

3 hours

80 Marks

N. B.:

1. Question no. 1 is compulsory
2. Attempt any **THREE Questions** from remaining **FIVE** questions.
3. Use illustrative diagrams wherever required.

- Q1)** Attempt any **FOUR** questions. **05**
- a) Explain advantages of fitting an air vessel to reciprocating pump. **05**
 - b) Explain how NPSH (Net Positive Suction Head) affects the working of centrifugal pump. **05**
 - c) List any five losses occurs in air compressors. **05**
 - d) A single acting reciprocating pump, running at 50 rpm delivers $0.00736 \text{ m}^3/\text{sec}$. of water. The diameter of piston is 200 mm and stroke length are 300 mm. The suction and delivery heads are 3.5 m and 11.5 m respectively. Determine the theoretical discharge and coefficient of discharge. **05**
 - e) Justify the statement. "Pressure ratio achieved per stage in axial flow compressor is much less than that of centrifugal compressor". **05**
- Q2)** a) Explain the construction and working of a centrifugal pump with neat sketch. **10**
- b) Draw indicator diagram for a reciprocating pump. Prove that work done by the pump is proportional to the area of indicator diagram. **10**
- Q3)** a) A centrifugal pump impeller runs at 80 rpm and has outlet vane angle of 60° . The velocity of flow is 2.5 m/sec throughout and diameter of impeller at exit is twice that at inlet. If the manometric head is 20 m and manometric efficiency is 75%. Determine, (i) diameter of the impeller at exit (ii) inlet vane angle. **10**
- b) The diameter and stroke length of single acting reciprocating pump are 75mm and 150mm respectively. It takes its supply of water from a sump 3m below the pump through a pipe 5m long and 40 mm in diameter. It delivers water to a tank 12m above the pump through a pipe 30mm in diameter and 15m long. If separation occurs 75 kN/m^2 below the atmospheric pressure. Find the maximum speed at which pump may be operated without separation. Assume value of atmospheric head as 10.3 m of water. **10**
- Q4)** a) Differentiate between fans, blowers and compressors considering efficiency, specific ratio, pressure rise, constructional features and applications. **10**
- b) Explain the working of an air compressor with enthalpy-entropy diagram. **10**

- Q5)** Write stepwise design procedure for selection and optimization of blowers. **10**
- a) **10**
- b) The volume flow rate through an axial-flow fan fitted with inlet guide vanes is $2.5\text{m}^3/\text{s}$ and the rotational speed of the rotor is 2604 rpm. The rotor blade tip radius is 23 cm and the root radius are 10 cm. Given that the stage static pressure increase is 325 Pa and the blade element efficiency is 0.80, determine
- the angle of the flow leaving the guide vanes at the tip, mean and root radius.
 - A diffuser is fitted at exit to the fan with an area ratio of 2.5 and an effectiveness of 0.82. Determine the overall increase in static pressure and the air velocity at diffuser exit.
- Q6)** a) A centrifugal compressor handles 528 kg/min of air. The ambient conditions are 1 bar and 20°C . The compressor runs at 20000 rpm with isentropic efficiency of 80%. The air is compressed from 1 bar static pressure to 4 bar total pressure. The air enters the impeller with velocity of 145 m/sec with no pre-whirl. Assuming slip factor as 0.9, Determine- **10**
- Rise in total temperature
 - Tip diameter of impeller
 - Power required
- b) Explain the role of performance curves in the design and analysis of centrifugal compressors? **10**
