QUESTION PAPER CODE - 54019

University Institute of Engineering & Technology
(Recognised Under Section 2(f) and 12B of UGC)
Kurukshetra University, Kurukshetra

Roll No. -

TIME – 3 Hrs.

THEORY EXAMINATION – MAY 2019	
B.TECH – MECHANICAL ENGG.	SEMESTER – 4TH

M.M. - 75

COURSE NO. - ME 208 | **COURSE TITLE - FLUID MECHANICS**

PART-A (15 Marks)

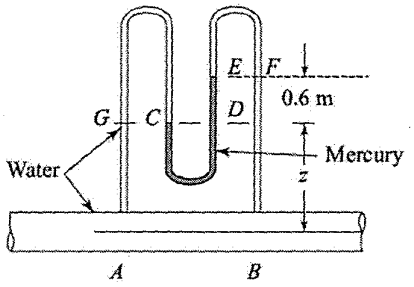
Q. No. – 1 Answer the following questions. For numerical questions show the calculation part also. **15x1=15**

(i)	Discuss the continuum concept as applied to fluid mechanics.			
(ii)	What is the pressure within a 1 mm diameter spherical droplet of water relative to the atmospheric pressure outside? Assume σ for pure water to be 0.073 N/m.			
(iii)	Define a stream line body.			
(iv)	Select the correct answer: A 25 cm diameter pipe carries oil of specific gravity 0.9 at a velocity of 3 m/s. At another section of diameter 20 cm, the velocity will be (a) 4.2 m/s (b) 4.68 m/s (c) 4.9 m/s (d) 3.75 m/s			
(v)	What is the difference between hydraulically smooth and rough pipes?			
(vi)	Navier-Stokes equation is useful in the analysis of (a) Viscous flow (b) non-viscous flow (c) rotational flow (d) turbulent flow			
(vii)	A smooth 2-D flat plate is exposed to wind velocity of 100 m/s (ν = 0.15 stokes). If the transition Re is $2x10^5$, the maximum distance from the leading edge upto which laminar boundary layer exists is ..... (a) 3 mm (b) 3 cm (c) 30 cm (d) 3 m			
(viii)	Boundary layer separation is caused by ..... gradient.			
(ix)	Explain what is meant by mixing length?			
(x)	A 50 mm dia shaft rotates at 500 rpm in a 80 mm long journal bearing. If the torque required to overcome friction is 0.082 Nm, find the rate of heat generated at the bearing.			
(xi)	The generation of lift by spinning cylinder in fluid stream is called			
	Match the following:			
(xii)	A	Pump impeller	1	Bernoulli's Principle
(xiii)	B	Orificemeter	2	Hydrostatic law
(xiv)	C	U-Tube manometer	3	Pascal's law
(xv)	D	Hydraulic brakes	4	Impulse momentum principle

PART-B (20 Marks)

Answer the following questions, one from each unit & all questions carry equal marks. **5x4=20**

UNIT-I

2	A typical differential manometer is attached to two sections A and B in a horizontal pipe through which water is flowing at a steady rate (Fig. 1). The deflection of mercury in the manometer is 0.6 m with the level nearer A being the lower one as shown in figure. Calculate the difference in pressure between sections A and B. Take the densities of water and mercury as 1000 kg/m^3 and 13570 kg/m^3 respectively.	 Figure 1	5

	UNIT-II	
3	A stream function in a two-dimensional flow is given by $\psi = 2xy$. Show that the function satisfies the continuity equation and that the flow is irrotational. Workout the corresponding velocity potential function.	5
	UNIT-III	
4	An oil of viscosity 0.2 Pa s flows between two stationary parallel plates which are kept at a distance of 10 mm apart. The plates are 1 m wide and the centre line flow velocity is stated to be 2.5 m/s. Make calculations for the average flow velocity, flow rate of oil, pressure gradient and the wall shear stress.	5
	UNIT-IV	
5	What is meant by vortex shedding? What is the frequency of vortex shedding for a 3.0 mm diameter wire in 100 km/hr wind in air at 20°C?	5

PART-C (40 Marks)

Students are required to attempt 4 questions, selecting atleast one question from each unit. 10x4=40

		UNIT-I	
6	(i)	Derive the relationship between centre of pressure and centre of gravity for a plane surface submerged in a fluid at an angle to the free surface.	5
	(ii)	A circular plate of diameter 0.65 m is immersed in a liquid of relative density 0.85 with its plane making an angle of 30 with the horizontal. Centre of the plate is at a depth of 1.5 m below the free surface. What is the total force on one side of plate and where does it act?	5
7	A wooden block (relative density 0.7) measures 2 m width x 1 m depth and has a length of 2.5 m. If it is placed horizontally on the surface of water (sp. wt 9.81 kN/m^3), calculate the metacentric height and comment on its stability.		10
		UNIT-II	
8	Derive the general three-dimensional equation of continuity and deduce from it the continuity equation for one-dimensional frictionless flow.		10
9	(i)	Derive the Euler's equation of motion along a streamline, and hence derive the Bernoulli's theorem.	6
	(ii)	A uniform tapering pipe is 20 cm diameter at one end A and 10 cm at the other end B. The pipe is 3 m long, is inclined to the horizontal at an angle of $\alpha = \tan^{-1}(1/4)$ with end A above B. If the flow velocity at section B is 0.6 m/s, determine the difference of pressure between the two sections.	4
		UNIT-III	
10	Derive the Hagen-Poiseuille equation and state the assumptions made.		10
11	A horizontal pipe of 8 cm diameter is joined by sudden enlargement to a pipe of 16 cm diameter. Water is flowing through it at a rate of 0.015 m^3/s. If the pressure just before the junction is 6 m head, what will be the pressure head in the 16 cm diameter pipe downstream of the junction? What will be the power loss at the junction?		10
		UNIT-IV	
12	Derive the von-Karman momentum integral equation for flow past a flat plate. Based upon this equation, find expressions for boundary layer thickness, wall shear stress, and local skin friction coefficient by assuming following velocity profile: $\frac{u}{U_0} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$		10
13	i.	Derive an expression for lift for uniform flow around a circular cylinder with clockwise circulation.	6, 4
	ii.	A cylinder of 300 mm diameter is rotated at 150 rpm fully immersed in water of velocity 5 m/s. The velocity of water is normal to the axis of the cylinder. Determine (a) the magnitude of the lift force experienced by the cylinder (b) the position of stagnation points.	