Q. P. Code : 27043

[Time : 3 hours] **[Marks : 80]**

Instructions : Question no 1 is COMPULSORY
Attempt any 3 questions from question no 2 to 6
Use illustrative diagrams wherever possible
Assume suitable data if necessary

Q1 Solve any 4 of the 5 sub questions

a Two large plane surfaces are 2.4cm apart. The space between the surfaces is filled with glycerin. What force is required to drag a very thin plate of surface area 0.5 square meter between the two large plane surfaces at a speed of $0.6m/s^2$, if the thin plate is at a distance of 0.8cm from one of the plane surfaces ? Take dynamic viscosity of glycerin = 0.81 N-s/m^2 **5**

b The stream function for a two dimensional flow is given by $\psi = 2xy$, calculate the velocity of the point P(2,3). **5**

c A projectile travels in air of pressure 10.1043 N/cm^2 at 10^0C at a speed of 1500 kmph. Find the Mach number and the Mach angle. Take k=1.4 and R= 287 J/kg K **5**

d Define the following terms : **5**
i) Boundary Layer Thickness
ii) Displacement Thickness

e Explain the working of a Orificemeter **5**

Q2 **a** A simple manometer is used to measure the pressure of oil (sp gr 0.8) flowing in the pipeline. It's right limb is open to atmosphere and the left limb is connected to the pipe. The centre of the pipe is 9cm below the level of mercury (sp gr 13.6) in the right limb. If the difference of mercury level in the two limbs is 15cm, determine the absolute pressure of the oil in the pipe in N/cm^2. **8**

b A horizontal pipe line 50m long is connected to a water tank at one end discharges freely into the atmosphere at the other end. For the first 30m of its length from the tank, the pipe is 200mm in diameter and its diameter is suddenly enlarged to 400mm. The height of water level in the tank is 10m above the centre of the pipe. Considering all minor losses, determine the rate of flow. Take f = 0.01 for both sections of the pipe. **12**

Q3 **a** For a two dimensional potential flow, the velocity potential function is given by : $\Phi = 4x(3y-4)$, determine the velocity at the point (2,3). Also determine the value of the stream function ψ at the point (2,3) **10**

b The velocity profile within a laminar boundary layer over a flat plate is given by **10**

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

Where U is the main stream velocity and δ is the boundary layer thickness.
Determine the i) Displacement thickness and ii) Momentum thickness

Q4	**a**	Derive the Euler's equation of motion and obtain the Bernoulli's equation. State the assumptions made.	**10**
	b	Calculate the stagnation pressure , temperature and density at the stagnation point on the nose of a plane, which is flying at 800 kmph through still air having a pressure of 8.0 N/cm^2 (abs) and temperature -10^0 C . Take R = 287 J/kg K and k=1.4	**10**
Q5	**a**	A 300mm diameter pipe carries water under a head of 20 meters with a velocity of 3.5m/s. If the axis of the pipe turns 45^0, find the magnitude and the direction of the resultant force of the bend. Assume the pipe to be in the horizontal plane.	**10**
	b	A fluid of viscosity 0.7 $N\text{-}s/m^2$ and specific gravity 1.3 is flowing through a circular pipe of diameter 100mm. The maximum shear stress at the pipe wall is given as 192.6 N/m^2, find the i) pressure gradient ii) average velocity iii) Reynold's number of the flow.	**10**
Q6	**a**	Draw a neat sketch of Venturimeter and derive an expression for discharge through the venturimeter. Explain the terms C_d, C_v and C_c.	**10**
	b	Solve any 2 of 3 sub questions below	
	i	Define the terms Drag and Lift	**5**
	ii	State and explain the hydro static law	**5**
	iii	Explain the Critical Pressure ratio	**5**

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