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Question Paper Code : 52763

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Third/Fourth Semester

Mechanical Engineering

CE 6451 — FLUID MECHANICS AND MACHINERY

(Common to Aeronautical Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/ Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering)

(Regulation 2013)

(Also common to PTCE 6451 — Fluid Mechanics and Machines for B.E. (Part-Time) – Second Semester – Mechanical Engineering – Regulation 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write down the effect of temperature on viscosity of liquids and gases.

2. Differentiate System and Control volume.

3. What is the average velocity and the discharge for an oil of viscosity 0.02 Ns/m² flowing between two stationary parallel plates 1 m wide maintained 10 mm apart if the velocity midway between the plates is 2 m/s.

4. What is the application of Moody's Diagram?

5. State Buckingham's π theorem. Why this method is considered superior to Rayleigh's method?

6. Write the scale ratio for velocity and pressure intensity using Froude model law.

7. Differentiate Vortex and Volute casing.

8. What is an air vessel in reciprocating pumps?

9. Define manometric head of the turbine.

10. Write short notes on Draft tube.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Derive the Bernoulli's equation with the basic assumptions. (8)

(ii) Calculate the capillary effect in millimeters in a glass tube of 4 mm diameter, when immersed in (i) water, and (ii) mercury. The temperature of the liquid is 20°C and the values of the surface tension of water and mercury at 20°C in contract with air are 0.073575 N/m and 0.51 N/m respectively. The angle of contact for water is zero and that for mercury is 130°. Take density of water at 20°C as equal to 998 kg/m^3. (5)

Or

(b) Derive the Continuity Equation in three dimensions. (13)

12. (a) Derive the Hagen Poiseuille formula for the flow through Circular pipes. (13)

Or

(b) Three pipes of 400 mm, 200 mm and 300 mm diameters have lengths of 400 m, 200 m and 300 m respectively. They are connected in series to make a compound pipe. The ends of this compound pipe are connected with two tanks whose difference of water levels is 18 m. If the coefficient of friction for this pipe is same and equal to 0.005, determine the discharge through the compound pipe neglecting first the minor losses and then including them. (13)

13. (a) Using Buckingham π theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gh}\phi[D/H, \mu/\rho\ VH]$, where H is the head causing flow, D is the diameter of the orifice, μ is the coefficient of the viscosity, ρ is the mass density and g is the acceleration due to gravity. (13)

Or

(b) (i) The pressure drop in an airplane model of size 1/10 of its prototype is 80 N/cm^2. The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air = 1.24 kg/m^3. The viscosity of water is 0.01 poise while the viscosity of air is 0.00018 poise. (7)

(ii) Explain similitude with its types. (6)

14. (a) Derive the expression for pressure head due to acceleration in the suction and delivery pipes of the reciprocating pumps. (13)

Or

(b) The internal and external diameter of an impeller of a centrifugal pump which is running at 1200 rpm are 350 mm and 650 mm. The discharge through the pump is 0.05 m^3/s and the velocity of the flow is constant and equal to 2.5 m/s. The diameters of the suction and delivery pipes are 150 mm and 100 mm respectively and suction and delivery heads are 6 m (abs) and 30 m (abs) of water. If the outlet vane angle is 45° and power required to drive the pump is 19 kw determine (i) Vane angle of the impeller at inlet (ii) Overall efficiency of the pump (iii) Manometric efficiency of pump. (13)

15. (a) Design a Pelton wheel for a head of 60 m when running at 200 rpm. The Pelton wheel develops 95.6475 kW shaft power. The velocity of buckets = 0.45 times the velocity of the jet, overall efficiency 0.85 and coefficient of velocity = 0.98. (13)

Or

(b) The following data is given for Francis turbine : Net Head = 65 m, speed = 720 rpm, shaft power = 297.3 kW, η_o = 84%, η_h = 93%, flow ratio = 0.2, breadth ratio = 0.1, outer diameter of the runner = 2*inner diameter of runner. The thickness of vanes occupies 5% of the circumferential area of the runner. Velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine :

(i) The guide blade angle

(ii) Runner vane angle at the inlet and outlet

(iii) Diameter of the runner at inlet and outlet

(iv) Width of the wheel at inlet. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Explain the principle and main working components of the centrifugal pump. (15)

Or

(b) Explain the principle and main working of components of a Kaplan turbine with neat sketch.

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