Fluid Mechanics and Hydraulics for Civil Engineering

Module Information

2022.01, Approved

Summary Information

Module Code	5501ICBTCE
Formal Module Title	Fluid Mechanics and Hydraulics for Civil Engineering
Owning School	Civil Engineering and Built Environment
Career	Undergraduate
Credits	15
Academic level	FHEQ Level 5
Grading Schema	40

Teaching Responsibility

LJMU Schools involved in Delivery
LJMU Partner Taught

Partner Teaching Institution

Institution Name
International College of Business and Technology

Learning Methods

Learning Method Type	Hours
Lecture	36
Practical	15
Tutorial	9

Module Offering(s)

Display Name	Location	Start Month	Duration Number Duration Unit
APR-PAR	PAR	April	12 Weeks

JAN-PAR	PAR	January	12 Weeks
SEP-PAR	PAR	September	12 Weeks

Aims and Outcomes

Aims	The aim of this unit is to develop learners' skills in determining hydrostatic principles, fluid and hydraulic parameters for pipelines and channels in civil engineering projects.

After completing the module the student should be able to:

Learning Outcomes

Code	Number	Description
MLO1	1	Analyse the properties and nature of a fluid, and assess the forces associated with static fluid systems.
MLO2	2	Analyse the behavioural characteristics and parameters of fluid flowing in pipelines and apply theories of fluid behaviour in open channel systems to civil engineering problems.
MLO3	3	Determine pipe size and pumping requirements for fluid flowing in pipelines and use computer/software packages to analyse/design fluid flow systems.
MLO4	4	Identify the operating principles of hydraulic machines and demonstrate experiments in fluid kinetic & present appropriate findings of experimental work.

Module Content

Outline Syllabus	Properties of fluids: Density, viscosity, surface tension, compressibility. Hydrostatic pressure: Static pressure and head, pressure at a point, Pascal's Law, relationship between pressure and head, measurement of fluid pressure and pressure differentials, centres of pressure on submerged planes, both inclined and vertical, buoyancy and stability of floating bodies.Behavioural characteristics and parameters of fluid flowing in pipelines Characteristics: boundary layers, viscosity of fluids, definition of boundary layer, displacement thickness, momentum thickness.Distribution of sheer stress and velocity: drag force in laminar/turbulent boundary layers, drag coefficient, dynamic pressure, drag and skin friction drag, wakes.Streamlining of shapes/bodies: lift and drag of aerofoils.Pipe systems and networks: equations for frictional loss, Darcy/Manning's/Hazen-Williams formulae, relationships between coefficients, Moody diagram, iterative methods for pipe network analysis (Hardy Cross method), transient flow in pipes, incompressible water column theory, elastic theory of water hammer, sudden/gradual closure and valve opening, strain energy water hammer theory, fundamental differential equation of water hammer, velocity of propagation end conditions, reflection at a reservoir, surge tanks (purpose, type, frictional effect, theory of mass), oscillation (simple finite difference methods of solution, solutions using scale models).Dimensional and hydraulic model analysis: dimensionless numbers, Buckingham's theorem, hydraulic.Similarity, hydraulic models (different types of structure), distorted models.Uniform flow in open channels: normal depth, economic/optimum section, flow under sluice gates.Relationship between inlet and discharge: critical depth, minimum specific energy in a rectangular channel, discharge through Venturi flumes, and flow over broad crested and crump weirs (discharge- head equations), flow through channels, compound sections, e.g. flooded river channels, flow from reservoirs and entry losses, planned energy losses at dam spillways and stilling basins.Hydraulic machinery: types of pumps and turbines, reciprocating pumps (components and mechanisms), simple harmonic motion of piston, single/double acting pumps, inertia pressure, friction in suction/delivery pipes, cavitation, practical applications and limitations.Selection of pumps and turbines: centrifugal pumps: general equation for head generated, velocity triangles, efficiencies, specific speed, performance at constant/variable speed, guide vanes, volute casing, priming/self- priming pumps, deep-well pumps (components and installation).Turbines: impulse/reaction types, general equation for power generated velocity triangles, Pelton turbine, velocity ratio/speed regulation, Francis turbines, specific speed, efficiencies, characteristic curves, guide vanes o volute casing o draft tubes.Fluid flow concepts for pipes and open channels: streamlines, velocity variations and velocity profile across pipe and channel sections, significance of Reynolds and Froude number, laminar and turbulent flow.Steady and unsteady flow in channels: channel transitions and over weirs, flow profile through a Venturi flume, formation of hydraulic jumps downstream of spillways, weir and gates, discharge characteristics of weirs, measure the velocity of approach, preparation of head discharge and coefficient of discharge.Non-dimensional head graphs: measurement and construction of stage discharge and rating curves(Methods and instrumentation).Flow measurement in pipes and channels: pitot static tube, current meters, Venturi meter, Orifice meter, rectangular notch, V notch.Combination weirs: flow measurement (electromagnetic and ultrasonic methods), energy losses at sudden transitions (pipelines and channels), effects of jets on turbines, Pelton wheels.Software related to fluid flow and hydraulics:
Module Overview	
Additional Information	

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Module Learning Outcome Mapping
Presentation	Portfolio	50	0	MLO3, MLO4
Exam	Exam	50	2	MLO1, MLO2

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
Karl Jones	Yes	N/A

Partner Module Team

Contact Name	Applies to all offerings	Offerings