14/07/22 - AN

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20323

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

Third/Fourth Semester

Aeronautical Engineering

CE 8394 — FLUID MECHANICS AND MACHINERY

(Common to Aerospace Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and management/Manufacturing Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering/Safety and Fire Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish between ideal fluids and real fluids.

2. Discuss the effect of increase in temperature on vapour pressure of liquid.

3. With the help of a discussion show that as a real fluid flows past a solid boundary, at the surface of the solid boundary, the layer of fluid undergoes retardation.

4. What do you mean by "Pipes in series"?

5. When is an equation said to be dimensionally homogeneous?

6. State Buckingham's π - Theorem.

7. Define specific speed of a pump.

8. What is the difference between single suction and double suction pump? State the advantages of double suction over single suction pump.

9. Enumerate the factors on which cavitation in turbines depend.

10. Define specific speed of a turbine.

(b) (i) In a single acting pump the cylinder has a diameter of 150 mm and a stroke 300 mm. The water is to be raised to a height of 20 m when the pump is running at 40 rpm. Determine the theoretical discharge and the theoretical power. If the actual discharge of the pump is 3.5 lps, find the coefficient of discharge and the percentage slip of the pump. (5)

(ii) Explain the working principles of reciprocating pump. (8)

15. (a) (i) What is a draft tube? What are its functions? (5)

(ii) Enumerate the main components of Pelton turbine and briefly state their functions. (8)

Or

(b) (i) What is a Pelton turbine? Enumerate the characteristics of a Pelton turbine. (5)

(ii) Explain briefly the functions of component parts of a Francis turbine. Enumerate the applications of a Francis turbine. (8)

PART C — (1 × 15 = 15 marks)

16. (a) Discuss various flow characteristics. (15)

Or

(b) Explain in detail the velocity triangles. (15)

PART B — (5 × 13 = 65 marks)

11. (a) (i) Define viscosity of a fluid. Enumerate the physical phenomena which are responsible for the property of viscosity. State the force and mass units of viscosity. (5)

(ii) Water flows through a branching pipeline as shown in the Figure Q.11(a)(ii). If the diameter, D_2, is 250 mm, V_2 = 1.77 m s^{-1} and V_3 = 1.43 ms^{-1}, find (1) diameter, D_3, required for $Q_3 = 2Q_2$ and (2) the total discharge at section 1. (8)

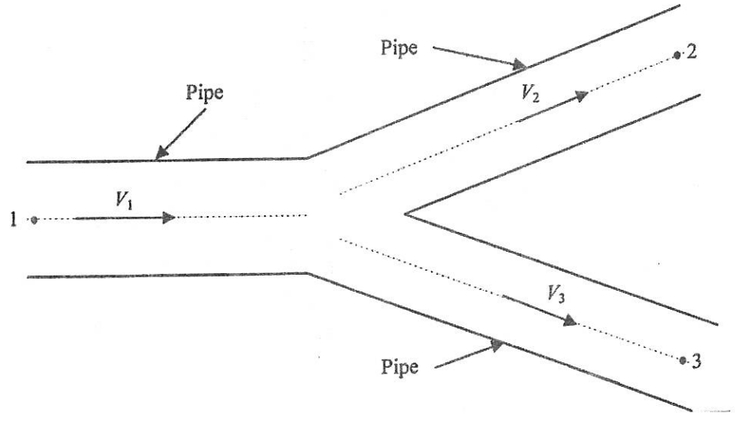

Fig. Q.11(a)(ii)

Or

(b) (i) Enumerate and differentiate between the properties possessed by liquids due to molecular attraction. What are the characteristics possessed by a liquid because of these properties? (5)

(ii) A hydraulic lift consists of a 500 mm diameter ram and slides in a cylinder of diameter 500.15 mm while the annular space is being filled up with oil having kinematic viscosity of 0.025 cm^2 s^{-1} and specific gravity of 0.85. If the rate of travel of the ram is 9.15 m min^{-1} find the frictional resistance when 3.85 m of ram is engaged in cylinder. (8)

12. (a) (i) Oil of specific gravity 0.9 and kinematic viscosity 0.00033 m^2 s^{-1} is pumped over a distance of 1.5 km through a 75 mm diameter tube at a rate of 0.007716 m^3 s^{-1}. Determine whether the flow is laminar. (5)

(ii) In a water pipeline there is an abrupt change in diameter from 140 mm to 250 mm. If the head lost due to separation when the flow is from the smaller to the larger pipe is 0.6 m greater than the head lost when the same flow is reversed, determine the flow rate. Take coefficient of contraction, Cc = 0.632. (8)

Or

(b) (i) Discuss the factors influencing the thickness of the boundary layer formed along a long, thin, flat and smooth plate? (5)

(ii) Water at a density of 998 kg m^{-3} and kinematic viscosity of 1×10^{-6} m^2s^{-1} flows through smooth tubing at a mean velocity of 2 ms^{-1}. If the tube diameter is 30 mm, calculate the pressure gradient per unit length necessary. Assume that the friction factor for a smooth pipe is given by 16/Re for laminar flow and $0.079/Re^{1/4}$ for turbulent flow. (8)

13. (a) (i) Define scale ratio, When are a model and the corresponding prototype said be geometrically similar? Let the lengths, breadths and depths of a model and the corresponding prototype be respectively, L_m, b_m and d_m and L_p, b_p and d_p. Work out the length scale ratios. What should be the relationship between these ratios for the model and the prototype to be geometrically similar? (5)

(ii) Show by Rayleigh method that the resistance R to the motion of a sphere of diameter D moving with a uniform velocity V through a fluid having density ρ and viscosity μ may be expressed as (8)

$$R = (\rho D^2 V^2)\phi\left(\frac{\mu}{\rho V D}\right).$$

Or

(b) (i) Explain the conditions under which a model and the corresponding prototype are said to be kinematically similar. (5)

(ii) In order to estimate the frictional head loss in a pipe 1 m in diameter, through which castor oil of specific gravity 0.96 and dynamic viscosity 9.9 poise, is to be transported at the rate of 5000 litres per second, a test was conducted on a pipe of diameter 50 mm using water at 15°C as the model fluid. Calculate the discharge required for the model pipe. (8)

14. (a) (i) Draw a typical layout of a centrifugal pumping installation and describe the functions of the various accessories. (5)

(ii) A single acting pump is equipped with an air vessel on the delivery side. The piston moves with simple harmonic motion. The diameter and stroke of the piston are 300 mm and 600 mm respectively. The delivery pipe is 175 mm in diameter and 60 m long. Determine the power saved (in horse power units) in overcoming friction in the delivery pipe by the air vessel. The pump runs at 120 rpm. Take f = 0.01 in the expression $h_f = 4fLv^2/2gd$. (8)

Or