15/05/2025 SE MECHANICAL SEM-IV C-SCHEME FM QP CODE: 10085336

Time: 3 Hours **Total Marks: 80**

N.B. : (1) **Question No. 1 is compulsory.**
(2) Attempt any three questions out of remaining five questions.
(3) Figures to the right indicates full marks.
(4) Assume any suitable data if necessary and justify the same.

Q.1 Solve any **FOUR**

A) Explain velocity potential and stream function. 5

B) Calculate the weight density, density and specific gravity of one litre of liquid which weighs 7N. 5

C) Define boundary layer and explain boundary layer formation. 5

D) State and prove Pascal's Law and give some application. 5

E) Write a short note on Reynold's experiment. 5

Q.2 A) The velocity vector in a fluid flow is given as $V = 4x^3i - 10x^2yj + 2tk$ 10
Find the velocity and acceleration of a fluid particle at (2, 1, 3) at t = 1.

B) A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 60 litres/sec. Find the reading of oil mercury differential manometer. Take Cd = 0.98 10

Q.3 A) An oil of viscosity 0.1 Ns/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and a length 300 m. The rate of flow of fluid through the pipe is 3.5 litres/s. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall. 10

B) Derive Euler's equation of motion and from that derive Bernoulli's equation. 10

Q.4 A) The velocity distribution in boundary layer is given by, 10

$$\frac{u}{U} = \frac{3}{2}\frac{y}{\delta} - \frac{1}{2}\frac{y^2}{\delta^2}$$

Calculate the following
i) Displacement thickness ii) Momentum thickness iii) Energy thickness
iv) check whether the boundary layer separation occurs or not.

B) The resisting force F of a plane during flight can be considered as dependent upon the length of aircraft *l*, velocity υ, air viscosity μ, air density ρ, and bulk modulus of air K. Express the functional relationship between these variables and the resisting force using dimensional analysis. 10

Q.5 A) 360 litres per second of water is flowing in a pipe. The pipe is bent by 120°. The pipe bend measures 360 mm × 240 mm and volume of the bend is 0.14 m^3. The pressure at the entrance is 73 kN/m^2 and the exit is 2.4 m above the entrance section. Find the force exerted on the bend. 10

B) Derive an expression for velocity distribution, discharge per unit width and shear stress when laminar flow between two parallel fixed plate. 10

Q.6 A) A horizontal pipeline 40 m long is connected to a water tank at 1 end, and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter, and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the center of the pipe. Considering all losses of head which occurs, determine the rate of low. Take f = 0.01 for both sections of the pipe. 10

B) Write a short note on **(any two)** 10
i) Newtonion and Non-Newtonion Fluids.
ii) Streamline and Bluff bodies.
iii) Importance of Reynold's transport theorem

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