

FLUID MECHANICS & HYDRAULIC MACHINERY

(Electrical & Electronics Engineering)

Time: 3 hours

Max. Marks: 70

PART – A

(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- Define and distinguish between surface tension and capillarity.
 - Name different forces acting on a fluid element in static equilibrium.
 - Define convective and local acceleration.
 - What are different forms of energy in a fluid?
 - Define coefficient of contraction.
 - Depict the theoretical variation of hydraulic efficiency of a Pelton wheel w.r.t bucket to jet speed ratio.
 - What is the function of spiral casing in reaction turbine?
 - Define specific speed of a pump.
 - State the factors limiting the suction head of a pump.
 - How the runoff is measured and what is its unit?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

- 2 (a) Distinguish between Newtonian and non-Newtonian fluids with the help of shear stress and velocity gradient plot
- (b) Two square flat plates of size 50 cm X 50 cm are spaced 12 mm apart and the space between the two is filled with oil of specific gravity 0.95. The lower plate is stationary and on the upper plate a force of 100 N is applied to move it with a velocity of 2.5 m/s. Assuming linear velocity distribution in the oil film determine the dynamic viscosity and kinematic viscosity of the oil.

OR

- 3 (a) Define Path Line, Streak line and stream line. For what type of flow these lines are identical.
- (b) Verify whether the following motions are kinematically possible for an incompressible fluid or not?
- $u = x^2 + y^2; v = x^2 + 2xy.$
 - $u = \frac{-ax}{y}; v = a \log xy$ where a is a numerical constant.

UNIT – II

- 4 (a) Derive Bernoulli's equation for steady flow incompressible fluid flowing through a non-uniform pipe
- (b) Determine the discharge of water flowing through a vertical pipe 30 cm in diameter where a venture meter is inserted having a throat diameter of 15 cm. The difference of pressure between the main and the throat measured by a liquid of specific gravity 0.7 in an inverted U-tube gives a reading of 30 cm. The loss of head between the main and the throat is 0.2 times the kinetic head of the pipe. Consider the flow in upward direction.

OR

- 5 (a) What are minor losses? Under what circumstances they are negligible.
- (b) A pipe line of 40 m length is connected to a water tank at one end and discharges freely in to atmosphere at the other end. The first 25 m length of the pipe is of 15 cm diameter and then it is suddenly enlarged to 30 cm. The height of water in the tank is 8 m above the center of the pipe. Determine the flow rate through the pipe considering all head losses. Use $4f = 0.04$ in Darcy formula.

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UNIT – III

- 6 (a) Show that Maximum efficiency attainable is 50% when a jet impinges on series of flat plates mounted on a wheel.
(b) A jet of water 4 cm in diameter with 20 m/s velocity impinges on series of vanes mounted on a wheel moving with a velocity of 5 m/s. Find the force acting on the vanes and the jet efficiency.

OR

- 7 (a) Distinguish between impulse and Reaction turbines with regard to their operation and application.
(b) A Pelton wheel working under a head of 300 m develops a power of 5 MW. The speed of the wheel is 500 rpm. The overall efficiency is 87%. Assuming the speed ratio 0.46 determine the:
(i) Wheel diameter. (ii) The discharge through the Pelton wheel.

UNIT – IV

- 8 (a) Differentiate between inward and outward flow turbines.
(b) A reaction turbine rotates at a speed of 500 rpm. Its inlet pipe diameter is 108 cm and the flow area is 0.4 m^2 . The angles made by absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Determine the: (i) Volume flow rate. (ii) Power developed. Assume whirl velocity at outlet is zero.

OR

- 9 (a) How do you classify centrifugal pumps? Explain working of any one type with a neat sketch.
(b) A multi stage centrifugal pump operating at a speed of 1200 rpm is used to lift water through a head of 100 m at the rate of $0.121 \text{ m}^3/\text{s}$. The specific speed of each impeller is 30. Assuming overall efficiency of the pump 80%, determine: (i) The head developed per stage. (ii) Number of stages required. (iii) The power required to run the pump.

UNIT – V

- 10 (a) What do you understand by a pump storage plant? What are the advantages and limitations of this type of plant?
(b) What is a penstock? What are the advantages and disadvantages of exposed penstock over buried penstock

OR

- 11 (a) Define: (i) Load factor. (ii) Power factor. (iii) Capacity factor. (iv) Diversity factor.
(b) Explain the construction of flow duration curve and discuss its significance
