FLUID MECHANICS AND HYDRAULIC MACHINES

SHORT QUESTIONS (From all 5 units) 2 Marks

1. What are the physical properties of fluids.
2. What is meant by a fluid?
3. Write short notes on viscosity.
4. What are the types of Pressures.
5. Write short notes on Piezometer.
6. How does the viscosity of air vary with temperature?
7. Define Vapour pressure and Surface tension.
8. Write about mass density and specific gravity.
9. Define specific volume.
10. Define the term cavitation.
11. Write short notes on Pitot tube.
12. Classify different types of fluid flows.
13. Write short notes on lines.
14. Define Path line and stream line.
15. What is stream lined body?
16. Differentiate between stream function and velocity potential.
17. Differentiate between steady and unsteady flow.
18. Write the phenomenon of boundary layer separation?
19. State the Bernoulli's equations.
20. Describe briefly about continuity equation.
21. State the momentum equation.
22. Write short notes on Boundary Layer Concept.
23. Write any two application of Boundary Layer Concepts.
24. What do you understand the term boundary layer and boundary layer theory?
25. Write Darcy Weisbach equation?
26. Write short notes on drag and lift.
27. What are the Minor losses in pipes?
28. Find the force exerted by jet of water of diameter 30mm on a stationary flat plate, when the jet strikes the plate normally with a velocity of 10 m/s.
29. Classify different types of Turbines.
30. Classify hydraulic turbines?
31. Write short notes on Reynold's experiment.
32. What are the applications of venturi meter.
33. Find the force exerted by jet of water of diameter 50mm on a stationary flat plate, when the jet strikes the plate normally with a velocity of 15 m/s.
34. What is the purpose of draft tube in turbine.

35. Mention the purpose of surge tank.
36. What is the difference between impulse turbine and reaction turbine.
37. What are the types forces.
38. Why pumps are generally less efficient than turbines.
39. What is meant by a pump?
40. What is the difference between pump and turbine
41. Define the term specific speed.
42. What are the different efficiencies of a centrifugal pump?
43. Define specific speed of a centrifugal pump.
44. Differentiate Reciprocating and Centrifugal pumps briefly.
45. Define the term NPSH.

Long Questions 10 Marks

UNIT-I

1. Briefly explain the physical properties of fluids with units.

2. Explain U-tube manometer with neat sketch and Find out the pressure.

3. Explain differential manometer with neat sketch and Find out the pressure head.

4. 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 off 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.

5. What is the difference between dynamic viscosity and kinematic viscosity? state their unit of measurement

6. The right limb of a simple U- tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp.gr. 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm

7. Define the terms: (i) absolute pressure (ii) Gauge Pressure (iii) vacuum pressure.

8. Find the difference of pressure in differential manometer with neat sketch.

9. A fan delivers 4 m3 of air per second at 200C and 1.25 bar. Assuming molecular weight of air as 28.97, calculate the mass of air delivered .Also determine the density, specific volume and specific weight of the air being delivered.

UNIT-II

1. Derive Bernoulli's equation from Euler's equations of motions for a stream line.

2. The water is flowing through a pipe having diameter of 20cm and 10 cm and section 1 and 2 respectively. The rate of flow through the pipe is 35 liters per sec. the section 1 is 6m above the datum line and section 2 is 4m above datum line. If the pressure at section 1 is 39.24N/cm_2. Find the intensity of pressure at section 2.

3. a). Describe all the types of flows.

b).A 30 cm diameter pipe conveying water branches in to two pipes of dia 20cm and 15cm. If average velocity in 30cm diameter pipe is 2.5 m/s, find the discharge in this pipe and also determine the velocity of 15cm pipe, if the average velocity in 20cm dia pipe is 2m/s.
Explain (i) Stream line (ii) path line (iii) Irrotational Flow (iv) Streak line

4. State and explain continuity equation. Derive continuity equation for three dimensional flow.

5. Water flows through a pipe AB 1.2m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe branches. Branch CD is 0.8 m in diameter and carries one-third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE.

6. The water is flowing through a taper pipe of length 100m having diameters 600mm at the upper end and 300mm at the lower end, at the rate of 50 litres/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm_2.

UNIT-III

1. a) Describe Boundary Layer Concepts.

b) How Reynold's experiment could be useful to fluid Mechanics.

2. Derive the expression for Darcy weisbach.

3. Find the head lost due to friction in a pipe of diameter 300 mm and length 50m, through which water is flowing at a velocity of 3m/s using Darcy formula. Take υ for water = 0.01stroke.

4. Derive Bernoulli's equation ?

5. Explain the development of boundary layer formation over a flat plate.

6. What type of turbine is Kaplan turbine? Explain how it works with a neat diagram. Discuss the importance of draft tube in reaction turbines.

7. Derive the expression for Loss of head due to Friction in Pipes.

8. Explain the separation of boundary layer with neat sketch.

9. Explain (i) Laminar Boundary layer (ii) Turbulent Boundary layer (iii) Boundary layer thickness (iv) Drag and (v) Lift

10. Explain Minor energy(head) losses in pipes.

11. Find the head lost due to friction in a pipe of diameter 300 mm and length 50m, through which water is flowing at a velocity of 3m/s using Darcy formula. Take υ for water = 0.01stroke

12. Water if flowing through a pipe having diameter 20 cm and 10 cm at section-1 and section-2 respectively the rate of flow through pipe is 35 lit/sec. The section-1 is 6m above datum and section-2 is 4m above datum. If the pressure at section-1 is 39.24N/cm^2, find the intensity of pressure at section-2.

UNIT-IV

1. a) Derive the expression for force exerted by the jet on a stationary vertical plate.

   b) Design Francis Turbine and find out work done and efficiency.

2. a). Explain with neat sketches of hydroelectric power station

b). The hydro power plant has a turbine with the following details. Find the power developed and what is the specific speed of the turbine. Hydraulic efficiency = 90%. Net head =65m discharge=15m_3/s, speed=100 rpm

3. a). A jet of water 120 mm in diameter and moving with a velocity of 25m/sec strikes normally on a flat plate. Determine the power developed and the efficiency of the system when

   i. The plate is stationary
   ii. The plate is moving with a velocity of 8m/sec in the direction of the jet.

b). What are the classifications of turbines?

4. A jet of water of diameter 7.5 cm strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the direction of the jet. The jet is deflected through an angle of 165^0. Assuming the plate is smooth. Find
(i) Force exerted on the plate in the direction of jet,
(ii) Power of the jet, and
(iii) Efficiency of the jet.

4. Explain construction and working proportion of Pelton wheel with neat sketch.

5. Explain construction and working proportion of Francis turbine with neat sketch.

6. Explain construction and working proportion of Kaplan turbine with neat sketch.

7. Reaction turbine works at 450rpm under a head of 120m. Its diameter at inlet is 1.2m and the flow area is 0.4m_2.The angle made by the absolute and relative velocities are 20° and 60° respectively with the tangential velocity. Determine 1).volumeflowrate,2)..Power developed, 3)

Hydraulic efficiency.

8. A 15 cm diameter jet of water with a velocity of 15 m/s strikes a plane normally. If the plate is moving with a velocity of 6 m/s in the direction of the jet calculate the work done per second on the plate and the efficiency (η) of energy transfer.

9. A Pelton wheel is working under a head of 45m and the discharge is 0.8m3/sec.The mean bucket speed is 14m/sec. Find the power produced if the jet is deflected by the blades through an angle of 165^0. The coefficient of velocity is 0.985

10. A Pelton wheel working under a head of 52 metres develops a shaft power of 92 kW at a speed of 250 rpm. If the overall efficiency is 82.5% and Cv =0.98, find the jet diameter, the diameter of the bucket circle, the size of the buckets and the number of buckets required. Assume maximum efficiency condition that the peripheral velocity is 0.47 times the velocity of the jet.

11. A 7.5 cm diameter of jet having a velocity of 30m/s strikes a flat plate, the normal of which isinclined at 450 to the axis of the jet. Find normal pressure on the plate, when (i) the plate is stationary and (ii) when the plate is moving with a velocity of 15m/s. determine the power and efficiency of the jet when plate is moving.

12. Differentiate between i) Impulse and Reaction turbine ii) Radial and Axial flow Turbines iii)Inward and Outward Radial flow turbines

13. a) Derive the expression for force exerted by the jet on a stationary vertical plate.
b) Derive the expression for force exerted by the jet on a stationary curved plate, where jet strikes at the centre.

14. Derive an expression for force exerted by the jet on a stationary unsymmetrical curved vane, strikes at tip of the vane.

15. A turbine is to operate under a head of 25m at 200 r.p.m. The discharge is 9 cumec. If theefficiency is 90%, determine the performance of the turbine under a head of 20 metres.

16. A jet of water of diameter 7.5 cm strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the direction of the jet. The jet is deflected through an angle of 165_0. Assuming the plate is smooth. Find

(i) Force exerted on the plate in the direction of jet,
(ii) Power of the jet, and

(iii) Efficiency of the jet.

17. A Pelton wheel is to be designed for the following specifications:

Shaft power =11,772 kw; Head = 380 metres; Speed = 750 r.p.m; Overall efficiency = 86%; Jet diameter is not to exceed one-sixth of the wheel diameter. Determine :

(i) The wheel diameter, (ii) The number of jets required, and (iii) Diameter of the jet.
Take $K_{v1} = 0.985$ and $K_{u1} = 0.45$.

UNIT-V

1. Explain the following terms

i) Specific speed ii) Performance characteristic curves iii) NPSH.

2. A centrifugal pump delivers 25 liters of water per second against a head of 10 meters and running at 1300 rpm requires 10 kW of power. Determine the discharge, head of the pump and power required if the pump runs at 1500 rpm.

3. How do you Classify the pumps?

4. Mention on which principle Centrifugal pump works. Explain the main parts of a Centrifugal pump with neat sketches.

5. Explain the Working principle of centrifugal pump with a neat sketch.

6. A centrifugal pump having an overall efficiency of 80% delivers 1850 liters of water per minute to a height 0f 20 meters through a pipe of 100mm diameter and 95 meters length. Taking $f = 0.0075$, find the power required to drive the pump.

7. A centrifugal pump is to discharge 0.118m3 / sec at a speed of 1450 rpm against a head of 25m. The impeller diameter at outlet is 250mm and its width at outlet is 50mm and manometric efficiency is 75%. Determine vane angle at outer periphery of the impeller

8. Explain about Reciprocating pump with neat sketch.