



THE UNIVERSITY OF SYDNEY

School of Physics

PHYS 1001 Physics 1 (Regular) – Semester 1, 2017

Module 1 – Mechanics

This module is one of 3 comprising PHYS 1001 Physics 1 (Regular). This document describes details of this module and should be read in conjunction with the *Unit of Study Outline* for PHYS 1001 Physics 1 (Regular).

GENERAL GOALS

The aim of this module is to reinforce and extend your previous knowledge of mechanics. You will firstly investigate the causes of changes in the state of motion — a field of physics called *dynamics* — in particular to understand the basis and application of Newton's laws of motion. You will also relate the ideas of Newtonian dynamics to the concepts of work and energy, and the laws of conservation of energy and momentum. These concepts will then be used to explore rotational dynamics and the parallels between the descriptions and dynamics of rotational and straight-line motion. All of these ideas are basic to physical ideas later in this unit.

MODULE DEFINITION – MECHANICS

Specified as references from the text: *University Physics (with Modern Physics)* by Young and Freedman, 14th edition. (Section numbers are the same in the 13th edition).

ASSUMED KNOWLEDGE AND REVIEW

The first three chapters of the textbook are considered to be review material for this module. Students interested in doing preliminary reading should cover sections 2–1 to 2–5 and 3–1 to 3–4 in particular. The content of these chapters will be covered rapidly in class.

Chapter 1 UNITS, PHYSICAL QUANTITIES AND VECTORS

Text sections: 1 to 9 (Vector Product in Section 10 will be addressed in Chapter 10.)
(Scalar Product in Section 10 will be addressed in Chapter 6.)

Chapter 2 MOTION ALONG A STRAIGHT LINE

Text sections: 1 to 5 (Some of this material will be reviewed in the first two lectures.)

Chapter 3 MOTION IN TWO OR THREE DIMENSIONS

Text sections: 1 to 5 (Some of this material will be reviewed in the first lecture.)

SPECIFIC OBJECTIVES:

There is no easy road to learning. Your marks will depend on the work that you do. You should therefore read through and understand the sections of the textbook specified below, and work through the specified 'Text examples'. You should then attempt as many as possible of the MasteringPhysics questions. Problem solving skills can only be acquired by practice.

Chapter 4 NEWTON'S LAWS OF MOTION

Text sections: 1 to 6

Specific objectives – after studying this chapter you should be able to:

- Define and apply the concepts of force, net force, mass and particle or point mass.
- Identify the forces on a body, particularly weight, normal force, frictional force, tension.
- Define and apply Newton's three laws of motion.
- Draw free-body diagrams and use them to assist with force problems.

Chapter 5 APPLYING NEWTON'S LAWS

Text sections: 1 to 3 (not Fluid Resistance and Terminal Speed), and 4

Specific objectives – after studying this chapter you should be able to:

- Define the concept of equilibrium for particles.
- Apply knowledge of Newton's laws to systems involving static frictional force, kinetic frictional force.
- Define and apply the coefficients of static and kinetic friction in force problems.
- Describe circular motion, in particular identify the force responsible for centripetal acceleration, and calculate properties of rotating systems.

Chapter 6: WORK AND KINETIC ENERGY

Text sections: 1 to 3

Specific objectives – after studying this chapter you should be able to:

- Define and calculate work and kinetic energy, and understand the relationship between them — the 'work-kinetic energy theorem'.
- Calculate the work done by variable forces, including systems that obey Hooke's law.
- Derive the relationships between different units of work: joule, electron volt, kilowatt hour.

Chapter 7: POTENTIAL ENERGY AND ENERGY CONSERVATION

Text sections: 1 to 3

Specific objectives – after studying this chapter you should be able to:

- Define and calculate potential energy, in particular gravitational and elastic PE.
- Define the law of conservation of mechanical energy, and apply it to various dynamical systems.
- Describe the difference between conservative and non-conservative forces.
- Calculate the work done by frictional forces, and describe the concept of the amount of work done on a system by a force.

Chapter 8: MOMENTUM, IMPULSE AND COLLISIONS

Text sections: 1 to 5

Specific objectives – after studying this chapter you should be able to:

- Define and calculate the linear momentum of a particle, the total linear momentum of a system and the relationship between impulse, force and momentum.
- Describe and apply the law of conservation of linear momentum in explosions and collisions .
- Describe the difference between internal and external forces.
- Describe inelastic and elastic collisions and apply the conservation laws appropriate in each case to examine collisions.
- Calculate the centre of mass for a system, and the motion of the centre of mass due to external forces.

Chapter 9: ROTATION OF RIGID BODIES

Text sections: 1 to 6

Specific objectives – after studying this chapter you should be able to:

- Define the variables of angular motion: angular position, displacement, speed, velocity and acceleration.
- Describe and apply the relationships between linear and angular kinematics.
- Define the moment of inertia and calculate it for simple situations.
- Calculate the energy in systems undergoing rotational motion, including the rotational kinetic energy.

Chapter 10: DYNAMICS OF ROTATIONAL MOTION

Text sections: 1 to 3, 4 (not Power), 5 to 6, 7 (qualitative only)

Specific objectives – after studying this chapter you should be able to:

- Define and apply the concept of torque, particularly as a vector product (introduction of vector product).
- Apply the relationship between torque and angular acceleration of an object.
- Describe the dynamics of systems undergoing combined translation and rotation — rolling without slipping (not rolling friction).
- Calculate the work done by a torque (not power).
- Define and calculate angular momentum (as a vector quantity), and derive Newton's 2nd law for angular quantities.
- Describe and apply the law of conservation of angular momentum.
- Calculate the total angular momentum for a system of bodies.
- Describe gyroscopic precession

NOTE: Since there are 17 lectures in this module, your lecturer will tell you how the material defined above will be covered in the lectures.