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Question Paper Code : 71563

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

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)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define Viscosity and what is the effect due to temperature on liquid and gases.

2. Calculate the height of capillary rise for water in a glass tube of diameter 1mm?

3. What are equivalent pipes? Mention the equation used for it.

4. Define Boundary Layer.

5. Explain the types of Similarities.

6. Write the expression for Mach number and state its application.

7. Explain the purpose of Air Vessel and in which pump it is used?

8. Define cavitation and its effects.

9. How do you classify turbines based on flow direction and working medium?

10. What is meant by Governing of Turbines?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8 m × 0.8 m in an inclined plane with an angle of inclination 30° to the horizontal. The weight of the square plate is 300N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5mm. (8)

(ii) An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$. (5)

Or

(b) Derive the expression of Bernoulli's equation from the Euler's equation and state the assumptions made for such a derivation? (13)

12. (a) (i) A fluid of viscosity 0.7 Pa.s and specific gravity 1.3 is flowing through a pipe diameter 120 mm. The maximum shear stress at the pipe value is 205.2 N/m². Determine the pressure gradient, Reynolds number and average velocity? (9)

(ii) A crude oil of kinematic viscosity 0.4 strokes is flowing through a pipe of diameter 300mm at the rate of 300 litres per sec. Find the head lost due to friction for a length of 50 m of the pipe. Take Coefficient of friction as 0.006. (4)

Or

(b) For a flow of viscous fluid flowing through a circular pipe under laminar flow conditions show that the velocity distribution is a parabola. And also show that the average velocity is half of the maximum velocity. (13)

13. (a) A 1:100 model is used for model testing of ship. The model is tested in wind tunnel. The length of ship is 400 m. The velocity of air in the wind tunnel around the model is 25 m/s and the resistance is 55N. Determine the length of model. Also find the velocity of ship as well as resistance developed. Take density of air and sea water as 1.24 kg/m³ and 1030 kg/m³. The kinematic viscosity of air and seawater are 0.018 stokes and 0.012 stokes respectively. (13)

Or

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

14. (a) (i) A Single acting reciprocating pump running at 50 RPM delivers 0.01 m^3/s of water. The diameter of the piston is 200mm and stroke length 400 mm. Determine

(1) The theoretical discharge of the pump

(2) Coefficient of discharge

(3) Slip and Percentage slip of the pump. (8)

(ii) Discuss the working of Gear pump using its schematic. (5)

Or

(b) A Centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a head of 40m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at angle of 40° at outlet. If the outer diameter of the impeller is 500 mm & width at outlet is 50 mm determine (i) Vane angle at inlet, (ii) Manometric efficiency, (iii) Workdone by impeller on water per second. (13)

15. (a) (i) A kaplan turbine runner is to be designed to develop 9100 kW. The net available head is 5.6m. If the speed ratio = 2.09, flow ratio = 0.68, overall efficiency = 86% and the diameter of the boss is 1/3 the diameter of the runner. Find the diameter of the runner, its speed and the specific speed of the turbine? (8)

(ii) Explain the Performance Characteristics curves of turbine. (5)

Or

(b) The following data is given for a Francis turbine. Net head H = 60 m, Speed N = 700 RPM, Shaft power 294.3 kw, Overall efficiency 84%, Hydraulic efficiency 93%. Flow ratio = 0.2, breadth ratio n = 0.1, Outer diameter of the runner is two times inner diameter of the runner. The thickness of vanes occupies 5% of circumference area of the runner. Velocity of flow is constant at inlet and outlet and the discharge is radial at outlet. Determine (i) Guide blade angle, (ii) Runner vane angle at inlet and outlet, (iii) Diameter of runner inlet and outlet, (iv) Width of wheel at inlet. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A liquid has a specific gravity of 0.72. Find its density, specific weight and its weight per litre of the liquid. If the above liquid is used as the lubrication between the shaft and the sleeve of length 100mm. Determine the power lost in the bearing, where the diameter of the shaft is 0.5 m and the thickness of the liquid film between the shaft and the sleeve is 1 mm. Take the viscosity of fluid as 0.5 $N\text{-}s/m^2$ and the speed of the shaft rotates at 200 rpm. (15)

Or

(b) For a high head storage capacity dam of net head 800 m, it has been decided to design and install a Pelton wheel for generating power of 13,250 kw running at a speed of 600 RPM, if the coefficient of jet is 0.97 Speed Ratio = 0.46 and the Ratio of jet diameter is 1/15 of the wheel diameter calculate (i) Number of jets, (ii) Diameter of jets, (iii) Diameter of Pelton wheel, (iv) No of buckets and (v) Discharge of one jet. (15)
