Ref. No.: Ex/PE/PE/B/T/323A/2023

B.E. Power Engineering, 3rd Year, 2nd Semester Examination, 2023

Thermal Power Plant System

Time: Three Hours **Full Marks: 100**

Answer any five (5) questions

CO1 1. a) What do you mean by BOP and BTG systems in steam power plants? What are the major components of this system? Briefly explain the function of each system.

b) Why equipment layout of a thermal power plant is critical during the initial design?

c) What do you mean by SCAPH in a flue gas system? Explain the function of SCAPH.

d) Why Deaerator is located at a higher elevation?

e) What are the LDO and HFO? When they are utilized in a steam generator and how?

f) Draw a schematic sectional view of a boiler and its auxiliaries and briefly explain the function of each component.

Marks: 3 + 3 + 2 + 2 + 2 + 8 = 20

CO2 2. a) Why regenerative feed heating of steam power plants is preferred? Explain the reasons.

b) What are the demerits of regenerative feed heating in the vapor power cycle?

c) In a cogeneration plant, the power load is 5.6 MW and the heating load is 1.163 MW. Steam is generated at 40 bar and 500 °C and is expanded isentropically through a turbine to a condenser at 0.06 bar. The heating load is supplied by extracting steam from the turbine at 2 bar, which is condensed in the process heater to saturated liquid at 2 bar and then pumped back to the boiler. Compute (a) the steam generation capacity of the boiler in t/h, (b) the heat input to the boiler in kW, (c) the fuel burning rate of the boiler in t/h if coal of calorific value 25 MJ/kg is burned and the boiler efficiency is 88%, (d) the heat rejected to the condenser, (e) the rate of flow of cooling water in the condenser if the temperature rise of water is 6°C. Neglect pump work.

Marks: 3 + 2 + 15 = 20

CO2 3. a) Write down the principle of operation and function of the Deaerator in a steam power plant.

b) Briefly describe about the practical high-pressure heater operation from the perspective of terminal temperature difference (TTD).

c) In A boiler feeds a turbine at 56 bar and 600°C. Before being passed on to the condenser at 30°C, the steam is bled for regenerative feed heating at 6.5 bar. For an ideal regenerative cycle and 1kg/s of throttle steam, determine (a) the amount of bled steam, (b) net work done, and (c) the ideal efficiency of the cycle.

Marks: 2 + 3 + 15 = 20

CO3 4. a) What is NRV? What is the function of NRV in a steam extraction line?

b) Briefly describe about the turbine lube oil system.

c) What are the functions of the HP-LP bypass system? Explain with the schematic diagram.

d) A textile factory requires 10 t/h of steam for process heating at 3 bar saturated and 1000 kW of power, for which a back pressure turbine of 70% internal efficiency is to be used. Find the steam condition required at the inlet of the turbine.

Marks: 2 + 3 + 5 + 10 = 20

CO4 5. a) Briefly describe about the generator hydrogen cooling system.

b) What are the different types of water used in a conventional steam power plant? Briefly describe.

c) What are the elements of the steam condensing plant (with a schematic diagram)? Briefly describe the function of each element.

d) A vacuum of 67 cm of Hg was obtained with a barometer reading of 75 cm of Hg. The condensate temperature is 20°C. Correct the vacuum to a standard barometer of 76 cm and hence determine the partial pressure of air and steam. Also, find the mass of air present with 1 kg of steam.

Marks: 3+ 4 + 5 + 8 = 20

CO4 6. a) Briefly describe about the pulverized fuel firing system in a steam power plant. What are the advantages of pulverized fuel firing system?

b) Briefly describe about the dry ash handling system in a steam power plant (with a schematic diagram).

c) A 200 kW steam engine has a steam consumption of 10 kg/kWh. The back pressure of the engine is equal to the condenser pressure of 0.15 bar. The condensate temperature is 32°C. The cooling water temperature at the inlet and outlet are 20°C and 30°C, respectively. Calculate the mass of cooling water required per hour if the exhaust steam is dry-saturated.

Marks: 6 + 6 + 8 = 20