B.E. Power Engineering, 3rd Year, 2nd Semester Examination, 2022

Thermal Power Plant System

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

Answer question no. 1 and any four (4) from the rest

1. Answer the following questions briefly (**any ten**)
   a) Why air cooler section is provided in a condenser?
   b) What are the advantages of pulverized fuel firing system?
   c) Briefly describe about the function of the auxiliary steam system?
   d) Do you prefer regenerative feed heating of a steam power plant? Explain the reasons.
   e) Briefly describe about the turbine lube oil system?
   f) What is particle migration velocity? What are the factors affecting the migration velocity?
   g) What is the function of a classifier in a coal mill?
   h) Briefly describe about the different processes for the production of demineralised water.
   i) What are the basic features of natural draught cooling towers (NDCT)?
   j) What do you mean by SCAPH in a flue gas system?
   k) What is function of flue gas desulphurization (FGD) unit a modern power plant?

   Marks: 10 × 2 = 20

2. a) What is the difference between the open and closed feedwater heaters? Write down the principle of operation and function of the Deaerator.
   b) In a single heater generative cycle, the steam enters the turbine at 30 bar at 400°C and the exhaust pressure is 0.10 bar. The feedwater heater is a direct contact type which operates at 5 bar. Find (a) the efficiency and the steam rate of the cycle, (b) the increase in mean temperature of heat addition, efficiency and steam rate, as compared to the Rankine cycle (without regeneration). Neglect the work done by the pump.

   Marks: 5 + 15 = 20

3. a) What are the functions of different types of safety valves in a steam boiler? Explain with schematic diagram.
   b) A regenerative steam power cycles operate between 20 bar of 300°C and 0.01 bar. Two feed water heaters are used to extract the steam at 5 bar and 1 bar, respectively. Determine (a) the quality of steam at turbine outlet, (b) mass of bled steam from each heater per kg of steam entering to the turbine, (c) net work done, (d) Cycle efficiency and (e) specific steam consumption. Assume all the processes are ideal and neglect the work done by pump.

   Marks: 5 + 15 = 20

P.T.O

4. Answer the following questions
   a) What is NRV? What is the function of NRV in a steam extraction line?
   b) Briefly describe about the practical high-pressure heater operation from the perspective of terminal temperature difference (TTD).
   c) What are the parameters for specifying a cooling tower? Briefly describe all the terms.
   d) Write down about the ash evacuation systems in a modern power plant.
   e) What are the probable reasons for the reduction in condenser vacuum? What are the probable causes for high levels in condensers?

   Marks: 5 × 4 = 20

5. a) What are the functions of the HP-LP bypass system? Explain with the schematic diagram.
   b) 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 turbine to a condenser at 0.06 bar. The heating load is supplied by extracting steam from the turbine at 2 bar, which 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; (b) the heat input to the boiler; (c) the fuel burning rate of the boiler if a coal of calorific value 25 MJ/kg is burned and the boiler efficiency is 88%; (d) the heat rejected to the condenser and (e) the rate of flow of cooling water in the condenser if the temperature rise of water is 6°C. Neglect pump work.

   Marks: 5 + 15 = 20

6. a) What are the methods for steam turbine governing? Explain with schematic diagram.
   b) A surface condenser receives 200 t/h of steam at 40 °C with 10 % moisture. The cooling water enters at 33 °C and leaves at 38 °C. The pressure inside the condenser is found to be 0.078 bar. Neglecting any subcooling, determine (a) the condenser cooling water flow in kg/s, (b) air ejector capacity in kg/s, and (c) the surface area of the condenser. Take U_0 = 2970 W/m^2 K.

   Marks: 5 + 15 = 20