

## Unit 204

## Hydraulics and hydrology

### Unit summary

This unit is about the principles and processes involved in fluid mechanics, hydraulics and engineering hydrology.

### Aims

The unit aims to develop understanding in flow situations in fluid mechanics and hydraulics and explain aspects of engineering hydrology. It also aims to identify problems and devise solutions.

### Prerequisites

It is expected that candidates will have a working knowledge of the materials in the four compulsory papers of the Certificate examination.

### Learning outcomes

There are **two** outcomes to this unit. The candidate will be able to:

- Identify and process solutions for problems in fluid mechanics, pipe flow, rotodynamic machines and open channel flow.
- Explain aspects of engineering hydrology

### Guided learning hours

It is recommended that 300 hours should be allocated for this unit. 120 of those hours are actual taught hours. This may be on a full time or part time basis.

### Key Skills

This unit contributes towards the Key Skills in the following areas:

#### N4.1

Develop a strategy for using application of number skills over an extended period of time.

#### N4.2

Monitor progress and adapt your strategy, as necessary, to achieve the quality of outcomes required in work involving:

- deductive and inferential reasoning;
- algebraic manipulation.

#### N4.3

Evaluate your overall strategy and present the outcomes from your work, including use of charts, diagrams and graphs to illustrate complex data.

## **Occupational Standards**

This unit has been mapped to the following National Occupational Standards:

- 1.1.1 Identify the requirements of clients for engineering products or processes
- 1.1.2 Produce specifications for engineering products or processes
- 1.3.1 Undertake research into engineering products or processes
- 1.4.3 Create designs for engineering products or processes
- 1.4.4 Evaluate designs for engineering products or processes
- 2.1.1 Determine the production requirements of engineering products and processes
- 3.1.1 Determine the installation requirements for engineering products or processes
- 3.3.2 Evaluate the installation process
- 4.1.1 Determine the operational requirements of engineering products or processes
- 4.1.2 Specify operational methods and procedures to achieve operational requirements
- 4.2.2 Solve operational problems with engineering solutions
- 4.3.1 Monitor operational processes
- 4.3.2 Evaluate operational processes
- 6.1.1 Analyse the risks arising from engineering products and processes
- 6.2.1 Assure the quality of engineering products or processes
- 7.1.1 Develop objectives for projects
- 7.2.2 Manage the implementation of projects
- 7.2.3 Evaluate projects
- 8.1.1 Maintain and develop own engineering expertise

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### Outcome 1

Identify and process solutions for problems in fluid mechanics, pipe flow, rotodynamic machines and open channel flow.

#### Knowledge requirements

##### The candidate knows how to:

- 1 determine fluid mechanics continuity and solve problems using Bernoulli's equation
- 2 assess fluid stream function and velocity potential function for a
  - a uniform stream
  - b source
  - c sink
  - d doublet and point vortex
  - e combinations of above
- 3 apply energy and momentum principles in an engineering context
- 4 assess free and forced vortex flow
- 5 determine laminar and turbulent flow
  - a boundary layers
  - b influence of surface roughness
- 6 analyse friction factors on flat plates
- 7 assess factors affecting
  - a boundary layer transition
  - b boundary layer separation and wake formation
- 8 investigate the drag force on single particles in fluids
- 9 calculate fluid
  - a drag coefficient
  - b Reynolds number
  - c terminal velocity
- 10 assess laminar flow between plates
- 11 assess steady flow in pipes
  - a pipe friction
  - b velocity distributions
  - c laminar and turbulent flows in
    - i smooth pipes
    - ii rough pipes
  - d Poiseuille's law
  - e Darcy's law
- 12 examine the relationship between friction factor, Reynolds number and relative roughness

- 13 examine local losses in pipe systems due to friction
- 14 analyse pipe networks using iterative methods
- 15 determine the reasons for unsteady pipe flow
  - a frictionless incompressible behaviour
  - b frictionless compressible behaviour
  - c surge tanks
- 16 describe the one-dimensional theory of
  - a pumps
  - b turbines
- 17 classify pumps and turbines
- 18 assess pump and turbine
  - a characteristics
  - b dimensionless parameters
  - c specific speed
  - d cavitation
- 19 select a pump for a range of pipe systems
- 20 assess steady flow in an open channel
  - a Chezy equations
  - b Manning equations
- 21 design non-erodible channels
- 22 recognise the effect of sediment transportation in open channels
- 23 analyse gradual varied non-uniform flow in channels
- 24 apply energy and momentum principles to rapidly varied flow in open channels
  - a hydraulic structures
  - b short channel transitions
  - c thin pipe weirs
  - d critical depth flow gauging structures
  - e hydraulic jump
- 25 investigate unsteady flow
  - a surges
  - b flood routing through channels
- 26 investigate the criteria, parameters and scales for physical models of
  - a rivers
  - b coasts
  - c harbours
  - d hydraulic structures
- 27 ascertain the relative merits of physical and computational models

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### Outcome 2

Explain aspects of engineering hydrology

#### Knowledge requirements

##### The candidate knows how to:

- 1 describe the hydrological cycle
  - a rainfall
  - b runoff
  - c unit hydrographs
- 2 operate river gauging systems
- 3 analyse groundwater flow
- 4 assess flood and drought forecasting
- 5 assess storage and flood control reservoirs, mass curves and reservoir flood routing

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### Recommended reading list

<b>Core texts</b>	<b>Author(s)</b>	<b>Publisher</b>	<b>ISBN</b>
Civil Engineering Hydraulics	Nalluri, Featherstone	Blackwell	0632055146
Engineering Hydrology	Wilson EM	Macmillan	0333517172
Fluid Mechanics	Douglas, Gasiorek	Prentice Hall	0582414768
Fluid Mechanics with Engineering Applications	Franzini, Finnemore	McGraw-Hill	007112196X
Hydraulics in Civil and Environmental Engineering	Chadwick, Morfett	Spon Press	0419225803
Hydrology in Practice	Shaw	Nelson Thornes	
Open Channel Hydraulics	French	McGraw-Hill	0071133100
Solving Problems in Fluid Mechanics Volume 1	Douglas, Matthews	Longman	0582239877
Solving Problems in Fluid Mechanics Volume 2	Douglas, Matthews	Longman	
Understanding Hydraulics	Hamill	Palgrave	0333779061