(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**

a) Differentiate between the high pressure & low pressure boilers with examples.
b) Write the classification of the water turbines with example.
c) Explain the principle of working of an impulse turbine.
d) Write the classification of the rockets.
e) Write applications of the gas turbine.
f) 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 ^{0}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^{0}C, then (i) what is the equivalent evaporation from the boiler & (ii) What is the thermal efficiency of the boiler? Take Cp of superheated steam as 2.27 kJ/kg K.

(b) 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 20^0. 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**

(c) Differentiate between jet engine and rocket engine. **4**

TURN OVER

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 Cp =1.005 kJ/kgK and γ =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**

$\eta_{net} = \eta_{stage} \times \eta_{Nozzle} \times \eta_{mech}$

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, η_h=0.95 and η_0=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**
