

Time: 3 hour

Max. Marks: 80

**Instructions:**

- **Question No.1 is compulsory.**
- Solve **ANY THREE** questions from the **remaining** five questions.
- Figure to the right indicates full marks.
- Assume suitable data wherever required, but justify the same.
- Use of steam table is permitted.

- Q.1** Solve **ANY FOUR** questions from following. (Each question carries 5 marks). **Marks (20)**
- Differentiate Fire tube boiler and Water tube boiler.
  - Explain construction and working of open cycle gas turbine power plant.
  - Explain the construction and working double acting reciprocating pump with neat sketch.
  - Illustrate significance of multistage compression in reciprocating air compressor with the help of P-V Diagram.
  - Define i) Suction head ii) Delivery head iii) Static head iv) Manometric head related to centrifugal pump with neat sketch.
- Q.2**
- In a Parson reaction turbine, the angles of receiving tips are  $35^\circ$  and of discharging tips  $20^\circ$ . The blade speed is 100 m/s. Calculate the tangential force, power developed, diagram efficiency, and axial thrust of the turbine, if its steam consumption is 1 kg/min. **(10)**
  - Explain the construction and working of Economizer. **(05)**
  - Derive the forms of Euler's equation applicable to all turbo machines. **(05)**
- Q.3**
- The following data refers to a gas turbine plant: **(10)**  
 Power developed = 5 MW  
 Inlet pressure and temperature of air to compressor = 1 bar and  $30^\circ\text{C}$   
 Pressure ratio of the cycle = 5  
 Isentropic efficiency of the compressor = 80%  
 Isentropic efficiency of turbines = 85%  
 Maximum temperature in the turbines =  $550^\circ\text{C}$   
 Take for air,  $C_p = 1.0 \text{ kJ/kgK}$ ,  $\gamma = 1.4$  and  
 for gases,  $C_p = 1.15 \text{ kJ/kgK}$ ,  $\gamma = 1.33$ .  
 If a reheater is used between two turbines at a pressure of 2.24 bar, calculate the following:  
 (a) Mass flow rate of air,  
 (b) The overall efficiency,  
 Neglect the mass of fuel.
  - Explain construction and working of Pelton wheel turbine. **(05)**
  - Explain construction and working of Turboprop engine with neat sketch. **(05)**

**Q.4**

- a** A steam generator evaporates 18000 kg/hrs. of steam at 12.5 bar and a quality of 0.97 dry from feed water at 105°C, when coal is fired at 2040 kg/hrs. If the higher calorific value of coal is 27400 kJ/kg, find the followings: **(10)**  
(a) Heat rate of the boiler in kJ/hrs.  
(b) Equivalent evaporation and  
(c) Thermal efficiency.
- b** Differentiate between boiler mounting and boiler accessories. **(05)**
- c** What is cavitation in hydraulic pump? Explain its effects on performance. **(05)**

**Q.5**

- a** A centrifugal pump has an impeller 0.5 m outer diameter and when running at 600 r.p.m. discharges water at the rate of 8000 liters/minute against a head of 8.5 m. The water enters the impeller without whirl and shock. The inner diameter is 0.25 m, and the vanes are set back at outlet at an angle of 45° and the area of flow which is constant from inlet to outlet of the impeller is 0.06 m<sup>2</sup>. Determine (a) the manometric efficiency of the pump, and (b) the vane angle at inlet. **(10)**
- b** What is surging and choking phenomenon in Centrifugal compressor **(05)**
- c** Explain the construction and working of Once through boiler with neat sketch. **(05)**

**Q.6**

- a** A single-acting, single-cylinder reciprocating air compressor is compressing 20 kg/min of air from 1.1 bar and 30°C to 6 bar and delivers it to a receiver. The law of compression is  $PV^{1.25} = \text{Constant}$ . Find the actual power input to compressor if mechanical efficiency is 85%. Neglecting losses due to clearance, leakages and cooling. **(10)**
- b** Explain velocity compounding in impulse turbine with neat sketch. **(05)**
- c** What is priming? Why is it necessary? **(05)**

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