Unit Description

This module is one of 3 comprising PHYS 1902 Physics 1 (Advanced). This document describes details of this module and should be read in conjunction with the more general unit of study outline for PHYS 1902 Physics 1 (Advanced).

General goals of this module

The aim of this module is to study the behaviour of fluids (gases and liquids) and to understand how we quantify their physical properties as functions, which exist continuously over extended regions of space. In other words, we describe the properties using scalar and vector fields. This work builds on earlier studies in mechanics, where physical properties are mostly reduced to considerations of point masses. We show how the laws of conservation of mass and energy are used to derive expressions to describe static and dynamic (moving) fluids. By studying the properties of fluids, we will also see how the process of measurement might affect the fluid.

MODULE DEFINITION & OBJECTIVES – FLUIDS

(specified as references from the text: University Physics (with Modern Physics) by Young and Freedman, 13th edition)

LEARNING OBJECTIVES

For each topic in this Module the Specific Objectives define what we expect you to learn and understand. “Understanding” a term or concept means that you should be able to:

- explain its meaning,
- interpret it correctly when you read or hear it,
- use it correctly in your own writing,
- apply it correctly to examples and problems.

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 examples. You should then attempt as many as possible of the recommended questions, exercises and problems. Problem solving skills can only be acquired by practice.

Chapter 14    FLUID MECHANICS

Text sections: 1 to 6

Text examples: 1 to 12

Recommended Discussion Questions:  2, 9, 19, 20, 29, 30

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

- Describe what a fluid is and understand how the concepts of density and pressure apply to fluids.
- Calculate the variation of pressure (both absolute and gauge) with depth and be able to explain and use Pascal’s law.
- Explain Archimedes’ principle and the concept of buoyancy and use them to solve problems of bodies immersed in fluids.
- Solve problems concerning surface tension, surface energy and capillary action at fluid interfaces.
- Describe an ideal fluid in motion and explain the concept of streamlines and flux.
- Derive the equation of continuity and Bernoulli’s equation and use them to solve problems of fluids in motion.
- Explain the effects of viscosity and turbulence on real fluids.
- Explain the concept of dimensionless quantities, such as the Reynolds number, and their use in describing fluid flow.
MODULE OUTLINE
14 - 1 Introduction to fluids
14 - 2 Density
14 - 3 Pressure in a fluid, variation with depth, Pascal's law
14 - 4 Buoyancy and Archimedes' principle
14 - 5 Surface tension, surface energy and capillarity
14 - 6 Fluid flow, streamlines, the continuity equation, volume flow rate, flux
14 - 7 Bernoulli's equation
14 - 8 Turbulence and real fluids
14 - 9 Viscosity, Poiseuille's equation, Reynolds number (additional notes)