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Question Paper Code: 43704

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018

Third Semester

Mechanical Engineering

14UME304 - FLUID MECHANICS AND MACHINERY

(Regulation 2014)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- A fluid in which resistance to deformation is independent of the shear stress is known as
 - Pseudo plastic fluid
 - Bingham plastic fluid
 - Dilatant fluid
 - Newtonian fluid
- Which one of the following is the correct statement? Streamline, path line and streak line are identical when the
 - Flow is steady
 - Flow is uniform
 - Flow velocities do not change steadily with time
 - Flow is neither steady nor uniform
- The Bernoulli's equation refers to conservation of
 - Mass
 - Linear momentum
 - Angular momentum
 - Energy
- The following instruments are used in the measurement of discharge through a pipe: 1. Orifice meter, 2. Flow nozzle and 3. Venturimeter. Decreasing order of use
 - 1, 3, 2
 - 1, 2, 3
 - 3, 2, 1
 - 2, 3, 1
- Geometric similarity between model and prototype means the similarity of
 - discharge
 - linear dimensions
 - motion
 - forces

6. Models are known as undistorted model if
- (a) the prototype and model are having different scale ratios
 - (b) the prototype and model are having same scale ratio
 - (c) the prototype and model are kinematically similar
 - (d) none of these
7. Consider the following statements
- 1. Pelton wheel is a tangential flow impulse turbine
 - 2. Francis turbine is an axial flow reaction turbine
 - 3. Kaplan turbine is a radial flow reaction turbine
- Which of the above statements is/ are correct ?
- (a) 1 and 3
 - (b) 1 alone
 - (c) 2 alone
 - (d) 3 alone
8. The use of a draft tube in a reaction type water turbine helps to
- (a) Prevent air from entering
 - (b) Increase the flow rate
 - (c) Convert the kinetic energy to pressure energy
 - (d) Eliminate eddies in the downstream
9. Which one of the following pumps is not a positive displacement pump?
- (a) Reciprocating pump
 - (b) Centrifugal pump
 - (c) Vane pump
 - (d) Lobe pump
10. Which of the following pump is preferred for flood control and irrigation purpose?
- (a) centrifugal pump
 - (b) axial flow pump
 - (c) mixed flow pump
 - (d) reciprocating pump

PART - B (5 x 2 =10 Marks)

- 11. Define surface tension.
- 12. State the assumptions used in deriving Bernoulli's equation.
- 13. State Reynold's model law.
- 14. Classify hydraulic turbine with respect to head available at inlet.
- 15. Define coefficient of discharge of reciprocating pump.

PART - C (5 x 16 = 80 Marks)

16. (a) The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the horse power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm. (16)

Or

- (b) A hollow cylinder of 150 mm OD with its weight equal to the buoyant forces is to be kept floating vertically in a liquid with a surface tension of 0.45 N/m. The contact angle is 60°. Determine the additional force required due to surface tension. (16)

17. (a) State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation and state the assumptions made. (16)

Or

- (b) A horizontal Venturimeter with inlet diameter 200 mm and throat diameter 100 mm is employed to measure the flow of water. The reading of the differential manometer connected to the inlet is 180 mm of mercury. If $C_d = 0.98$, determine the rate of flow. (16)

18. (a) Using Buckingham's π - theorem, show that the velocity through a circular orifice in a pipe is given by $v = \sqrt{2gH} f \{d/H, \mu/\rho vH\}$ where v is the velocity through orifice of diameter d and H is the head causing the flow and ρ and μ are the density and dynamic viscosity of the fluid passing through the orifice and g is acceleration due to gravity. (16)

Or

- (b) Water is flowing through a pipe of diameter 30 cm at a velocity of 4 m/s. Find the velocity of oil flowing in another pipe of diameter 10 cm, if the condition of dynamic similarity is satisfied between the two pipes. The Viscosity of water and oil is given as 0.01 poise and 0.025 poise. The specific gravity of oil = 0.8. (16)
19. (a) A Pelton turbine running at 720 rpm uses 300 kg of water per second. If the head available is 425 m, determine the hydraulic efficiency. The bucket deflects the jet by 165°. Also find the diameter of the runner and jet. Assume $C = 0.97$ and $f = 0.46$, Blade velocity coefficient is 0.9. (16)

Or

- (b) A Francis turbine developing 16120 kW under a head of 260 m runs at 600 rpm. The runner outside diameter is 1500 mm and the width is 135 mm. The flow rate is 7 m³/s. The exit velocity at the draft tube outlet is 16 m/s. Assuming zero whirl velocity at exit and neglecting blade thickness determine the overall and hydraulic efficiency and rotor blade angle at inlet. Also find the guide vane outlet angle. (16)
20. (a) The following details refer to a centrifugal pump. Outer diameter: 30 cm, Eye diameter: 15 cm, Blade angle at inlet: 30°, Blade angle at outlet: 25° and Speed 1450 rpm. The flow velocity remains constant. The whirl at inlet is zero. Determine the work done per kg. If the manometric efficiency is 82%, determine the working head. If width at outlet is 2 cm, determine the power $\eta_o = 76\%$. (16)

Or

- (b) Explain about working principle of reciprocating pump with neat sketch. (16)
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