

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Third Semester

Mechanical Engineering

20CEPC306 - FLUID MECHANICS AND MACHINERY

Regulations - 2020

Duration: 3 Hours

Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

	<i>Marks</i>	<i>K- Level</i>	<i>CO</i>
1. Fluid is a substance which offers no resistance to change of (a) pressure (b) flow (c) shape (d) volume	1	K1	CO2
2. One poise is equal to (a) $1 \times 10^{-3} \text{Ns/m}^2$ (b) $1 \times 10^{-1} \text{Ns/m}^2$ (c) $1 \times 10^{-4} \text{Ns/m}^2$ (d) 0.01Ns/m^2	1	K1	CO2
3. A simple manometer consists of: (a) A U-shaped tube filled with a liquid. (b) A straight tube filled with gas, (c) A diaphragm, (d) A spring-loaded needle	1	K1	CO2
4. Pressure of a fluid is measured by a (a) Barometer (b) Thermometer (c) Manometer (d) None	1	K1	CO2
5. A control volume is defined as: (a) A fixed region in space through which fluid flows, (b) The total volume of the fluid (c) The volume occupied by solid boundaries, (d) The volume of the fluid at rest	1	K1	CO1
6. Fluid kinematics is the study of: (a) The forces causing fluid motion, (b) The geometry of fluid motion (c) The energy of fluid motion, (d) The viscosity of fluids	1	K1	CO1
7. The throat of a Venturimeter is: (a) The widest section, (b) The narrowest section (c) The section with the highest pressure, (d) The section with the lowest velocity	1	K1	CO1
8. Which one indicates continuity equation? (a) $A_1 \times Q_1 = A_2 \times Q_2$ (b) $A_1 \times V_1 = A_2 \times V_2$ (c) $A_1 \times V_2 = A_2 \times V_1$ (d) None of the above	1	K1	CO1
9. Minor losses in a piping system are associated with: (a) Friction in straight pipes, (b) The viscosity of the fluid (c) Changes in flow direction or velocity, (d) The length of the pipe	1	K1	CO5
10. The vertical distance from boundary surfaces in that velocity reaches 99% of the free stream velocity, is called as (a) Laminar boundary layer (b) Turbulent boundary layer (c) Boundary layer thickness (d) None of the above	1	K1	CO5
11. The Reynolds number for laminar flow in a pipe must be below which value? (a) 2000, (b) 4000, (c) 500, (d) 3000	1	K1	CO5
12. The head loss due to a sudden contraction is a type of: (a) Major loss, (b) Minor loss, (c) Total loss, (d) Dynamic loss	1	K1	CO5
13. Viscosity has the dimension of (a) $(\text{MT}^2)/\text{L}$ (b) $\text{M}^2/(\text{LT})$ (c) $\text{M}/(\text{LT}^2)$ (d) $\text{M}/(\text{LT})$	1	K1	CO6
14. Euler's number is the ratio of _____ force to pressure force. (a) Inertia (b) gravity (c) viscous (d) None of the these	1	K1	CO6

15. What is the main purpose of dimensional analysis? 1 K1 CO6
 (a) To determine the units of physical quantities,
 (b) To simplify complex physical problems
 (c) To calculate exact numerical solutions
 (d) To avoid using empirical data
16. A prototype refers to: 1 K1 CO6
 (a) A reduced-scale model of the original system
 (b) The full-scale original system being modeled
 (c) A numerical simulation, (d) An approximate analytical solution
17. What type of turbine is a Pelton wheel? 1 K1 CO4
 (a) Axial flow turbine, (b) Radial flow turbine
 (c) Impulse turbine, (d) Mixed flow turbine
18. Which of these turbines is typically used for low head and high discharge applications? 1 K1 CO4
 (a) Pelton wheel, (b) Francis turbine, (c) Kaplan turbine, (d) Turgo turbine
19. In a reciprocating pump, the working principle relies on: 1 K1 CO3
 (a) Continuous flow, (b) Displacement of a fixed volume by a piston
 (c) Acceleration of fluid by a rotating impeller, (d) Creating a vacuum in the casing
20. Which type of pump has a lower efficiency but simpler construction? 1 K1 CO3
 (a) Centrifugal pump, (b) Reciprocating pump, (c) Rotary pump, (d) Axial flow pump

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21. Calculate the pressure inside a soap bubble, over the atmospheric pressure if its diameter is 2cm and the surface tension is 0.1N/m. 2 K2 CO2
22. Define compressibility. 2 K1 CO2
23. Distinguish between Newtonian and non-Newtonian fluids in terms of viscosity. 2 K2 CO1
24. Name any two devices used for measuring rate of flow of a fluid flowing through a pipe. 2 K1 CO1
25. Mention the general characteristics of a laminar flow. 2 K1 CO5
26. What is meant by Displacement thickness? 2 K1 CO5
27. Define dimensional homogeneity. 2 K1 CO6
28. Elaborate about distorted models. 2 K2 CO6
29. Outline the working principle of a Pelton wheel turbine. 2 K2 CO4
30. Define the term "Net Positive Suction Head (NPSH)". 2 K1 CO3

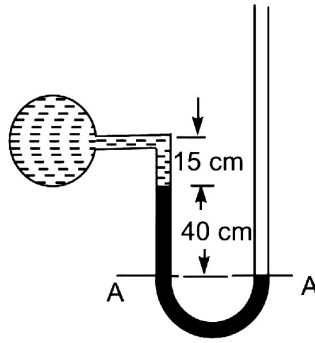
PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

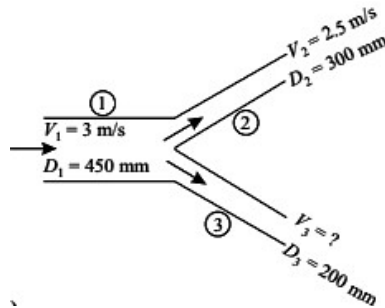
31. a) The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 9 Poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Determine the power lost in the bearing for sleeve length of 90mm. The thickness of the oil film is 1.5 mm. 10 K3 CO2

OR

- b) A simple U tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the centre of pipe is 15 cm below. 10 K3 CO2



32. a) A pipe (1) 450 mm in diameter branches into two pipes (2 and 3) of diameters 300 mm and 200 mm respectively as shown in Fig. If the average velocity in 450 mm diameter pipe is 3 m/s calculate: (i) Discharge through 450 mm diameter pipe; (ii) Velocity in 200 mm diameter pipe if the average velocity in 300 mm pipe is 2.5 m/s. 10 K3 CO1



OR

- b) A 45° reducing bend is connected in a pipeline, the diameters at the inlet and outlet of the bend being 500mm and 250mm respectively. Determine the force exerted by water on the bend if the intensity of pressure at the inlet to bend is 8.829N/cm² and at the outlet is 5.45N/cm² and the rate of flow is 600 litres/s. 10 K3 CO1
33. a) An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 litres/sec. Calculate the head lost due to friction for a 500 m length of pipe. 10 K3 CO5

OR

- b) Determine the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = 2 \left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. 10 K3 CO5
34. a) Using Buckingham's pi theorem, show that the velocity through a circular pipe orifice is given by, $V = \sqrt{2gH} \cdot \phi \left[\frac{D}{H}, \frac{\mu}{\rho V H} \right]$ Where H = Head causing flow, D=diameter of orifice, μ =coefficient of viscosity, ρ = mass density, g=acceleration due to gravity. 10 K3 CO6

OR

- b) The ratio of lengths of a submarine and its model is 30:1. The speed of the prototype is 10 m/s. The model is to be tested in a wind tunnel. Determine the speed of air in wind tunnel. Also determine the ratio of the drag between the model and prototype. Take values of kinematic viscosities of sea water and air as 0.012 stokes and 0.016 stokes respectively, the density of sea water and air is given as 1030 kg/m³ and 1.24 Kg/m³ respectively. 10 K3 CO6

35. a) The penstock supplies water from a reservoir to the Pelton wheel with a gross head of 400 m. One third of the gross head is lost in friction in the penstock. The rate of flow of water through the nozzle fitted at the end of the penstock is $2 \text{ m}^3/\text{s}$. The angle of deflection of the jet is 165° . Find the power given by the water to the runner and also hydraulic efficiency of the Pelton wheel. Take speed ratio = 0.45 and $C_v = 1.0$. 10 K2 CO4

OR

- b) Explain the construction and working principle of a Francis turbine with the help of neat diagram. Also discuss about its advantages, disadvantages and applications. 10 K2 CO4

36. a) A double-acting reciprocating pump, running at 60 r.p.m., is discharging $200 \text{ m}^3/\text{s}$ of water per minute. The pump has a stroke of 400 mm. The diameter of the piston is 200 mm. The delivery and suction head are 25 m and 10 m respectively. Find the slip of the pump and power required to drive the pump. 10 K2 CO3

OR

- b) Explain the working principle of centrifugal pump with neat diagram in detail. Also list its Applications, Advantages and Disadvantages. 10 K2 CO3