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B.Tech-5th

FM &FPE

FLUID MECHANICS AND FLUID POWER ENGINEERING

Time: 3 Hours

FM=70

Answer any SIX questions including Q. No.1 which is compulsory.

1. Answer all questions in brief and to the point: [2×10]
   (i) A fluid at rest ~~can rest~~ can sustain normal stress. True/False.
   (ii) Define stream line. Is it defined at a given instant or over a period of time?
   (iii) To increase the sensitivity of a manometer the specific gravity of manometric fluid should be low. True/False.
   (iv) A ship carrying oil barrels should be kept in large no of small containers instead of small number of big containers. True/false. Explain
   (v) Write an expression for acceleration of a fluid particle. Identify the convective acceleration term.
   (vi) Boundary layer separation occurs in a favorable pressure gradient situation. True/false? Explain
   (vii) Discuss two methods to reduce drag.
   (viii) In a Pelton turbine, the blade deflection is not 180^0, even though at this angle ,power becomes maximum. Explain the reason.
   (ix) Cavitations may occur in Impulse turbine. True/False. Explain
   (x) Which one is a positive displacement pump? Reciprocating or Centrifugal?

2. Oil of specific gravity 0.8 acts on a vertical triangle whose apex is in the oil surface. The triangle is isosceles of 5m high and 8m wide base. The oil acts up to a height of 2.5m from the apex of the triangle and water acts on the rest 2.5 m of height. Determine the magnitude and point of action of the resultant hydrostatic force on the entire area. [5+5]
3. A closed tank 2m high and 1m in diameter contains 1.5m water. The air in the space above the water is subjected to a pressure of 117 KPa. If the tank is rotated at a speed of 12 rad/s, what is the pressure intensity at a location 0.2m from the centre line and 0.5 m above bottom of the tank? [5]
   Find the speed at which this tank should be rotated so that the centre of the bottom has zero depth of water. [5]
4. (a)Derive Bernoulli's equation .Write down all the assumption. [5]
   (b)Water is flowing through a diverging tube with diameters 10cm and 20cm at the two ends. The 20cm diameter pipe is at a height of 1m w.r.t the 10cm diameter. If the inlet velocity is 2m/s find the pressure difference between two ends of the pipe.[5]
5. (a) A flow field for an incompressible flow is given by $\vec{V} = tx^2 y\hat{i} - ty^2 x\hat{j}$ .Does the velocity field satisfies continuity equation? Check whether flow is rotational. Evaluate the acceleration at a point (1,2) at t=5sec. [5]

(b) A torpedo shaped object with 900mm diameter is to move in air at 60m/s and its drag is to be estimated from tests in water on a half scale model. Determine the necessary speed of the model and drag of the full scale object. **Hint**: Using Pi theorem, Obtain a set of dimensionless groups that can be used to correlate the data. [5]

6. Consider a two dimensional laminar boundary-layer flow along a flat plate. Assume the velocity profile in the boundary layer is sinusoidal, i.e. $\frac{u}{U_\infty} = a + by + cy^2$ .Applying suitable boundary condition evaluate constants a, b and c. Find expressions for (i)rate of growth of boundary layer thickness δ as a function of x.(ii)the displacement thickness δ^* as a function of x and (iii) the total drag force on a plate of length L and width b. [10]

7. A reaction turbine works at 450rpm under a head of 120m. The diameter at the inlet and the flow area are 120cm and $0.4m^2$ respectively. The angles made by the absolute and relative velocities at inlet are 20^0 and 60^0 respectively. Determine(i)the volume flow rate(ii) the power developed and (iii)the efficiency [10]

8. Write short notes on(i)Stability of floating bodies(ii)Cavitations in centrifugal pump(iii)Micro manometer(iv)Air vessels in reciprocating pump [2.5x4]