GUJARAT TECHNOLOGICAL UNIVERSITY

BE-7 SEMESTER – OLD PAPER – S22 TO S26 – QUESTION BANK

Subject Name & Code: Power Plant Engineering - 3171910

Chapter 1: Coal Based Thermal Power Plant

Repeated Questions:

1. Layout & Major Subsystems:

- **Q.** Draw the general layout of a modern coal-based thermal power plant and label the components. **(SUMMER 2025, 3 Marks; WINTER 2024, 3 Marks - main circuits; WINTER 2023, 4 Marks; SUMMER 2022, 3 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks - Enlist major subsystems of coal based thermal power plants and draw the air and gas circuit for modern thermal power plant)**

2. Boilers & Combustion:

- **Q.** Explain the principle, construction, and working of Fluidized Bed Combustion (FBC) Boilers. **(SUMMER 2023, 3 Marks; WINTER 2023, 4 Marks; SUMMER 2025, 7 Marks - pressurized FBC; SUMMER 2026, 4 Marks - Explain the principle of fluidized bed combustion with a neat sketch)**
- **Q.** Explain the construction and working of a High-Pressure Boiler (e.g., La-Mont, Benson, Supercritical). [Diagram required – refer to the original question paper] **(SUMMER 2022, 4 Marks - La-Mont; SUMMER 2024, 7 Marks - Benson; SUMMER 2025, 4 Marks - features; WINTER 2024, 4 Marks - La-Mont & Supercritical; WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks - Draw a neat sketch of La-Mont boiler and explain its construction and working)**

3. Draught, Dust Collection & Feed Water:

- **Q.** Compare Forced Draught and Induced Draught. **(SUMMER 2023, 4 Marks; WINTER 2022, 3 Marks; SUMMER 2022, 7 Marks; SUMMER 2025, 4 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Explain the working of an Electrostatic Precipitator with a neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; WINTER 2024, 4 Marks)**
- **Q.** What is the necessity of Feed Water Treatment? List the impurities and explain one treatment method. **(SUMMER 2023, 4 Marks; SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2024, 7 Marks; SUMMER 2026, 4 Marks)**

4. Steam Nozzles & Turbines:

- **Q.** Derive the condition for maximum discharge through a nozzle (Critical Pressure Ratio). **(SUMMER 2023, 7 Marks; SUMMER 2024, 7 Marks; WINTER 2023, 7 Marks; WINTER 2024, 7 Marks)**
- **Q.** Explain with a neat sketch: Impulse Turbine vs. Reaction Turbine. [Diagram required – refer to the original question paper] **(SUMMER 2023, 3 Marks - comparison; WINTER 2022, 3 Marks - differentiate; SUMMER 2025, 3 Marks - define; SUMMER 2026, 3 Marks - Differentiate between impulse and reaction steam turbines)**

5. Cooling Tower:

- **Q.** Define: (i) approach, (ii) range, (iii) cooling efficiency of a cooling tower. **(WINTER 2022, 3 Marks; SUMMER 2026, 3 Marks)**

Other Important Questions:

1. Power Position, Site Selection & Disadvantages:

- **Q.** Explain the present power position of India. **(SUMMER 2023, 3 Marks)**
- **Q.** State the criteria for site selection of a thermal power plant. **(WINTER 2024 - part of 3 Marks question)**

- **Q.** Discuss disadvantages of Thermal Power Plant. **(WINTER 2025, 4 Marks)**

2. Coal Handling:

- **Q.** Discuss with a flow diagram the various stages in a coal handling system. [Diagram required – refer to the original question paper of W22] **(WINTER 2022, 7 Marks)**
- **Q.** List the characteristics of a good coal handling plant. **(WINTER 2024, 3 Marks)**
- **Q.** What is coal handling system? **(WINTER 2025, 3 Marks)**

3. Burners & Firing:

- **Q.** Explain the working of a cyclone burner. **(SUMMER 2023, 3 Marks)**
- **Q.** What is the function of an oil burner? **(WINTER 2025, 3 Marks)**
- **Q.** Explain the principle of pulverized coal firing system. **(SUMMER 2026, 4 Marks)**

4. Draught & Boiler Operation:

- **Q.** Give the classification of draught. **(SUMMER 2022, 3 Marks)**
- **Q.** Explain with neat sketch of Natural boiler draft. [Diagram required – refer to W25] **(WINTER 2025, 7 Marks)**
- **Q.** What is blowdown? Why is it needed? **(SUMMER 2022, 4 Marks)**
- **Q.** What is a supercritical boiler? Merits and demerits. **(WINTER 2022, 4 Marks)**

5. Steam Nozzles (Theory & Numerical):

- **Q.** Prove that the velocity of steam through a nozzle is $C_2 = 44.72 \sqrt{(h_1 - h_2)}$. **(SUMMER 2022, 7 Marks)**
- **Q.** Draw the sketch of convergent divergent type steam nozzle. [Diagram required – refer to W25] **(WINTER 2025, 4 Marks)**
- **Q.** Numerical on Steam Nozzle: Steam at 30 bar, 350°C expands to 3 bar. Find throat area, exit area, velocity, and quality. **(WINTER 2022, 7 Marks)**
- **Q.** Steam at 20 bar and 300°C expands through a convergent-divergent nozzle to 2 bar with a mass flow rate of 0.4 kg/s. The nozzle efficiency is 0.92 and initial velocity is negligible. Assuming critical pressure ratio as 0.546, determine the throat area, exit area, and exit velocity of steam. **(SUMMER 2026, 7 Marks)**

6. Steam Turbines & Condenser:

- **Q.** Explain with a neat sketch a pressure-compounded impulse turbine. **(SUMMER 2023, 3 Marks)**
- **Q.** Draw neat sketches of the profiles of steam pressure and steam velocity during velocity compounding of steam turbines. [Diagram required – refer to S26] **(SUMMER 2026, 3 Marks)**
- **Q.** Numerical on De Laval Turbine: Steam velocity 1400 m/s, nozzle angle 15°, blade velocity 450 m/s. Find blade angles, power, efficiency, etc. **(SUMMER 2023, 7 Marks)**
- **Q.** Steam leaves the nozzle of a De Laval turbine at 1000 m/s with nozzle angle 20°. The mean blade speed is 300 m/s, and blade inlet and outlet angles are equal. Mass flow rate is 800 kg/hr. Assuming blade velocity coefficient as 0.85, determine: (i) Blade angles, (ii) Relative velocity at inlet, (iii) Tangential force, (iv) Power developed, (v) Blade efficiency. **(SUMMER 2026, 7 Marks)**
- **Q.** What are the functions of a condenser? Give its classification. **(SUMMER 2023, 4 Marks)**
- **Q.** Define: (i) vacuum efficiency, (ii) condenser efficiency. **(SUMMER 2022, 3 Marks)**

Chapter 2: Gas Turbine Power Plant

Repeated Questions:

1. Open Cycle vs. Closed Cycle & Classification:

- **Q.** Compare Open Cycle and Closed Cycle Gas Turbines. **(SUMMER 2024, 3 Marks; WINTER 2024, 4 Marks - with diagrams)**
- **Q.** Explain the working of a closed cycle gas turbine/combined cycle plant with a neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2024, 4 Marks - closed cycle; SUMMER 2024, 7 Marks - combined cycle; WINTER 2022, 3 Marks - advantages of combined cycle)**
- **Q.** Give the classification of gas turbines. **(SUMMER 2024, 3 Marks)**

2. Brayton Cycle & Performance:

- **Q.** Derive the efficiency equation of the Brayton cycle. **(SUMMER 2024, 4 Marks; WINTER 2024, 4 Marks)**
- **Q.** Explain the effect of operating variables (Pressure Ratio, TIT, etc.) on the thermal efficiency and work output of a gas turbine. **(SUMMER 2022, 7 Marks - work ratio; SUMMER 2025, 4 Marks - efficiency; WINTER 2024, 7 Marks - efficiency; SUMMER 2026, 4 Marks - work ratio)**

3. Comparison & Applications:

- **Q.** State the advantages and disadvantages of a gas turbine over a steam turbine. **(SUMMER 2022, 3 Marks; WINTER 2024, 4 Marks - comparison; WINTER 2024, 3 Marks - merits/demerits)**
- **Q.** State the uses / various applications of Gas Turbine. **(SUMMER 2024, 3 Marks; WINTER 2025, 4 Marks)**

Other Important Questions:

1. Gas Turbine Layout & Closed Cycle:

- **Q.** Draw the line diagram of constant pressure open cycle Gas turbine power plant. [Diagram required – refer to W25] **(WINTER 2025, 3 Marks)**
- **Q.** Write advantages of closed cycle Gas turbine power plant. **(WINTER 2025, 4 Marks)**

2. Definitions, Efficiency Improvement & Blade Cooling:

- **Q.** Define: (i) work ratio, (ii) air rate, (iii) specific fuel consumption. **(WINTER 2024, 3 Marks)**
- **Q.** Enlist methods to improve the thermal efficiency of a gas turbine and explain any one. **(WINTER 2022, 4 Marks)**
- **Q.** Explain the need for cooling gas turbine blades and explain transpiration cooling. **(WINTER 2024, 4 Marks)**

3. Gas Turbine Cycle (Numerical):

- **Q.** Numerical on Gas Turbine Cycle: Pressure ratio=6, Tmax=900°C, compressor and turbine efficiencies given. Find thermal efficiency, power output, A:F ratio, SFC. **(SUMMER 2023, 7 Marks)**
- **Q.** Numerical on Two-Stage Compressor: With perfect intercooling, find net power per kg of air. **(SUMMER 2024, 7 Marks)**
- **Q.** Numerical on Reheat Cycle: Two-stage turbine with reheat, find maximum power. **(SUMMER 2024, 7 Marks)**
- **Q.** Numerical on Gas Turbine with Regenerator: Given efficiencies and pressure drops, determine the thermal efficiency of the plant. **(WINTER 2022, 7 Marks)**
- **Q.** Numerical on Open Cycle Gas Turbine: Given pressure, temperatures, efficiencies, and A:F ratio, find thermal efficiency and power output. **(SUMMER 2025, 7 Marks)**
- **Q.** Numerical on Brayton Cycle: Calculate efficiency and specific work output, then find power generated considering mechanical/generation efficiencies. **(SUMMER 2025, 7 Marks)**

- **Q.** A Gas turbine unit has pressure ratio of 6:1, maximum temperature of 627°C. The isentropic efficiency of compressor and turbine are 0.82 and 0.85 respectively. Calculate the power output in kW of an electric generator generated to the turbine when the air enters the compressor at 15°C at the rate of 18 kg/sec. Assume Cp = 1.005 kJ/kgK and γ = 1.4 for the compressor. **(WINTER 2025, 7 Marks)**
- **Q.** A gas turbine plant operates on Brayton cycle with air entering the compressor at 1 bar and 27°C. The pressure ratio is 6 and the maximum temperature is 800°C. The compressor and turbine efficiencies are 82% and 87% respectively. Mass flow rate of air is 2 kg/s. Determine the thermal efficiency and power output of the plant. Take Cp = 1 kJ/kg K and γ = 1.4 for air and gases. **(SUMMER 2026, 7 Marks)**
- **Q.** In an open cycle gas turbine plant, air is compressed from 1 bar, 300 K to 5 bar with compressor efficiency of 80%. The turbine inlet temperature is 900 K with turbine efficiency of 85%. If the mass flow rate is 3 kg/s, calculate the net power output and thermal efficiency. Assume Cp = 1 kJ/kg K and γ = 1.4 for air and gases. **(SUMMER 2026, 7 Marks)**

Chapter 3: Nuclear Power Plant

Repeated Questions:

1. Nuclear Reactors:

- **Q.** Explain with a neat sketch the construction and working of: Pressurized Water Reactor (PWR). [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks; WINTER 2024, 7 Marks; WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Explain with a neat sketch the construction and working of: Boiling Water Reactor (BWR). [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; WINTER 2022, 7 Marks; SUMMER 2025, 7 Marks)**
- **Q.** Explain with a neat sketch the construction and working of: CANDU Reactor. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 4 Marks)**

2. Fission, Fusion & Reactor Materials:

- **Q.** Differentiate between Nuclear Fission and Fusion. **(SUMMER 2023, 3 Marks; WINTER 2022, 4 Marks; WINTER 2023, 3 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Give the functions and materials used for: (i) Fuel, (ii) Moderator, (iii) Reflector. **(SUMMER 2023, 3 Marks; WINTER 2024, 7 Marks)**

3. Nuclear Waste:

- **Q.** Explain nuclear waste and its disposal methods. **(SUMMER 2024, 7 Marks; WINTER 2022, 7 Marks; SUMMER 2025, 4 Marks)**

Other Important Questions:

1. Reactor Theory & Components:

- **Q.** Discuss the chain reaction in a nuclear power plant. **(SUMMER 2023, 3 Marks)**
- **Q.** Explain the principle, construction, and working of a Liquid Metal Cooled Reactor. **(SUMMER 2024, 7 Marks)**
- **Q.** With a neat sketch, list the components of a nuclear reactor. [Diagram required – refer to W22] **(WINTER 2022, 3 Marks)**
- **Q.** Give the names of the components of a nuclear power plant and explain any three. **(SUMMER 2025, 4 Marks)**
- **Q.** Discuss the role of moderator and control rods in the nuclear power plant. Also discuss the effects if any of these two fails in its operation. **(SUMMER 2026, 7 Marks)**

2. Site Selection, Pollution & Safety:

- **Q.** Discuss factors for site selection of a nuclear power plant. **(WINTER 2022, 4 Marks; WINTER 2025, 7 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Explain the pollution due to nuclear power plants. **(WINTER 2022, 3 Marks)**
- **Q.** State safety measures required for nuclear power plants. **(SUMMER 2025, 3 Marks)**

Chapter 4: Power from Renewable Energy

Repeated Questions:

1. Hydro Power:

- **Q.** Draw the general layout of a Hydroelectric Power Plant and explain its components. [Diagram required – refer to the original question paper] **(SUMMER 2025, 7 Marks; WINTER 2023, 7 Marks; WINTER 2025, 7 Marks)**

2. Wind Energy:

- **Q.** Compare Horizontal Axis and Vertical Axis Wind Turbines. **(SUMMER 2024, 4 Marks - in comparison; SUMMER 2025, 4 Marks; WINTER 2024, 3 Marks; SUMMER 2026, 4 Marks)**

3. Solar Energy:

- **Q.** Explain the principle, construction, and working of a Solar Photovoltaic Cell. [Diagram required for S26 – refer to S26] **(SUMMER 2025, 7 Marks; WINTER 2022, 7 Marks - photovoltaic conversion; WINTER 2025, 4 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Explain Concentrating Solar-Thermal Power (CSP) technology. **(SUMMER 2024, 7 Marks; SUMMER 2022, 7 Marks)**

Other Important Questions:

1. Wind Energy:

- **Q.** Explain the principle, construction, and working of a Horizontal Axis Wind Turbine. **(SUMMER 2023, 7 Marks)**
- **Q.** List components of a windmill power system with a neat sketch. **(SUMMER 2024, 7 Marks)**
- **Q.** Write advantages and disadvantages of wind energy system. **(WINTER 2025, 7 Marks)**

2. Solar Energy:

- **Q.** Explain the solar furnace. **(SUMMER 2023, 7 Marks)**
- **Q.** Explain power production from solar photovoltaic cells. **(WINTER 2024, 3 Marks)**
- **Q.** Enlist types of solar thermal power systems. **(SUMMER 2026, 3 Marks)**

3. Hydro Power:

- **Q.** State factors for site selection of a Hydro Power Plant. **(SUMMER 2024, 4 Marks)**
- **Q.** List the essential elements of a hydroelectric power plant. **(WINTER 2022, 3 Marks)**

4. Geothermal, Tidal Energy & Fuel Cells:

- **Q.** What is geothermal energy? Give its applications. **(WINTER 2022, 3 Marks)**
- **Q.** Write any two advantages of Geothermal energy system. **(WINTER 2025, 3 Marks)**
- **Q.** Explain how tidal energy is converted to electrical energy. **(WINTER 2022, 4 Marks)**
- **Q.** What is Tidal energy? **(WINTER 2025, 4 Marks)**
- **Q.** Explain the principle and working of a single basin tidal turbine. **(SUMMER 2026, 4 Marks)**
- **Q.** Explain the principle and working of fuel cells. **(WINTER 2024, 4 Marks)**
- **Q.** State types of fuels used in fuel cells. **(WINTER 2025, 3 Marks)**

Chapter 5: Energy, Economic and Environmental Issues

Repeated Questions:

1. Load & Plant Factors:

- **Q.** Define the following terms: Load Factor, Demand Factor, Diversity Factor, Plant Capacity Factor, Plant Use Factor. **(SUMMER 2023, 3 Marks; SUMMER 2024, 4 Marks; WINTER 2022, 4 Marks; WINTER 2023, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**

2. Tariff:

- **Q.** What is the significance of a Two-Part Tariff and a Three-Part Tariff? **(SUMMER 2024, 4 Marks; SUMMER 2022, 3 Marks)**

3. Load Curves:

- **Q.** Explain Load Curves and Load Duration Curves. **(SUMMER 2024, 3 Marks; SUMMER 2022, 3 Marks; SUMMER 2025, 3 Marks - load duration curve; WINTER 2025, 3 Marks)**

Other Important Questions:

1. Power Plant Economics (Numerical):

- **Q.** Numerical on Power Station Load: Given peak load and max demands of consumers, find average load, energy supplied, diversity factor, demand factor. **(SUMMER 2023, 4 Marks)**
- **Q.** Numerical on Power Plant Economics: Given capacity, max load, load factor, coal consumption & cost, calculate annual revenue and capacity factor. **(SUMMER 2023, 7 Marks)**
- **Q.** Numerical on Connected Load: Given max demand and diversity/demand factors for different loads, find connected load and overall max load. **(WINTER 2022, 4 Marks)**
- **Q.** Numerical on Power Plant Performance: Rated capacity 400 MW, peak load 350 MW, consumer demands given. Calculate average load, capacity factor, energy/year, reserve factor, demand factor, diversity factor. **(WINTER 2022, 7 Marks)**
- **Q.** A 50 MW power plant has an annual peak load of 40 MW and average load factor of 0.55. It supplies loads with maximum demands: Domestic 15 MW, Commercial 20 MW, Industrial 25 MW. The overall diversity factor is 1.3. Calculate: (i) Annual energy supplied, (ii) Connected load, (iii) Plant capacity factor. **(SUMMER 2026, 7 Marks)**

2. Tariff:

- **Q.** What do you understand by the term tariff? State various methods for its calculation. **(WINTER 2023, 7 Marks)**

3. Draught & Ash Handling:

- **Q.** Numerical on Chimney Draught: Calculate the mass flow rate of flue gases given draught, temperatures, and chimney diameter. **(WINTER 2024, 7 Marks)**
- **Q.** Name various methods of ash handling. Describe the pneumatic system. **(WINTER 2024, 4 Marks)**

4. Environmental Issues:

- **Q.** Explain about pollution from thermal power plant and its harmful effects. **(WINTER 2025, 7 Marks)**
- **Q.** Explain about acid rains and its effects. **(WINTER 2025, 7 Marks)**

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