

ES2G9-15 Hydraulics and Water Resources

25/26

Department

School of Engineering

Level

Undergraduate Level 2

Module leader

Soroush Abolfathi

Credit value

15

Module duration

25 weeks

Assessment

30% coursework, 70% exam

Study location

University of Warwick main campus, Coventry

Description

Introductory description

Hydraulics and Water Resources

[Module web page](#)

Module aims

Knowledge of water engineering is essential for good practice of civil and environmental engineering. This module provides background material on fluid mechanics, open channel hydraulics, and engineering hydrology that serves as a sound base for other relevant civil and environmental modules and for future professional practice. The module will enable students to understand the principles of free surface flows and engineering hydrology applied to civil engineering problems.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Open Channel Hydraulics

- Review of hydrostatics, pipe flow, pumps, and Bernoulli equation
- Laminar and turbulent flow in open channels
- Laminar flow analysis
- Principles of uniform flow
- Development of friction equations - the magnitude of friction coefficients
- Channels with distorted cross-sections & “Best form” cross-sections
- Development of energy concepts & specific energy
- Critical flow considerations
- Applications of the energy principle
- Measurement structures and dilution gauging
- Development of conservation of momentum principle
- Specific Energy considerations
- Analysis of hydraulic jump
- Gradually varied flow equation & classification of gradually varied flow profiles
- Methods for the calculation of gradually varied flow profiles
- Location of hydraulic jump
- Introduction to numerical software for flow analysis

Engineering Hydrology

- The hydrological cycle
- Precipitation, initial losses, infiltration, percolation, evapotranspiration, surface runoff, groundwater flow
- Rainfall types and spatial variability of rainfall (UK)
- Rainfall. Intensity - duration - frequency (return period) analysis
- The Flood Estimation Handbook (FEH)
- Design storm rainfall. Uniform intensity and FEH rainfall profiles
- River flow analysis
- The unit hydrograph
- FEH techniques to estimate runoff from catchment characteristics; impacts of urbanisation
- Reservoir routing

Learning outcomes

By the end of the module, students should be able to:

- Apply mathematical and engineering principles to explain the principles controlling open channel flows. [M1(M), M2(M)]
- Formulate and analyse problems different flow types evaluating available data and observations. [M1(M), M2(M), M3(M)]
- Analyse free surface flow problems using friction, energy and momentum considerations by means of analytical methods and laboratory observations [M1(M), M2(M), M3(M), M12(D)]
- Predict rainfall and runoff characteristics for UK catchments critically evaluating existing information. [M1(M), M2(M), M3(M), C4-M4(D), C7(M), M7(D)]

Indicative reading list

- (1) Chadwick, A.J. & Morfett, J.C. Borthwick M. Hydraulics in Civil and Environmental Engineering (5th Edition) Spon 2013
- (2) Chanson, H. The Hydraulics of Open Channel Flow Arnold (2nd Edition) 2004
- (3) Douglas, J.F., Gasiorek, J.M., Swaffield, J.A. & Jack L., Fluid Mechanics (6th Edition) Wiley 2011
- (4) Shaw E.M., Beven K.J., Chappell N.A. & Lamb R., Hydrology in Practice, Spon 2010

Subject specific skills

1. Ability to conceive, make and realise a component, product, system or process
2. Ability to develop economically viable and ethically sound sustainable solutions
3. Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for, often complex, concepts to become reality
4. Ability to seek to achieve sustainable solutions to problems and have strategies for being creative and innovative
5. Ability to be risk, cost and value-conscious, and aware of their ethical, social, cultural, environmental, health and safety, and wider professional engineering responsibilities

Transferable skills

1. Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions
 2. Apply problem solving skills, information retrieval, and the effective use of general IT facilities
 3. Communicate (written and oral; to technical and non-technical audiences) and work with others
 4. Exercise initiative and personal responsibility, including time management, which may be as a team member or leader
 5. Awareness of the nature of business and enterprise in the creation of economic and social value
 6. Overcome difficulties by employing skills, knowledge and understanding in a flexible manner
 7. Ability to formulate and operate within appropriate codes of conduct, when faced with an ethical issue
 8. Appreciation of the global dimensions of engineering, commerce and communication
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Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Tutorials	13 sessions of 1 hour (9%)
Demonstrations	1 session of 2 hours (1%)
Private study	105 hours (70%)
Total	150 hours

Private study description

105 hrs of guided independent learning

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group D

	Weighting	Study time	Eligible for self-certification
Written design exercise Hydrology Design Exercise (timed, 8 pages max length)	30%		Yes (extension)
Online Examination QMP ~Platforms - AEP,QMP	70%		No

- Online examination: No Answerbook required
- Students may use a calculator
- Engineering Data Book 8th Edition
- Graph paper

Feedback on assessment

Oral feedback (as group and one-to-one if requested) in dedicated session and marked script

[Past exam papers for ES2G9](#)

Availability

Courses

This module is Core for:

- Year 2 of UESA-H216 BEng Civil Engineering
- Year 2 of UESA-H217 MEng Civil Engineering