Model Question Paper-1/2 with effect from 2023-24 (CBCS Scheme)

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Fourth Semester B.E. Degree Examination

Subject Title: FLUID MECHANICS AND FLUID MACHINES

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. Question on a topic of a Module may appear in either its 1st or 2nd question

		Module -1	**RBT**	**Marks**
Q.01	a	Define the following terms with S.I units: i. Weight density and Mass density ii. Specific gravity and specific volume iii. Absolute viscosity and kinematic viscosity iv. Capillarity	L1	8
	b	State and prove the Pascal's law.	L1	8
	c	An oil film of thickness 115 mm is used for lubricating between a square plate of size 0.8x0.8 m and an inclined plane having an inclination of 30^0 with the horizontal. The weight of the square plate is 300N and slides down the plane with a uniform velocity of 0.3 m/s. Find the dynamic viscosity of oil	L2	4
		OR		
Q.02	a	Define (i) absolute pressure (ii) gauge pressure (iii) vacuum pressure	L1	6
	b	Derive the expression for the Centre of pressure of the vertical plane surface submerged in a liquid	L2,L3	8
	c	A U-tube differential manometer is used to measure the pressure of oil of a specific gravity of 0.85 flowing in a pipeline. Its left limb is connected to the pipe and the right limb is open to the atmosphere. The under of pipe is 100 mm the level of mercury level in the right limb. If the difference of mercury level in the two limbs is 160 mm. Determine the absolute pressure of the oil in the pipe. Take specific gravity of mercury is 13.6	L3	6
		Module-2		
Q 03	a	Define i. Buoyancy ii. Centre of Buoyancy iii. Meta-centre iv. Meta-centric height	L1	8
	b	Derive an experimental method of determination of metacentric height of a floating body	L2,L3	6
	c	A wooden block of specific gravity 0.75 floats in water. If the size of the is 1m x 0.5 mx 0.4 m, find its metacentric height.	L3	6
		OR		
Q.04	a	Explain different types of fluid flow	L2	6
	b	Derive continuity equation for three-dimensional fluid flow in Cartesian co-ordinates	L2, L3	8
	c	The stream function for a 2D flow is $\psi = 8 x y$. Calculate the velocity at (4,5) and find the velocity potential function	L3	6
Module-3				

Q.05	a	State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principle and state the assumptions made for such a derivation.	L1, L2	8
	b	Explain with a neat sketch the working of Pitot tube. Mention its applications	L3	6
	c	A horizontal venturi meter with inlet diameter is 20cm and the throat diameter 10 cm used to measure the flow of water. The pressure at inlet is 17.658 n/cm2 and vacuum pressure at the throat is 30 cm of mercury. Find the discharge of water through venture meter take Cd = 0.9	L3	6
		OR		
Q 06	a	Explain the terms: i. Vena-contracta ii. Cavitation	L2	6
	b	Derive an expression for theoretical Discharge through the triangular notch	L2, L3	8
	c	In a 100 mm diameter horizontal pipe a venturi meter of 0.5 contraction ratio has been fixed. The head of water on the meter when there is no flow is 3 m (gauge). Find the rate of flow for which the throat pressure will be 2 meters of water absolute. The co-efficient of meter is 0.97. Take atmospheric pressure head = 10.3 m of water.	L3, L4	6
		Module-4		
Q.07	a	Explain with a neat sketch the Total energy line and the hydraulic gradient line	L2	6
	b	Derive expression for Darcy equation for loss of head due to friction in pipe.	L3	8
	c	A crude oil of kinematic viscosity 0.4 stoke is flowing through a pipe of diameter 300 mm at the rate of 300 liters per second. Find the head lost due to friction for a length of 50 m of pipe.	L3,L4	6
		OR		
Q.08	a	Define Reynolds number. What is its significance? List the characteristics of Laminar flow	L1, L2	4
	b	Derive an expression for loss of head due to sudden enlargement.	L2, L3	8
	c	A 10 cm diameter pipe takes off abruptly from a large tank and run 5 m, then expands to 20 cm diameter abruptly and runs 50 m and next discharge directly to open air with a velocity of 25 m/s. Calculate the height of water surface above the point of discharge. Take Darcy's coefficients as 0.0065	L3	8
		Module-5		
Q.09	a	Define the following: I. Froude's Number ($F_{c)}$ ii. Euler's number ($E_{u)}$ iii. Euler's number (W_e)	L1	6
	b	Explain the various forces acting in moving fluid	L2	6
	c	Water is flowing through a pipe of diameter 30 cm at a velocity of 4 m/s. Find the velocity of oil flowing in another pipe of diameter 10 cm, if the condition of dynamic similarity is satisfied between the two pipes. The viscosity of water and the oil is given as 0.01 poise and 0.25 poise the sp.gr. of oil =0.8	L3	8
		OR		
Q.10	a	What is similitude? Explain the different types of similarities.	L2	6
	b	What is model analysis? List out the merits and limitations model analysis	L2, L3	8
	c	Derive an expression for Buckingham's - π - theorem	L3	

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		Module -1	**RBT**	**Marks**
Q.01	a	State newtons law of viscosity and explain the different types of fluids.	L1	6
	b	Derive an expression for a capillary rise of a liquid	L2	6
	c	Two large plane surfaces are 2.4 cm apart. Space between those surfaces is filled with glycerine whose dynamic viscosity is $8.1x10^{-1}NS/m^{2.}$ The surface area of the plate is 0.5 m^2 and determine force required to drag that plate at a speed of 0.6 m/s to the below conditions (i) Thin plate is at middle of two plane surface. (ii) Thin plate is at a distance of O.8m from one of the plane surface	L3	8
		OR		
Q.02	a	List the different types of manometers and explain any two types with a neat sketch.	L1, L2	6
	b	Prove that pressure intensity at a point in static fluid is same in all direction	L2	7
	c	A Stone weighs 392.4 N in air and 196.N in water. Compute the volume of stone and its specific gravity	L3	7
		Module-2		
Q 03	a	Determine the condition of equilibrium for a floating body with a neat sketch.	L2	4
	b	Explain the method to find metacentric height experimentally	L2	8
	c	A solid cylinder of diameter has a height 3meters. Find the meta centric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder is 0.6.	L3	8
		OR		
Q.04	a	The velocity vector in a fluid flow is given by $V= 4x^2i-10x^2yj+2tk$. Determine the velocity and acceleration of a fluid particle at (2,1,3) at time t=1	L3	8
	b	Differentiate 1) laminar & turbulent flow (ii) steady and unsteady flow	L2	4
	c	The velocity potential for a 2D potential flow is given by $\Theta=x(2y-1)$ determine velocity and steam function at the point P(4,5)	L3	8
		Module-3		
Q.05	a	Derive Eulers equation of motion for a ideal fluid and hence deduce Bernoulli's equation of motion	L1	10
	b	The water is flowing through the 100m length pipe having 600mm and 300mm diameters at upper end and lower ends respectively.	L3	10

		Slope of pipe is 1 in 30. Determine the pressure at lower end if pressure at upper end is 19.62 N/cm^2		
		OR		
Q 06	a	Derive an expression for actual discharge through venturimeter	L2	10
	b	An orifice meter with 10cm diameter is inserted in a pipe of 20cm diameter. The pressure gauges fitted upstream and down stream of the orifice meter gives readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Coefficient of discharge for the meter is given as 0.6. Find the discharge of water through the pipe	L3	10
		Module-4		
Q.07	a	Write a note on HGL and TEL	L1	6
	b	Determine the head lost due to friction in a pipe of diameter 300mm and length 50m through which water is flowing at velocity 3m/s use darcy and chezys formula. Tale c=60 and υ for water is 0.01 stoke.	L3	10
	c	Explain the different types of minor losses in the pipe	L2	4
		OR		
Q.08	a	For the laminar flow through the circular pipe prove that shear stress variation across the pipe section is linear.	L3	10
	b	Fluid of viscosity 0.7N S/m^2 and specific gravity 1.3 is flowing through circular pipe of diameter 100 mm, maximum shear stress at pipe wall is 196.2 N/m^2 Find the pressure gradient and Reynolds number.	L3	10
		Module-5		
Q.09	a	Explain the Rayleigh's and Buckingham's π theorem in dimensional analysis	L2	8
	b	Define the following dimensionless numbers and their significance i) ReynJh's number ii) Mach number	L1	4
	c	Using Buckingham's π theorem prove that frictional torque T of a disc of diameter D rotating at a speed of N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5N^2\ \rho\phi\ [\frac{\mu}{DN\ \rho}]$	L3	8
		OR		
Q.10	a	Explain the working of a centrifugal pump and reciprocating compressor with a neat sketch.	L2	10
	b	The diameter and width of a centrifugal pump impeller are 50cm 2.5cm. The pump runs at 1200rpm. The suction head is 6m and delivery head is 40m. The frictional drop in suction is 2m and in delivery 8m.the blade angle at outlet is $30^{0.}$ The manometric efficiency is 80% and overall efficiency is 75%. Determine the power required to drive a pump. Also calculate the pressure at the suction and delivery side of the pump	L3	10