PHYS1003 Physics 1 (Technological) – Semester 2, 2013

MODULE 2 OUTLINE: FLUIDS

Unit Description

This module is one of 3 comprising PHYS 1003 Physics 1 (Technological). This document describes details of this module and should be read in conjunction with the more general unit of study outline for PHYS 1003 Physics 1 (Technological).

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 that exist continuously over extended regions of space. 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.

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 12 FLUID MECHANICS

Text sections: 1 to 6
Text Examples: 1 to 11 (*very helpful*)
Recommended Discussion Questions: 2–4, 6, 9, 14, 15, 18–20, 23, 24, 26, 28, 30
Recommended Exercises (do at least one per section): 3, 5; 9, 11, 23; 27, 29, 33; 35, 37; 43, 47; 49
Recommended Problems (for extra practice): 57, 59, 61, 65, 71, 73, 77, 91, 95, 97

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.
- Identify the approximations frequently used in fluid calculations. Determine which are applicable in various physical situations and which are required by each important equation and principle discussed.
- Calculate the variation of pressure (both absolute and gauge) with depth (static fluids) 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.
- Describe an ideal fluid in motion and explain the concept of streamlines.
- Derive the equation of continuity and Bernoulli's equation, and use them to solve problems of fluids in motion and of objects in motion through a fluid.
- Explain the effects of viscosity and turbulence on real fluids.
- Understand the implications and use of the concept of the dimensionless quantity called the Reynolds number in describing fluid flow. Reynolds number is not discussed in the textbook but is covered in the web notes.

MODULE OUTLINE

- Fluid statics
    - Introduction to fluids, density, pressure
    - Pressure and depth, Pascal's law, buoyancy
    - Archimedes' Principle, examples
- Fluid dynamics
    - Fluid flow, streamlines, Bernoulli's equation
    - Applications of Bernoulli's equation
    - Viscosity, turbulence, Reynolds number *(not covered in textbook)*

Notes:

- These are the core topics for this course and are all covered in the textbook (Chapter 12, all sections) **with the exception** of the material covering viscosity, turbulence, and Reynolds number, which will be presented in lecture and also in the web notes.
- Additional topics, applications, demos, and examples will be presented as time permits.
- **All topics are examinable** unless explicitly specified otherwise.

Additional resources:

- Web notes for this course (available via elearning.sydney.edu.au)
- Ian Cooper's notes (subject to change or removal): http://www.physics.usyd.edu.au/teach_res/jp/fluids/wfluids.htm
- Dr Julia Bryant's notes from Sem 2, 2011 (subject to change or removal): http://www.physics.usyd.edu.au/~jbryant/Fluids.html