Model Question Paper-1with effect from 2022-23 (CBCS Scheme)

USN | | | | | | | | | |

Fourth Semester B.E. Degree Examination
FLUID MECHANICS

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

Note: 01.Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. M: Marks, L: Blooms Level, C: Course outcomes
03. Assume missing data suitably

		Module-1	**M**	**L**	**C**
Q.01	**a**	Define the following properties of fluids and mention their SI Units: (i) Weight Density (ii) Surface Tension (iii) Kinematic Viscosity	**6**	**L2**	**CO1**
	b	The dynamic viscosity of oil used for lubrication between a shaft and sleeve is 6poise. The shaft is of diameter 0.4m. It rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. The thickness of the oil film is 1.5mm.	**8**	**L3**	**CO1**
	c	A simple manometer is used to measure the pressure of oil (s = 0.8) flowing in a pipeline. Its right limb is open to the atmosphere and the left limb is connected to the pipe. The centre of the pipe is 90mm below the level of mercury in the right limb. If the difference of mercury level in the two limbs is 150mm, determine the absolute pressure of oil in the pipe in KPa.	**6**	**L3**	**CO1**
		OR			
Q.02	**a**	Distinguish between: (i) Absolute pressure (ii) Gauge pressure (iii) Gauge vacuum (iv) Atmospheric pressure. Indicate their relative positions on a chart.	**6**	**L2**	**CO1**
	b	Derive an expression for the total pressure and the depth of centre of pressure for an inclined surface submerged in water.	**8**	**L3**	**CO1**
	c	A square plate of diagonal 1.5m is immersed in water with its diagonal vertical and upper corner 0.5m below the free surface of water. Find the hydrostatic force on the plate and the depth of centre of pressure from free surface of water.	**6**	**L3**	**CO1**
		Module-2			
Q.03	**a**	Define the following types of flow: (i) Steady and unsteady flow (ii) Laminar and turbulent flow (iii) Compressible and Incompressible flow	**6**	**L2**	**CO2**
	b	Derive the general three dimensional continuity equation in Cartesian coordinates and then reduce it to the continuity equation for steady, three dimensional incompressible flow.	**8**	**L3**	**CO2**
	c	The velocity components in a two dimensional flow field for an incompressible fluid are expressed as	**6**	**L3**	**CO2**

		$$u = \frac{y^3}{3} + 2x - x^2 y$$ $$v = xy^2 - 2y - \frac{x^3}{3}$$ Obtain an expression for stream function			
OR					
Q.04	**a**	Define Reynolds Number. Explain its significance in fluid flow	**4**	**L2**	**CO2**
	b	Derive an expression for the velocity distribution and shear stress distribution for the viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of the pipe.	**8**	**L3**	**CO2**
	c	Water at 15^0C flows between two large parallel plates at a distance of 1.6 mm apart. Determine (i) the maximum velocity (ii) the pressure drop per unit length and (iii) the shear stress at the walls of the plates if the average velocity is 0.2 m/s. the viscosity of water at 15^0C is given as 0.01 poise.	**8**	**L3**	**CO2**
Module-3					
Q.05	**a**	Derive Euler's equation of motion along a stream line. Obtain Bernoulli's equation from Euler's equation. Mention the assumptions made.	**8**	**L3**	**CO3**
	b	Derive an expression for discharge over a triangular notch.	**6**	**L3**	**CO3**
	c	A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 17.658 N/cm^2 and the vacuum pressure at the throat is 30 cm of Hg. Find the discharge of water through venturi meter. Take C_d = 0.98.	**6**	**L3**	**CO3**
OR					
Q.06	**a**	Using Impulse Momentum equation, derive the expressions for the force exerted by the jet of fluid on a vane with the following cases: (i) Flat fixed vane (ii) Symmetrical fixed curved vane with the jet striking the vane at the centre	**6**	**L3**	**CO3**
	b	Derive Darcy - Weisbach equation for the loss of head due to friction in a pipe flow.	**8**	**L3**	**CO3**
	c	In a pipe of diameter 400 mm and length 100 mm, water is flowing at a velocity of 3.5 m/s. Find the head loss due to friction using (i) Darcy – Weisbach formula (ii) Chezy's formula for which c = 55.	**6**	**L3**	**CO3**

Module-4					
Q.07	**a**	Briefly explain what is meant by Boundary layer and hence define the following: (i) Boundary layer thickness (ii) Displacement thickness	**6**	**L2**	**CO4**
	b	Explain the following terms: (i) Drag (ii) Lift	**6**	**L2**	**CO4**
	c	Experiments were conducted in a wind tunnel with a wind speed of 50km per hour on a flat plate 1m long and 1m wide. The density of air in 1.15 kg/m^3. The plate is kept at such an angle that coefficient of lift and drag are 0.75 and 0.15 respectively. Determine (i) Lift force (ii) Drag force (iii) Resultant force (iv) Power exerted by air stream on the plate.	**8**	**L3**	**CO4**
OR					
Q.08	**a**	Explain the following terms: (i) Geometric similarity (ii) Kinematic similarity (iii) Dynamic similarity	**6**	**L2**	**CO4**
	b	What do you mean by repeating variables? How are the repeating variables selected in dimensional analysis?	**4**	**L2**	**CO4**
	c	Assuming that the rate of discharge Q of a hydraulic machine is dependent upon the mass density ρ of the fluid, speed of the machine N, diameter of the impeller D, pressure P and viscosity μ. Show using Buckingham's π–theorem that $Q = ND^3\phi\left[\frac{P}{\rho N^2 D^2}, \frac{\mu}{\rho N D^2}\right]$ where H being the head and γ the Kinematic viscosity of the fluid.	**10**	**L3**	**CO4**
Module-5					
Q.09	**a**	Derive expressions for the sonic velocity in a compressible fluid medium for (i) Isothermal process (ii) Adiabatic process.	**8**	**L3**	**CO5**
	b	Define Mach Number Explain its importance in Compressible fluid flow.	**6**	**L2**	**CO5**
	c	A supersonic aircraft flies at an attitude of 1.8 km where the temperature is 4°C. Determine the speed of the aircraft if its sound is heard 4 seconds after its passage over the head of an observer. Take R=287J/Kg K, γ=1.4.	**6**	**L3**	**CO5**
OR					
Q.10	**a**	Define and write the expressions for (i) stagnation enthalpy (ii) stagnation temperature (iii) stagnation pressure (iv) stagnation density	8	**L2**	**CO5**
	b	What is CFD? What are its applications and limitations?	6	**L2**	**CO5**
	c	Write a note on components of CFD and its reliability.	6	**L2**	**CO5**

Model Question Paper-2with effect from 2022-23 (CBCS Scheme)

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Fourth Semester B.E. Degree Examination
FLUID MECHANICS

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

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		Module-1	**M**	**L**	**C**
Q.01	**a**	Explain the phenomenon of Capillarity. Obtain an expression for the capillary rise of a liquid.	**6**	**L3**	**CO1**
	b	The space between two square parallel plates is filled with an oil of relative density 0.95. Each side of the plate is 60cm. The thickness of the oil film is 12.5mm. It requires a force of 100N to move the upper plate at a velocity of 2.5m/s relative to the lower fixed plate. Determine: (i) the dynamic viscosity of oil in Pa-s (ii) kinematic viscosity of oil.	**8**	**L3**	**CO1**
	c	A U-tube manometer is used to measure the pressure of water in a pipeline which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the mainline if the difference in the level of mercury in the limbs of U tube is 10cm and the free surface of mercury is in level with the centre of the pipe.	**6**	**L3**	**CO1**
		OR			
Q.02	**a**	State and prove Pascal's law.	**6**	**L3**	**CO1**
	b	Show that the centre of pressure lies below the centre of gravity when the immersed surface is vertical.	**8**	**L3**	**CO1**
	c	A triangular plate of 1m base and 1.5m altitude is immersed in water. The plane of the plate is inclined at 30^0 with free water surface and the base is parallel to and at a depth of 2m from water surface. Find the total pressure on the plate and the position of centre of pressure.	**6**	**L3**	**CO1**
		Module-2			
Q.03	**a**	Define: (i) Path line (ii) Stream line (iii) Streak line (iv) Streak tube	**8**	**L1**	**CO2**
	b	Differentiate between local and convective acceleration of a fluid. Write the expressions for acceleration of a fluid in x, y and z directions.	**6**	**L3**	**CO2**
	c	The velocity potential in a flow field is given by $\phi = -2\ln\left(x^2 + y^2\right)$. Show that it represents a possible case of fluid flow.	**6**	**L3**	**CO2**
		OR			
Q.04	**a**	Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic in nature. Also prove that maximum velocity is equal to one and a half times the average	**10**	**L3**	**CO2**

		velocity.			
	b	A lubricating oil of viscosity 1 poise and specific gravity 0.9 is pumped through a 30mm diameter pipe. If the pressure drop per meter length of pipe is 20 kPa, Determine (i) the mass flow rate in kg/min, (ii) the shear stress at the pipe wall, (iii) the Reynolds number of flow, (iv) the power required per 50m length of the pipe to maintain the flow.	**10**	**L3**	**CO2**
		Module-3			
Q.05	**a**	Which are the forces considered to be acting on the fluid whenever the fluid is in motion?	**4**	**L1**	**CO3**
	b	Derive the expression for the rate of flow of fluid through a horizontal Venturimeter	**8**	**L3**	**CO3**
	c	A pipeline carrying oil of specific gravity 0.87 changes in diameter from 200mm at a position A to 500mm at a position B which is 4m at higher level. If the pressure at A and B are 10N/cm^2 and 6N/cm^2 respectively and discharge is 200litres/s, determine the loss of head and indicate the direction of fluid flow.	**8**	**L3**	**CO3**
		OR			
Q.06	**a**	Write the Momentum equation. Mention the different applications of Momentum equation.	**6**	**L2**	**CO3**
	b	Derive Chezy's formula for the head loss due to friction in a pipe.	**8**	**L3**	**CO3**
	c	Derive an expression for the loss of head due to to the sudden enlargement in the pipe.	**6**	**L3**	**CO3**
		Module - 4			
Q. 07	**a**	Find the displacement thickness and the momentum thickness for the velocity distribution in the boundary layer given by $\frac{u}{U_\infty} = \frac{y}{\delta}$, where u is the velocity at a distance y from the plate and u=U at y=δ, where δ=boundary layer thickness. Also calculate the value of $\frac{\delta^*}{\theta}$.	**6**	**L3**	**CO4**
	b	Explain the following terms: (i) Drag (ii) Lift (iii) Friction drag (iv) Pressure drag.	**8**	**L2**	**CO4**
	c	A man descends to the ground from an aero plane with the help of a parachute which is hemispherical having a diameter of 4 m against the resistance of air with a uniform velocity of 25 m/s. Find the weight of the man if the weight of the parachute is 9.81 N. Take C_D = 0.6 and density of air = 1.25 kg/m^3.	**6**	**L3**	**CO4**
		OR			

Q.08	**a**	Define the following dimensionless numbers: (i) Reynolds number (ii) Froude's number (iii) Euler's number (iv) Weber's number (v) Mach number.	**10**	**L2**	**CO4**
	b	The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft l, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and resisting force. Use Buckingham's π theorem method.	**10**	**L3**	**CO4**
		Module-5			
Q.09	**a**	Derive an expression for the velocity of a sound wave in terms of change of pressure and change of density.	**8**	**L3**	**CO5**
	b	Differentiate between stagnation and static state.	**4**	**L2**	**CO5**
	c	Compute the velocity of a bullet fired in still air and Mach number when the Mach angle is 30^0. Take R = 0.28714 kJ/kgK and γ = 1.4. Assume air temperature to be 15^0c.	**8**	**L3**	**CO5**
		OR			
Q.10	**a**	Derive the expressions for stagnation temperature and stagnation pressure in terms of Mach number.	**8**	**L3**	**CO5**
	b	Mention the advantages and disadvantages of CFD.	**6**	**L2**	**CO5**
	c	What are the steps involved in solving a CFD problem? Explain.	**6**	**L2**	**CO5**