LONDON SOUTH BANK UNIVERSITY

HYDRAULICS

BCE/2/121

Faculty of Engineering, Science and
the Built Environment

2008/09

become what you want to be

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1. UNIT DETAILS

Unit Title:	Hydraulics
Unit Level:	2
Unit Reference Number:	BCE/2/121
Credit Value:	1
Student Study Hours:	150
Contact Hours:	61
Private Study Hours:	89
Pre-requisite Learning (If applicable):	BCE/1/122 or equivalent
Co-requisite Units (If applicable):	None
Course(s):	BEng (Hons) Civil Engineering
Year and Semester	Stage 2 semester 2
Unit Coordinator:	Professor J T Douglas
UC Contact Details (Tel, Email, Room)	john.douglas@lsbu.ac.uk T620
Teaching Team & Contact Details	Professor J T Douglas
(If applicable):	Dr S Mitchell
Subject Area:	Civil Engineering
Summary of Assessment Method:	Examination and coursework

2. SHORT DESCRIPTION

This unit develops the fundamental principles introduced in the unit BCE/1/122 and applies them to practical applications of analysis and design. The student will develop a greater understanding of the flow of ideal and real fluids and will apply these principles to the analysis and design of pipes and open channels. The student will perform simple laboratory tests and prepare a formal report.

3. AIMS OF THE UNIT

To investigate steady flow of real and ideal fluids in pipes and open channels and to introduce the concept of non-steady flow.

4. LEARNING OUTCOMES

4.1 Knowledge and Understanding

The student should be able to:

Understand the principles of two-dimensional inviscid flow for both linear and curved motion,

Understand the concept of the boundary layer in real fluids and its importance in the analysis of turbulent flow,

Analyse and design complex pipe network systems,

Match pump with load in pipeline systems for both a single pump and a combination of pumps,

Understand the fundamental principles of waterhammer,

Apply the principles of energy and momentum to rapidly varied steady flow in open channels,

Understand the principles of dynamic similarity,

Design fixed-bed and mobile-bed models for rivers and estuaries,

Carry out laboratory experiments and prepare a technical report.

4.2 Intellectual Skills

Use mathematical methods to analyse engineering problems.

Analyse and solve engineering problems.

Design engineering elements and whole systems to meet a need, critically evaluate, and make improvements.

Apply engineering knowledge and understanding in the solution of problems and the development of designs.

Be aware of all the relevant frameworks in solving problems and designing systems, taking into account financial aspects, risk analysis, and environmental impact.

4.3 Practical Skills

Carry out safely a series of planned experiments.

Use laboratory and field work equipment to generate data.

Analyse experimental results and determine their validity and accuracy.

Prepare technical reports.

Use the library, Internet, and other sources effectively.

Use computer packages.

4.4 Transferable Skills

Communicate effectively - oral presentations, report writing, drawing.

Apply mathematical skills.

Work independently.

Manage time and work to deadlines.

Use Information and Communications Technology

Work constructively as a member of a group.

Manage tasks and solve problems, transfer techniques and solutions from one area to another, apply critical analysis and judgement.

5. ASSESSMENT OF THE UNIT

70% 3 hour end of unit examination. Students should attempt any five questions out of eight.
30% An individual report describing fully the outcome of a number of short experiments carried out in small groups.
Regular coursework examples.

6. FEEDBACK

Feedback will normally be given to students 15 working days after the submission of an assignment.

7. INTRODUCTION TO STUDYING THE UNIT

7.1 Overview of the Main Content

Ideal Flow
Equation of continuity for two-dimensional flow. Circulation and vorticity. Stream function and velocity potential. Curved motion, free, forced, and combined vortices. Basic flow patterns and combinations of flow patterns.

Boundary Layer Theory
Laminar and turbulent boundary layers on plane surfaces. Displacement thickness and momentum thickness. Drag force. Flow round a cylinder. Separation and wakes.

Steady Pipe Flow
Turbulent flow in pipes. Smooth and rough turbulence. Viscous sub-layer. Resistance equations. Solution of pipe networks using the method of Hardy Cross.

Pumps
Performance curves for pumps. Pump-system characteristics. Laws of similarity. Pumps in combination. Change of pump speed and diameter.

Non-steady Pipe Flow
Slow valve closure. Inertia head. Rapid valve closure. Waterhammer equations

Steady Flow in Open Channels
Rapidly varied flow. Specific energy and critical depth. Subcritical and supercritical flow. Flow force and the hydraulic jump. Weirs and flumes.

Hydraulic Modelling
Dynamic similarity. Scaling laws and scale effect. Fixed-bed river and estuary models. Distortion of scales. Mobile-bed models.

7.2 Overview of Types of Classes

Lectures and tutorials supplemented by printed handouts and supported by laboratory demonstrations and experiments. There will be an emphasis on problem-solving activities to develop further the principles and concepts of hydraulics. This will be used extensively in the lecture programme and will be further supported in regular tutorial sessions.

7.3 Importance of Student Self-Managed Learning Time

The student is provided with a full set of notes and problem sheets that cover all aspects of the unit. These problem sheets should be attempted in the student's self-managed time in order that they may be discussed at the regular tutorial sessions.

7.4 Employability

This unit will provide the student with a knowledge and understanding of hydraulics at an intermediate level, thereby enabling the student to work to this level in engineering practices.

8. THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

Date	Week No	Lecture
26 January	1	Rapidly varied flow. Specific Energy and critical depth. Weirs and flumes.
2 February	2	Flow force and the hydraulic jump. Hydraulic modelling.
9 February	3	Ideal flow. Equation of continuity for two-dimensional flow. Circulation and vorticity. Stream function and velocity potential.
16 February	4	Vortex motion. Basic flow patterns and combinations of flow patterns.
23 February	5	Boundary layer theory
2 March	6	Flow round a cylinder
9 March	7	Steady pipe flow
16 March	8	Steady pipe flow
23 March	9	Pipe networks
30 March	10	Pumps
		Easter Vacation
27 April	11	Non-steady pipe flow
4 May	12	Field trip (provisional)
11 May	13	Revision
18 May	14	Examination period
25 May	15	Recess Week
1 June	16	Examination period

9. LEARNING RESOURCES

9.1 Core Materials

Chadwick, A., Morfett, J. and Borthwick, M, Hydraulics in Civil and Environmental Engineering, 4th edition, E & FN Spon, 2004.

Douglas, J. F., Gasiorek, J. M., and Swaffield, J. A., Fluid Mechanics, 4th edition, Prentice Hall, 2001.

Kay, M., Practical Hydraulics, 2nd edition, Taylor & Francis, 2008.

Featherstone, R. E., and Nalluri, C., Civil Engineering Hydraulics, 4th edition, Blackwell, 2001.

Hamill, L., Understanding Hydraulics, Palgrave, 2nd edition, 2001.

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