Dr Debasish Das 5/12/2022 (115)

National Institute of Technology, Hamirpur (HP)

Name of the Examination: B.Tech End Semester

Branch: Mechanical Engineering Semester: 5th

Title of the course: Thermal Power Engineering-I. Course Code: ME-313

Time: 3 Hours Maximum Marks: 50

Note: Answer all the question & Consider suitable Values if required. Steam table is allowed.

Q1. Write short notes of the following: (5X2 = 10)

(a) Mach Number (b) Back Pressure (c) Coefficient of skin friction

(d) Turbine efficiency (e) Carnot cycle

Q2. Determine height and diameter of chimney to produce static draught of 18 mm of water column if mean flue gas temperature and flow rate are 300°C and 2100 kg/min respectively, the atmospheric air temperature is 25°C. The gas constant for air is 287 KJ/Kg K. Assume no loss of draught in chimney and barometer reading is 760 mm of mercury. (6)

Q3. A boiler is provided with a chimney of 26 m height. The boiler house temperature is 30°C and temperature of flue gases leaving chimney is 300°C. If air supplied to the boiler is 20 kg/kg of fuel. Estimate: (i) Draught in mm of water. (ii) Velocity of gases passing through chimney with 50% loss of draught in chimney. (6)

Q4. What do you mean by Chocking of nozzle? What are the disadvantages of Super Saturated Flow through Nozzles? (3+3=6)

Q5. The net power output of a regenerative-reheat cycle power plant is 80MW. Steam enters the high pressure turbine at 80 bar, 500°C and expands to a pressure P_2 and emerges as dry vapour. Some of the steam goes to an open feed water heater and the balance is reheated at 400°C at constant pressure P_2 and then expanded in the low pressure turbine to 0.05 bar. Determine (i) the reheat pressure P_2, (ii) the mass of bled steam per kg boiler steam, (iii) the steam flow rate in HP turbine, (iv) cycle η. Neglect pump work. Sketch the relevant lines on h-s diagram. Assume expansion in the turbines as isentropic. (8)

Q6. Consider a 210-MW steam power plant that operates on a simple ideal Rankine cycle. Steam enters the turbine at 10 MPa and 500°C and is cooled in the condenser at a pressure of 10kPa. Show the cycle on a T-s diagram with respect to saturation lines, and determine (a) the quality of the steam at the turbine exit, (b) the thermal efficiency of the cycle, and (c) the mass flow rate of the steam. (8)

Q7. An Aero-plane travels in air of pressure of 1 bar at 10 degree Celsius at a speed of 1800 km/hr. Find the Mach number and Mach angle. Take $\gamma = 1.4$ and $R = 287$ J/KgK. (6)