Con. 8884–13. **GS–7077**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume **suitable** data wherever **required**.
(4) Illustrate answer with **sketches** wherever **required**.
(5) Use of **steam table** and **Mollier** chart is **permitted**.

1. Solve the following **(any FOUR)** **20**
   (a) Differentiate between high and low pressure boiler.
   (b) Differentiate between Impulse and reaction turbine.
   (c) Define enthalpy of combustion and Enthalpy of formation.
   (d) Explain Multistaging of reciprocating air compressor.
   (e) Write the applications of gas turbine.
   (f) Explain effect of air leakage on the performance of condenser.

2. (a) Differentiate between fire tube and water tube boiler. **08**
   (b) A double acting, single stage reciprocating air compressor has a bore of 330 mm, stroke of 350 mm, clearance of 5 % and runs at 300 rpm. It receives air at 95 kPa and 25°C. The delivery pr is 4.5 bar and index of compression is 1.25. The free air conditions are 1.013 bar and 20°C. Determine (a) FAD (b) Heat rejected during the compression (c) Power input to the compressor, if η_{mech} = 80%. **12**

3. (a) An unknown hydrocarbon is burnt with dry air. The volumetric analysis of products on a dry basis is 12.5% CO_2, 0.5%CO, 3%O_2 & 84%N_2. Determine (a) air-fuel ratio (b) percentage of excess air used. **10**
   (b) Define free air delivered and volumetric efficiency. Discuss the effect of clearance volume and pressure ratio on these. **06**
   (c) What is perfect intercooling? What is the condition for the same? **04**

4. (a) The following observations were taken during test on a steam boiler; **12**
   Pressure of steam = 9.8 bar; Temperature of steam leaving the superheater = 250 °C.
   Feed water temperature entering the economiser = 25°C
   Feed water temperature leaving the economiser = 80°C
   Dryness fraction of the steam entering the superheater = 0.95
   CV of coal = 30,000 kJ/kg; Quantity of coal burnt per hour = 750 kg.
   Quantity of steam generated per hour = 7000 kg; Determine thermal efficiency of the plant and percentage heat utilised in economiser, boiler and superheater.
   (b) Explain Adiabatic flame temperature and Stoichiometric air fuel ratio. Explain importance of adiabatic flame temperature in combustion. **08**

5. (a) Prove that maximum blade efficiency is given by $(\eta_b)_{max} = \frac{2\cos^2\alpha}{1+\cos^2\alpha}$ in case of 50% reaction turbine. **12**
   (b) Explain regenerative type open cycle gas turbine. **08**

6. (a) In a gas turbine power plant, air is compressed from 1 bar and 15 °C through a pressure ratio of 6. It is then heated to 727 °C in the combustion chamber and expanded back to a pressure of 1 bar. Calculate the net work done, cycle efficiency and work ratio. Assume isentropic efficiency of turbine and compressor are 90% and 85% respectively. Take Cp for gas & air = 1kJ/kgK and γ = 1.4. **12**
   (b) Differentiate between surface condenser and jet condenser. **08**

7. Write short notes on any **FOUR**: **20**
   (a) Boiler mountings and accessories.
   (b) Two pass down flow surface condenser.
   (c) Classification of steam turbine.
   (d) Lamont boiler.
   (e) Ramsbottom safety valve.
   (f) Different calorific values of fuel.