CBCS SCHEME

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BCV402

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2024
Fluid Mechanics and Hydraulics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define the following terms along with symbols and units : (i) Compressibility (ii) Capillarity (iii) Surface tension	6	L1	CO1
	b.	State and prove Pascal's law.	6	L2	CO1
	c.	A tube differential manometer connects two pipes A and B. Pipe A contains carbon tetra chloride having specific gravity 1.594 under a pressure of 117.72 kN/m^2 and pipe B contains oil of specific gravity 0.8 under a pressure of 117.72 kN/m^2. The pipe A lies 2.5 m above pipe B. Find the difference in pressure measured by mercury as fluid filling U-tube. Assume mercury in the right limb is 50 cm below centre of pipe B.	8	L2	CO1
		OR			
Q.2	a.	Differentiate between : (i) Pressure intensity and Pressure head (ii) Simple and differential manometers. (iii) Absolute and Gauge pressure.	6	L2	CO1
	b.	Derive an expression for total pressure and centre of pressure on a plane surface immersed vertically in water.	6	L2	CO1
	c.	A 1200 mm × 1800 mm size rectangular plate is immersed in water with an inclination of 30° to the horizontal. The 1200 mm side of the plate is kept horizontal at a depth of 30 m below the water surface. Compute the total pressure on the surface and the position of centre of pressure.	8	L3	CO1
		Module – 2			
Q.3	a.	Differentiate between : (i) Laminar and turbulent flow (ii) Uniform and non uniform flow (iii) Steady and Unsteady flow	6	L2	CO2
	b.	Derive continuity equation for a three dimensional flow in Cartesian co-ordinates.	6	L2	CO2
	c.	The velocity potential function is given by $\phi = 5(x^2 - y^2)$. Calculate the velocity components at the points (4, 5)	8	L3	CO2
		OR			
Q.4	a.	List the assumptions made in deriving Bernoulli's equation.	6	L2	CO2
	b.	Derive the equation for the discharge through Venturimeter.	6	L2	CO2
	c.	Crude oil of G = 0.84 flow through a pipe with a rate of 450 lps. The diameter of pipe and pressure in the pipe at one section are respectively 25 cm and 55 kPa and at section two are 50 cm and 320 kPa. Find the direction of flow through the pipe and head loss. Pipe is horizontal.	8	L3	CO2

		Module – 3			
Q.5	a.	Define Orifice and Mouth piece. Also derive the hydraulic co-efficients experimentally.	6	L2	CO3
	b.	Derive an expression for discharge over a triangular notch.	6	L2	CO3
	c.	A rectangular channel 2 m wide has a discharge 250 lps, which is measured by a right angled V-notch weir. Find the position of the apex of the notch from the bed of the channel of maximum depth of water is not to exceed 1.3 m. Take $C_d = 0.62$.	8	L3	CO3
		OR			
Q.6	a.	Define : (i) Major and Minor losses in a pipe flow. (ii) Pipes in series and parallel (iii) Water hammer in pipe flow	6	L2	CO3
	b.	Derive Darcy-Weisbach equation for head loss due to friction in a pipe.	6	L2	CO3
	c.	Water is required to be supplied to a colony of 4000 residents at a rate of 180 litres per person from a source 3 km away. If half the daily requirement needs to be pumped in 8 hours against a friction of 18 m, find the size of the main pipe supplying water. Assume friction factor as 0.028.	8	L3	CO3
		Module – 4			
Q.7	a.	Define most economical channel section. For the most economical trapezoidal section show that half of top width is equal to the side slope length.	6	L2	CO4
	b.	What is specific energy curve? Draw and derive expressions for critical depth and critical velocity.	6	L2	CO4
	c.	The discharge of water through a rectangular channel of width 8 m is 15 m^3/s. When the depth of flow of water is 1.2 m. Calculate (i) Specific energy of flowing water. (ii) Critical depth and critical velocity. (iii) Value of minimum specific energy.	8	L3	CO4
		OR			
Q.8	a.	What is gradually varied flow? Derive the dynamic equation for gradually varied flow.	6	L2	CO4
	b.	Derive an expression for conjugate depths in case of hydraulic jump in a rectangular channel laid horizontal.	6	L2	CO4
	c.	A sluice gate discharges water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4 m. The width of the channel is 8 m. Determine whether a hydraulic jump will occur, and if so, find its height and loss of energy per kg of water. Also determine the power lost in the hydraulic jump.	8	L3	CO4
		Module – 5			
Q.9	a.	Obtain an expression for force exerted by a jet striking at the centre of a moving symmetrical curved vane. And show that its maximum efficiency is limited to $\frac{16}{27}$.	6	L3	CO5
	b.	Give the classification of turbines based on different criteria.	6	L2	CO5
	c.	A jet of water having velocity 45 m/s impinges without shock on a series of curved vanes moving at 15 m/s, the direction of motion of vanes being 20° to that of jet. The relative velocity at the outlet is 0.9 of that at inlet and the absolute velocity of water at the exit is to be normal to the motion of vanes. Find (i) Vane angles at entrance and exit. (ii) Hydraulic efficiency.	8	L3	CO5

OR					
Q.10	a.	By means of neat sketch, explain the Francis turbine.	6	L2	CO5
	b.	A Pelton wheel turbine has to be designed for the following : Data : Power = 6000 kW, Net head = 300 m, Speed = 550 rpm, Jet ratio = $\frac{1}{10}$, Overall efficiency = 85%, C_V = 0.98, Speed ratio = 0.46 Determine diameter of runner and jet, discharge and number of jets required.	6	L3	CO4
	c.	Explain various efficiencies of centrifugal pumps. Also define (i) Manometric head (ii) Static head (iii) Suction head (iv) Delivery head	8	L1	CO5

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