CE 105 FLUID MECHANICS

Co-ordinator: Dr.G.R. Hunt (Room 331), gary.hunt@imperial.ac.uk

Lecturers:	Dr G.R.Hunt (GRH) (Rm 331) Dr R MacIver
Structure:	19 lecture hours, 19 tutorial hours, 10 laboratory hours
Links:	CE103 Basic Mechanics, all subsequent Hydraulics & Fluid Mechanics courses (years 2 to 4)

Introduction

A key area of civil engineering enterprise is concerned with fluids and fluid flow. Water, for example, can be harnessed to generate hydroelectric power or to irrigate tracts of drought-prone agricultural land. The natural landscape and the built environment must be protected from floods, surge tides and waves and the design of protective hydraulic structures requires knowledge of the **underlying fluid mechanics**.

The design of hydraulic structures demands an understanding of the three fundamental relationships of fluid mechanics: the principle of mass continuity, Newton's law relating to momentum and the constancy of energy within a conservative system. This module develops these fundamental relationships in a series of lectures and explores them through laboratory demonstrations and exercises.

Aims

The aims of the module are:

- to introduce you to the physical processes which govern the behaviour of fluids at rest and in motion
- to provide you with a solid foundation in fundamental fluid mechanics on which specialist fluid dynamics courses in years 2,3 and 4 will build
- to give you experience and confidence in problem-solving
- to give you insights into the practical world of civil engineering hydraulics

Links with other Course Modules

There is common ground in the material covered in Basic Mechanics and in the fluid statics of the Fluid Mechanics module. The three relationships you are exposed to here are extended in the core modules of Hydraulics of the second and third years. In addition there are fluid mechanics/hydraulic modules in the third and fourth years that build on the preliminary material covered in the first year.

The lectures are supported by tutorial periods where you will tackle a range of problems designed to illustrate the lecture material.

SYLLABUS

Order of lectures:

<u>Fluid statics and fluid dynamics (GRH)</u>

The nature of fluids.

Forces and pressures in fluids at rest.

Fluids in motion.
Energy and Momentum.
Application of the governing equations to a broad range of fluid flow problems.

Open channel flow: ()

Introduction.
Energy and momentum.
Contractions and expansions; the hydraulic jump.
Critical depth theory I.Critical depth theory II.Elementary friction.

Coursework and Submission Dates

1. Laboratory experiments , Weeks (to be confirmed)
   You will undertake experiments in the Fluid Dynamics Laboratory that are designed to assist your understanding of the material covered in the lectures. You will be required to document your findings and submit in the form of a concise scientific report in Week 14 for a coursework mark.

2. Laboratory exercises
   Two formal exercises linked to the lecture material will be undertaken and submitted for coursework marks.

   i. Design of a spillway. The aim of this practical is to give you experience in identifying the physical processes involved in a spillway and then to make an outline design of a full-scale structure. This work is to be written up in a professional manner and in order to limit the time you spend on your presentation, you will confine your report to one side of A4 only! Submission will be in Week 18.
   ii. Open Channel Flow. The aim of this practical is to demonstrate processes relating to minimum energy and critical depth theory and to illustrate the effects of friction. A professional report will be submitted in Week 22.

Assessment

The three coursework submissions together with a contribution from a progress test under examination conditions will be assessed for a coursework mark. An examination in Fluid Mechanics at the end of the session will consist of ??? questions covering each half of the module. Two questions are compulsory and there is a free choice for three others.

Recommended Textbooks/Reading

You are strongly advised to consult textbooks to expand and supplement the information in the lecture notes and lectures. Any of the texts shown below will cover the module material adequately. All can be found in the library.

VENNARD and STREET: Elementary Fluid Mechanics.
FRANCIS and MINTON: A Textbook of Fluid Mechanics.
MASSEY: Mechanics of Fluids.
WEBBER: Fluid Mechanics for Civil Engineers.

Learning outcomes
Through your tutorial and coursework submissions and in your examinations you should demonstrate

- an understanding of the physical processes of fluid statics and dynamics,
- an appreciation of many of the practicalities involved in the design of hydraulic structures.