hydrogen atom
- Explain what is meant by "atomic line spectra"
- Distinguish between continuous, discrete and absorption spectra
- Carry out calculations using the Rydberg formula

Lecture 20: Photoelectric effect

Students should be able to

- Describe and explain the photoelectric effect
- Explain the meaning of the "Photon theory of Light"
- Carry out calculations using the photon energy equation,
  $E = hf$
- Explain the meaning of "wave-particle duality"

2.3 Subject Content

Week	Lecture
1	Lecture 1:Introduction
	Lecture 2: Graphs and Thermal Expansion
2	Lecture 3: Gas Laws
	Lecture 4: Specific Heat Capacity
3	Lecture 5: Heat Transfer
	Lecture 6: Thermodynamics
4	Lecture 7: Thermodynamics Revision
	Lecture 8: Property of Waves
5	Lecture 9: Refraction
	Lecture 10: Lenses
6	Lecture 11: Mirrors
	Lecture 12: Midterm revision lecture
7	Lecture 13: Midterm Test
	Lecture 14: Interference
8	Lecture 15: Sound Waves and the Doppler effect
	Lecture 16: Harmonics
9	Lecture 17: Alpha, beta and Gamma
	Lecture 18: Rutherford's Model and Half Lives
10	Lecture 19: Einstein
	Lecture 20: Bohr's Model
11	Lecture 21: Photoelectric effect
	Lecture 22: Revision Lecture : Nuclear Physics
12	Lecture 23: Revision Lecture : Waves
	Lecture 24: Revision Lecture : Thermodynamics

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	Lecture
1	Lecture 1:Introduction
	Lecture 2: Graphs and Thermal Expansion
2	Lecture 3: Gas Laws
	Lecture 4: Specific Heat Capacity
3	Lecture 5: Heat Transfer
	Lecture 6: Thermodynamics
4	Lecture 7: Thermodynamics Revision
	Lecture 8: Property of Waves
5	Lecture 9: Refraction
	Lecture 10: Lenses
6	Lecture 11: Mirrors
	Lecture 12: Midterm revision lecture
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	Lecture 14: Interference
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