

(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.



- Q.1 Attempt any **FIVE** of the following: 20
- Differentiate between the high pressure & low pressure boilers with examples.
 - Write the classification of the water turbines with example.
 - Explain the principle of working of an impulse turbine.
 - Write the classification of the rockets.
 - Write applications of the gas turbine.
 - Define specific speed and unit speed.
- Q.2 (a) A boiler generates steam at the rate of 6000 kg/hr at a pressure of 800 kPa with a dryness fraction of 0.98. The feed water is supplied at 40 °C. If the efficiency of the boiler is 75%, Calculate the rate of coal consumption, which has a calorific value of 31000 kJ/kg. What is equivalent evaporation from this boiler? 8
- If the superheater is used with the boiler and temperature of the superheated stream reaches 250°C, then (i) what is the equivalent evaporation from the boiler & (ii) What is the thermal efficiency of the boiler? Take C_p of superheated steam as 2.27 kJ/kg K.
- The velocity of steam exiting the nozzle of the impulse stage of a turbine is 400 m/s. The blades operate close to the maximum blade efficiency. The nozzle angle is 20°. Considering equiangular blades and neglecting blade friction, calculate for a steam flow of 0.6 kg/s, the diagram power and the diagram efficiency. 8
 - Differentiate between jet engine and rocket engine. 4

TURN OVER

(2)

- Q. 3 (a) Air enters the compressor of a gas turbine 1 bar and 300 K and compressed to 10 bar. The temperature at the inlet to the first turbine is 1400 K. The expansion takes place isentropically in two stages with reheat to 1400 K between the two stages at a constant pressure of 300 kPa. A regenerator having an effectiveness of 100% is also incorporated in the cycle. Determine the thermal efficiency of the cycle. Take for air $C_p = 1.005 \text{ kJ/kgK}$ and $\gamma = 1$. 8
- (b) Explain with the help of neat diagram – Benson Boiler. 8
- (c) Prove that net efficiency of a simple impulse turbine is given by 4
- $$\eta_{\text{net}} = \eta_{\text{stage}} \times \eta_{\text{Nozzle}} \times \eta_{\text{mech}}$$
- Q. 4 (a) Explain velocity compounded impulse steam turbine showing pressure and velocity variations along the axis of the turbine. 8
- (b) In a hydroelectric generation plant, there are four similar turbines of total output 220 MW. Each turbine is 90% efficient and runs at 100 rpm under a head of 65m. It is proposed to test the model of the above turbines in a flume where discharge is 400 litres /s under a head of 4m. Work out the size (scale ratio) of the model. Also calculate the model speed and power results expected from the model. 8
- (c) Explain the working principle of turbo jet engine. Write its applications also. 4
- Q. 5 (a) Write the merits and demerits of closed cycle gas turbine over open cycle gas turbine. 4
- (b) What are the different methods for improving thermal efficiency of open cycle gas turbine plant? Explain one method with the help of schematic and TS diagram. 8
- (c) What is meant by cavitation? On what factors does the cavitation in water turbine depend? 8
- Q. 6 (a) The following data pertain to an inward flow reaction turbine: 12
 Net head=60m, speed = 650 rpm, Brake power = 275 kW, Ratio of wheel width to wheel diameter at inlet = 0.10, ratio of inner diameter to outer diameter = 0.5, flow ratio $K_f = 0.17$, $\eta_h = 0.95$ and $\eta_o = 0.85$. The flow velocity remains constant and the discharge is radial. Neglecting area blockage by blades, work out the main dimensions and blade angles of the turbine.
- (b) What is draft tube and what are its functions? 4
- (c) Define boiler mounting and accessories. 4