Engineering Tripos Part IIA, 3D5: Water Engineering, 2018-19

Module Leader

Dr D Liang [1]

Lecturers

Dr D Liang and Prof A McRobie [1]

Lab Leader

Dr D Liang [1]

Timing and Structure

Michaelmas term. 16 lectures and coursework.

Aims

The aims of the course are to:

- Explain some fundamental principles necessary for understanding the common water issues in the world.
- Cover the basic topics in practical hydrology, civil engineering hydraulics, turbulent mixing, and water/waste water treatments.
- Allow students to grasp essential concepts and procedures for analysing hydro-environmental processes and develop skills to solve practical water engineering problems.
- Highlight some of the most pressing water-related global challenges, such as freshwater scarcity, soil erosion, water quality deterioration and flooding, and stress the need for sustainable and integrated management of water resources.

Objectives

As specific objectives, by the end of the course students should be able to:

- Comprehend the scope of water-related topics in civil and environmental engineering
- Appreciate the environmental, social, political and economical implications of water engineering
- Understand the hydrologic cycle and the Earth’s water budget
- Understand simple models of infiltration
- Undertake simple rainfall-runoff calculations over small catchments
- Understand river hydraulics.
- Be aware of a wide range of hydro-environmental issues
- Understand the advective, diffusive, dispersive and reactive processes related to pollutant transports in uniform flows
- Evaluate the impact of large hydraulic engineering projects
- Solve steady flows using the equations of mass, energy and momentum conservations
- Analyse unsteady flows using the method of characteristics.
- Explain the cause of soil erosion and mitigation measures.
- Understand the mechanism of sand particle motion.
- Calculate the sediment transport rate and determine the bed regime.

- Select pipeline systems for water conveyance
- Make appropriate pump selections and design simple pumping systems
- Be aware of the principles and elements of water/wastewater treatments and the key engineering variables for their design
- Notice the limitations of the traditional water supply and sewage treatment systems in a sustainability context

Content

Hydrology (3L) 2 lectures/week, weeks 1-2 (Prof F. A. McRobie)

- Global water issues
- Hydrologic cycle
- Unit hydrographs

Open Channel Flows, Pollutant and Sediment Transports (12L) 2 lectures/week, weeks 2-8 (Dr D. Liang)

- Boundary layer and turbulence
- Flow resistance
- Steady flow in pipelines
- Water pollution
- Steady flow in open channels
- Pollutant advection,diffusion,dispersion and reaction
- Unsteady flow,flood routing and method of characteristics
- Sediment transport and bed form
- Pipeline systems
- Pumping systems

Water/Waste Treatments (1L) 2 lectures/week,week 8 (Prof F. A. McRobie)

- Water treatment
- Wastewater treatment

Coursework

Sign up sheets and handouts will be available on the Inglis Building Mezzanine Floor at the start of the Term.

Sediment transport

Learning objectives:

- To gain first-hand experience of open channel flow and sediment transport phenomena.
- To study the threshold condition under which sediments are moved. This condition separates the state of the clear-water flow over an immobile bed from the state where sediment transport and bed deformation take place.
- To investigate the relationship between the bed forms and the flow conditions. This is important because the bed forms have a significant impact on the bed roughness and thus the channel conveyance.
- To appreciate the local scour phenomena around underwater structures.

Practical information:

- Sessions will take place in Room ISG-86 (Inglis Building Ground Floor, Centre for Smart Infrastructure & Construction).
- This activity doesn't involve preliminary work, but it will be beneficial to read the handouts beforehand.

Full Technical Report:

Students will have the option to submit a Full Technical Report.

Booklists

Please see the Booklist for Part IIA Courses [2] for references for this module.

Examination Guidelines

Please refer to Form & conduct of the examinations [3].

UK-SPEC

The UK Standard for Professional Engineering Competence (UK-SPEC) [4] describes the requirements that have to be met in order to become a Chartered Engineer, and gives examples of ways of doing this.

UK-SPEC is published by the Engineering Council on behalf of the UK engineering profession. The standard has been developed, and is regularly updated, by panels representing professional engineering institutions, employers and engineering educators. Of particular relevance here is the 'Accreditation of Higher Education Programmes' (AHEP) document [5] which sets out the standard for degree accreditation.

The Output Standards Matrices [6] indicate where each of the Output Criteria as specified in the AHEP 3rd edition document is addressed within the Engineering and Manufacturing Engineering Triposes.

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Links
[1] mailto:dl359@cam.ac.uk
[2] https://www.vle.cam.ac.uk/mod/book/view.php?id=364091&chapterid=46611
[3] http://teaching.eng.cam.ac.uk/content/form-conduct-examinations
[4] http://www.engc.org.uk/ukspec.aspx
[5] http://www.engc.org.uk/standards-guidance/standards/accreditation-of-higher-education-programmes-ahep/
[6] http://teaching.eng.cam.ac.uk/content/output-standards-matrices