

B.E. Power Engineering, 3rd Year, 2nd Semester Examination, 2025

Thermal Power Plant Systems

Time: Three Hours

Full Marks: 100

Group A: CO1 (15 Marks)

1. Answer the following questions briefly (any three questions)
 - a) Describe the general layout of a thermal power plant and explain the functions of its main components. Provide a brief explanation of the underlying principles used in developing such a layout, and support your description with a schematic diagram
 - b) Define BTG and BOP systems in a thermal power plant. Explain the interrelationship between BTG and BOP systems.
 - c) What role does a deaerator play in a thermal power plant? Additionally, explain why it is typically installed at an elevated position, and discuss the engineering reasoning behind this placement.
 - d) Explain the importance of flue gas path layout in a thermal power plant. Support your description with a schematic diagram.

Marks: $3 \times 5 = 15$

Group B: CO2 (30 Marks)

2. Answer the following questions briefly (any four questions)
 - a) Using a schematic diagram, explain the function and working of a Pulverized Fuel (PF) system?
 - b) Explain the fundamental working principle of an Electrostatic Precipitator (ESP), including a schematic representation. Also, discuss the key factors that influence its operational efficiency.
 - c) What makes the reheat regenerative feedwater heating system a preferred choice in modern steam power plants? Describe its impact on the thermodynamic cycle's performance, using a temperature-entropy (T-S) diagram for illustration.
 - d) Using a schematic diagram describe the air and flue gas system in a thermal power plant.
 - e) Explain the function of superheaters and reheaters in steam systems. Support your description with T-S diagram.
3. In a Rankine cycle, steam inlet to the turbine is (a) dry saturated steam at 10 bar, (b) superheated steam 200°C of 10 bar. The steam is exhausted from the turbine at 0.5 bar. In each of the above case calculate (i) condition of steam after adiabatic expansion, (ii) Rankine efficiency, (iii) specific steam consumption, (iv) heat rate..

Marks: $4 \times 4 = 16$

OR

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 feed water 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

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of heat addition, efficiency and steam rate, as compared to the Rankine cycle (without regeneration). Neglect the work done by the pump.

Marks: 14

Group C: CO3 (35 Marks)

4. Answer the following questions briefly (any four questions)
 - a) Explain the role of the condensate system in a thermal power plant. Support your description with T-S diagram.
 - b) Define the HP-LP bypass system as used in conventional utility boiler-turbine configurations. Discuss its purpose and functionality, supported by a schematic diagram.
 - c) Why is a lubrication system essential for the proper functioning of a steam turbine? Provide an overview of the turbine lubrication system along with its supporting auxiliary components.
 - d) Explain the concept of the turbine gland sealing steam system. Use a schematic to demonstrate its structure and operation.
 - e) Outline the different methods used for steam turbine governing. Include a schematic diagram to aid in explaining each method.

Marks: $4 \times 5 = 20$

5. A textile factory requires 12 t/h of steam for process heating at 3.2 bar saturated and 1050 kW of power, for which a back pressure turbine of 72% internal efficiency is to be used. Find the steam condition required at the inlet of the turbine.

OR

In 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: 15

Group D: CO4 (20 Marks)

6. Answer the following questions briefly (any four questions)
 - a) Using a schematic diagram, describe the process of demineralized (DM) water system for a thermal power plant.
 - b) Explain the operation of the ash handling system in a utility boiler, and support your explanation with a schematic diagram.
 - c) Define natural draft and mechanical draft cooling tower. Explain their advantages over other types.
 - d) Using a schematic diagram, describe the coal handling process for a steam thermal power plant.
 - e) What are the key performance characteristics of a cooling tower? What are the factors affect the cooling tower performance?

Marks: $4 \times 5 = 20$