(3 Hours) [Total Marks: 80

NOTE:

- Question No 1 is **COMPULSORY**.
- Attempt any **THREE** questions from question number 2 to 6.
- Assume suitable data wherever required.
- Illustrate answers with sketches wherever required.
- Use of steam table is permitted.

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1. Solve the following **(any Five)** **20**
   (a) Differentiate closed and open cycle gas turbine based on working fluid, efficiency, size of plant and control.
   (b) Differentiate between mounting and accessories with example.
   (c) Differentiate between fire tube and water tube boiler.
   (d) Explain working principle of any one mounting with sketch.
   (e) Define for turbojet engine: Propulsive power and propulsive efficiency.
   (f) State the factors on which nozzle efficiency depends.

2. (a) Write the difference between Francis and Kaplan turbine. **6**
   (b) State impulse momentum principle. **2**
   (c) A steam generator evaporates 18000 kg/hr 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/hr. If the high calorific value of coal is 27400 kJ/kg. Find: (i) amount of heat supplied in boiler (ii) Equivalent evaporation (iii) thermal efficiency. **12**

3. (a) Explain performance characteristics of water turbines with sketch. **8**
   (b) Following data refers to a stage in a reaction turbine: **12**
   Mean blade ring diameter = 1 m, Turbine speed = 3000 rpm, degree of reaction = 50%, exit and inlet angles = 30° & 50°, Steam flow rate = 10000 kg/hr, stage efficiency = 85%. Determine (i) power output of the stage (ii) specific enthalpy drop in kJ/kg (iii) percentage increase in relative velocity of steam over moving blades.

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4. (a) Derive an equation for discharge though an isentropic nozzle. **8**

   (b) Air enters the compressor of a gas turbine plant operating on air standard cycle at 100 kPa & 300 K with volumetric flow rate 5 m^3/s. The compressor pressure ratio is 10. The turbine inlet temperature is 1400 K. The turbine and compressor each has an isentropic efficiency of 80%. Calculate (a) thermal efficiency of cycle. (b) Back work ratio (c) net power developed in kW. **12**

5. (a) An inward flow turbine (reaction type with radial discharge) with an overall efficiency of 80% is required to develop 150 kW. The head is 8 m, peripheral velocity of the wheel is $0.96\sqrt{2gH}$. The radial velocity of flow is $0.36\sqrt{2gH}$. The wheel is to make 150 rpm. The hydraulic losses in the turbine are 22% of the available energy. Determine: (a) angle of the guide blade at inlet (b) wheel vane angle at inlet (c) diameter of the wheel (d) width of the wheel at inlet. **12**

   (b) Define unit speed, unit discharge, unit power & specific speed. Write their equations also. **8**

6. (a) Write the detailed classification of jet propulsion engine. **4**

   (b) Explain construction and working of Velox boiler. **7**

   (c) Why are the steam turbines compounded? Explain. **4**

   (d) 2.5 cm diameter jet of water strikes a symmetrical vane tangentially at one end and leaves at the other end. After impingement, the jet gets deflected through 160° by the vane. Calculate the thrust exerted by the jet on the vane if the discharge is 0.0736 m^3/s. Assume vane to be smooth. **5**
