

**FLUID MACHINERY
(MECH 2201)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) A fast centrifugal pump impeller will have
 - (a) forward facing blades
 - (b) backward facing blades
 - (c) radial blades
 - (d) propeller type blades.
 - (ii) Head developed by a centrifugal pump is
 - (a) proportional to N only
 - (b) proportional to N and D both
 - (c) proportional to D only
 - (d) proportional to N² and D² both.
 - (iii) The hydraulic efficiency of a centrifugal pump takes into account the losses in
 - (a) pump impeller
 - (b) bearings and windage
 - (c) pipes
 - (d) all of the above.
 - (iv) Shut-off head of a pump is the head developed at
 - (a) zero impeller speed
 - (b) zero input power
 - (c) zero discharge
 - (d) maximum efficiency.
 - (v) Pelton turbine is a
 - (a) impulse turbine
 - (b) reaction turbine
 - (c) may either impulse or reaction turbine
 - (d) radial flow turbine.
 - (vi) For operating characteristics of centrifugal pump, the parameter that is kept constant, is
 - (a) speed
 - (b) discharge
 - (c) head
 - (d) power.
 - (vii) Which of the following statement is incorrect for a Kaplan turbine?
 - (a) It has blades of small chamber to avoid separation
 - (b) It has adjustable blades
 - (c) It has large guide blade angles than of a Francis turbine
 - (d) It has mixed flow velocity.

- (viii) Efficiency of Pelton wheel shall be maximum, if the ratio of jet velocity to tangential velocity of the wheel is
(a) 0.5 (b) 1 (c) 2 (d) 0.75.
- (ix) NPSH is the abbreviation of
(a) Net Pressure and Suction Head (b) Nominal Positive Suction Head
(c) Net Positive Suction Head (d) Net Positive Static Head
- (x) An air vessel at the delivery side of a reciprocating pump
(a) maintains steady discharge output
(b) prevents cavitation in the system
(c) enables suction head to be increased
(d) enables the pump to run at higher speed.

Group- B

2. (a) Define Fluid Machine. Obtain an expression of work done by impeller of a centrifugal pump on water per unit time per unit weight of water.
(b) Compare radial, axial and mixed flow pump based on head developed and discharge. Explain why backward curved vane is preferred over forward curved vane in case of centrifugal pump impeller.

6 + (3 + 3) = 12

3. (a) A centrifugal pump is to discharge $0.118 \text{ m}^3/\text{s}$ at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, its width at the outlet is 50 mm and manometric efficiency is 75%. Determine the blade angle at the outer periphery of the impeller.
(b) Differentiate between Impulse and Reaction turbine.

7 + 5 = 12

Group - C

4. (a) Write a short note on Draft Tube.
(b) A reaction turbine works at 450 rpm under a head of 120 m. Its diameter at the inlet is 1.2 m and the flow area is 0.4 m^2 . The angles made by the absolute and relative velocities at the inlet are 20° and 60° , respectively with the tangential velocity. If whirl at the outlet is zero, then determine (i) the volume flow rate, and (ii) power developed.

6 + 6 = 12

5. (a) With a neat sketch explain the working procedure and construction of Pelton turbine.
(b) A conical draft-tube of 2 m diameter at the top and pressure head 7 m of water (vacuum), discharges water from the outlet at the rate of $25 \text{ m}^3/\text{s}$ with a velocity of 1.2 m/s. If atmospheric pressure head is 10.3 m of water and losses between the inlet and outlet of the draft tube are negligible, find the length of the draft-tube immersed in water. Total length of the draft-tube is 5 m.

6 + 6 = 12

Group - D

6. (a) Explain the cavitation phenomenon in a centrifugal pump. State any two methods to prevent cavitation in centrifugal pump.
(b) Draw the operating characteristics (H - Q , P_{in} - Q , η - Q) of a centrifugal pump. Show the system resistance curve in the same diagram and locate the operating point and design point.

6 + 6 = 12

7. (a) With neat sketches, explain the characteristic curves of two dissimilar centrifugal pumps operated (i) in series and (ii) in parallel. Also, state the conditions for which two centrifugal pumps will be operated in series or in parallel.
(b) Two homologous pumps **A** and **B** are to run at the same speed of 600 rpm. Pump **A** has an impeller of 50 cm diameter and discharges $0.4 \text{ m}^3/\text{s}$ of water under a net head of 50 m. Determine the diameter of impeller of pump **B** and its net head, if it is to discharge $0.3 \text{ m}^3/\text{s}$ of water.

6 + 6 = 12

Group - E

8. (a) Explain the working principle of a single acting reciprocating pump.
(b) Draw the schematic diagram of a double-acting reciprocating pump and show all important components.
9. (a) Compare reciprocating pump and centrifugal pump.
(b) A reciprocating pump has a suction head of 6 m and delivery head of 15 m. it has a bore of 150 mm and stroke of 250 mm and piston makes 60 double stroke in a minute. Calculate the force required to move the piston during the (i) suction stroke, (ii) delivery stroke. Find also the power to drive the pump.

6 + 6 = 12

4 + 8 = 12

