B.E. (MECHANICAL ENGINEERING)
402047: ENERGY ENGINEERING

Unit No. 1 - Introduction and Thermal Power Plant

Q.1 Discuss the present scenario of power generation in India.

Q.2 Give layout of unit system of pulverized fuel burning. List its advantages and disadvantages.

Q.3 Discuss the general layout of a steam power plant. Explain its fuel, gas, feed water and steam and cooling water circuits.

Q.4 Discuss factors to be considered in selecting the site for steam power stations.

Q.5 Explain with neat sketch theme mechanical ash handling system.

Q.6 Write a note on role of private organizations in power generations to meet the power demands of the nation.

Q.7 Write a short note on 1) energy scenario in India 2) Carbon credits

Q.8 Write a short note on 1) load shedding

Q.9 Write a note on Indian and global energy sources.

Q.10 Write a note on non-conventional energy sources relevant to India.

Q.11 Explain Coal handling.

Q.12 Write a note on dust collectors.

Q.13 Explain La Mont boiler with diagram.

Q.14 Explain Benson boiler.

Q.15 Write a note on Fluidized bed combustion (FBC) system. Write different FBC systems.

Q.16 Explain Co-generation.

Q.17 In a reheat cycle steam at 500°C expands in HP turbine till it is saturated vapour. It is heated at constant pressure to 400°C and then expands in a low pressure turbine to 40°C. If the maximum moisture content at turbine exhaust is limited to 15%, determine i) reheat pressure ii) boiler pressure iii) cycle efficiency iv) steam rate.

Q.18 In a single feed water heater, regenerative cycle, the steam enters turbine at a pressure of 30 bar and 400°C. The exhaust pressure of steam is 0.1 bar. The feed water heater is direct contact type, which operates at a pressure of 5 bar. Find the thermal efficiency of the cycle and the specific steam consumption. Show the flow diagram, the regenerative cycle on h-s or T-s diagram.

Q.19 Steam is supplied by steam generator at 90 bar and 500°C. After expansion in turbine to 10 bar a portion of steam is bled for regeneration in open heater and

remaining steam is related to 500°C. Condenser pressure is 0.07 bar. Draw schematic diagram of the system and show the cycle on T-S chart. Find thermal efficiency and steam rate in Kg/kWh. Neglect pump work.

Q.20 The steam at 70 bar and 500°C is supplied to the steam turbine. Steam is expanded in high pressure turbine isentropically till it is dry saturated. The steam is reheated to 400°C passing to reheater. Expansion after reheating is carried to condenser pressure up to 0.2 bar. Find efficiency of cycle and work output if flow of steam is 10 kg/sec. Consider pump work. Represent cycle on TS and h-s plot and sketch flow diagram. Find: i) Reheating pressure ii) Dryness fraction of steam at low pressure turbine outlet iii) Thermal efficiency of cycle iv) Work ratio.

Q.21 A simple Rankine cycle works between pressure 28 bar and 0.06 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption (simple Rankine Cycle)

Q.22 Steam at a pressure of 15 bar abs and 250°C is expanded through a turbine at first to a pressure of 4 bar abs. it is then reheated at constant pressure to the initial temperature of 250 °C and is finally expanded to 0.1 bar abs. Using Mollier chart, estimate the work done per kg of steam flowing through the turbine and amount of heat supplied during the process of reheat. Compare the work output when the expansion is direct from 15 bar abs to 0.1 bar abs. without any reheat. Assume all expansion processes to be isentropic. (Reheat cycle)

Q.23 A turbine is supplied with steam at a pressure of 32 bar and a temperature of 410 °C. The steam then expands isentropically to a pressure of 0.08 bar. Find the dryness fraction at the end expansion and thermal efficiency of the cycle. If the steam is reheated at 5.5 bar to a temperature of 400°C and then expanded isentropically to a pressure of 0.08 bar. What will be the dryness fraction and thermal efficiency of the cycle. (Reheat cycle)

Q.24 In a single – heater regenerative cycle the steam enters the turbine at 30 bar, 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: i) The efficiency and the steam rate of the cycle. ii) The increase in mean temperature of heat addition, efficiency and steam rate as compared to the Rankine cycle (without regeneration). Pump work may be neglected (Regenerative cycle)

Q.25 A team power plant operates on a theoretical reheat cycle. Steam at boiler at 150 bar , 550°C expands through the high pressure turbine . it is reheated at a constant pressure of 40 bar to 550 °C and expanded through the low pressure turbine to a condenser at 0.1 bar. Draw t-s and hs diagram find (i) quality of steam at turbine exhaust (ii) cycle efficiency (iii)steam rate in kg/kWh (Reheat cycle)

Q.26 In a co-generation steam power plant shown in fig, the boiler generates steam at 50 bar and 400°C which is supplied to turbine for expansion, steam at 5 bar is extracted from turbine for process heating and remainder continues to expand up to condenser pressure of 0.05 bar. No steam is extracted from PRV. The mass flow rate of steam from boiler is 15 kg/s. if the amount of steam extracted for process heating is 5 kg/s. which is condensed at 5 bar from the process heater. Find

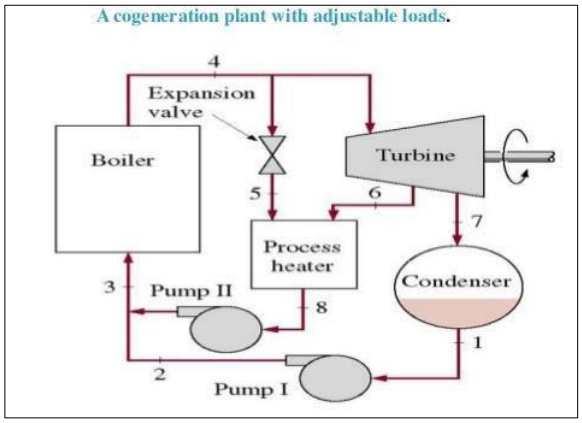
i) Power output of turbine in KW

ii) Process heat energy utilized in KW

iii) The thermal efficiency of the plant

iv) Effectiveness of co-generation

Neglect pump work



Q.27 In a cogeneration plant, 25 kg/s steam enters turbine at 40 bar and 400°C. 20 % of steam is withdrawn for process heating at 3 bar and remaining continues to expand in turbine up to condenser pressure of 0.8 bar. Neglect pumps work. Represent cycle on T-S diagram. Find

1) Thermal efficiency of cycle
2) Capacity of power plant in MW
3) Effectiveness of cogeneration

Q.28 In a cogeneration plant steam is generated at 50 bar and 500 °C and expanded through an isentropic turbine to a condenser pressure of 0.05 bars. The heating load is supplied by extracting steam from turbine at 3 bar which is condensed in a process heater to saturated liquid at 3 bar and then pumped back to boiler. The power load on the system is 6 MW and the heating load is 1.2 MW. Show the process on T-s diagram and find

i) Steam generation capacity of boiler in TPH
ii) Heat transfer to water in the boiler in KW
iii) Rate of cooling water flow across the condenser if the temperature rise of the water is 5°C. Neglect the pump work

Unit No. 2 – Steam Condenser & Environmental Impacts of Thermal Power Plant

Q.1 Explain elements of steam condensing plant.

Q.2 What are the different pollutants due to thermal power plants & explain their effects on human health.

Q.3 What are the sources of air leakage in a condenser? How it affects the condenser performance?

Q.4 Describe air cooled condenser.

Q.5 Write short notes on the following points : (i) Acid rain (ii) Thermal Pollution

Q.6 Write short note on global warming and greenhouse effect.

Q.7 Explain the different methods adopted to control Nuclear Pollution

Q.8 What is the necessity of condenser in steam power plant?

Q.9 Write a note on noise pollution in thermal power plants and its control.

Q.10 Define vacuum efficiency & condenser efficiency.

Q.11 Explain different types of condenser.

Q.12 Explain with diagram central flow condenser.

Q.13 Write a note on air cooled cooling tower.

Q.14 A vacuum of 710 mm was obtained in a condenser when the barometer reads 755 mm. The temperature of condensate was 25° C . Determine the pressure of air and steam in the condenser and the mass of air per kg of steam. Also determine the vacuum efficiency.

Q.15 The following observation were recorded during a trial on a steam condenser, condenser vacuum = 680 mm Hg, Barometer reading = 764 mm of HG, Mean condenser temperature = 36.2 C °, Hot well temperature = 30° C Determine i) condenser vacuum corrected to standard barometer ii) Vacuum efficiency iii) condenser efficiency if cooling water inlet and outlet
temperature is 20° C and 32 ° C respectively.

Q.16 In a thermal power plant steam is condensed in a surface condenser at 14000 kg/hr and the leakage is 6 kg/hr. The vacuum near the suction pump is 69 cm of Hg and the temperature is 35 ° C. The air and the condensate are removed by a wet air pump. Find the capacity and the dimension of the pump if N= 120 rpm, L/D is 1.2 and the pump is single acting. Take barometric pressure as 760 mm of Hg.

Q.17 A surface condenser is designed to handle 12000 kg /hr of steam. The steam enters at 8 kPa., 0.9 dry. The condensate leaves the condenser at the corresponding saturated temp. Calculate the rate of cooling water if cooling water temperature rise is limited to 12 ° C.

Q.18 The following data refers to test of the surface condenser. Absolute pressure of steam entering condenser = 5.62 kPa. Inlet temp of cooling water = 15 ° C, outlet temp of cooling water = 30 °C. Mass of cooling water per kg of steam = 32 kg. Temp of condensate leaving condenser is 32 °C. Determine dryness fraction of steam as it enters the condenser.

Q.19 The steam is supplied to a steam turbine at 3 MPa and 300 ° C. The expansion of steam is carried out isentropically to condenser to a condenser vacuum of 713 mm of Hg . The barometer reads 758 mm of Hg. The condenser temp is 20° C and rise in temp of cooling water is 12 ° C. Determine i) quality of steam entering the condenser ii) quality of cooling water circulated per kg of steam. (Use Mollier chart)

Q.20 The following data was recorded from a test of surface condenser. Inlet temp of circulating water = 21 ° C, exit temp of circulating water = 35 ° C. vacuum in the condenser = 704.7 mm of Hg. Barometer reading = 76 mm of Hg. Calculate the efficiency of condenser.

Unit No. 3 - Hydroelectric and Nuclear Power Plant

Q.1 How the dams are classified? What factors are considered in selecting a type of dam?

Q.2 What are the different types of spillways used in practice? Discuss the advantage of one over the others.

Q.3 Where the siphon spillway is used? What are its different features? Explain its advantages and disadvantage over the other.

Q.4 What different methods are used to dissipate the energy of water passing over the overflow spillways? Why it is necessary?

Q.5 Differentiate between conduit and penstock. How the length of penstock is decided in the hydraulic power plant? What are the advantages and disadvantages of exposed penstock over the buried penstock?

Q.6 Describe the advantages and disadvantages of underground power stations compared with overground power stations.

Q.7 What are the different types of draft tube? Sketch the different types of draft tubes and state which one of them gives maximum efficiency.

Q.8 What do you understand by water hammer and what are its effects on the power plant is design?

Q.9 What are the functions of surge tank? How will you differentiate differential type with that of simple or restricted orifice type?

Q.10 What do you understand by moderation? Why it is essential?

Q.11 What different moderators are used in practice? What different properties make them suitable moderators?

Q.12 What do you understand by fertile material and breeding? What is the importance of breeding in power engineering?

Q.13 Draw a neat diagram of nuclear reactor and explain the functions of different components.

Q.14 Draw a neat diagram of PWR and BWR and explain the advantages and disadvantages. What are the conditions which prefer PWR over BWR and vice versa?

Q.15 PWR is a self-regulating reactor and can be used for variable loads whereas BWR is only useful for base load plant. Justify this statement giving reasons.

Q.16 Draw a neat diagram of CANDU type reactor and give its advantages and disadvantages over the other types. Under what circumstances this reactor is more preferable than PWR and BWR?

Q.17 What are the outstanding features of gas cooled reactor over the other types when these are preferred?

Q.18 Availability of fuel and moderator generally controls the economic selection of the reactor. Justify the statement.

Q.19 Draw a neat diagram of organic moderated and cooled reactive power plant and list out its advantages and disadvantages over the other reactors.

Q.20 Draw a neat diagram of liquid metal fast breeder reactor and list out its advantages and disadvantages. Why only sodium is used as a coolant in breeder reactors?

Q.21 Why the moderator is not required in the breeder reactors?

Q.22 List out the advantages and disadvantages of nuclear plants over conventional thermal plants.

Q.23 Compare the properties of stainless steel and zirconium for use as a reactor fuel element cladding.

Q.24 Why cladding is necessary? What are the requirements of good cladding material?

Q.25 What are the desirable properties of control rod materials? Compare the merits and demerits of Boron.

Q.26 Why shielding of reactor is necessary? What do you understand by thermal shielding?

Q.27 What are the different types of nuclear waste? Which are more dangerous and why?

Q.28 What are the types of nuclear radiation and their major effects on human and plant life?

Q.29 The average rate of inflow during 12 months for a river are as under

Month	Inflow q (m3/s)	Month	Inflow q (m3/s)	Month	Inflow q (m3/s)
Jan	800	May	600	Sept	1200
Feb	1000	June	1200	Oct	600
Mar	600	July	2400	Nov	600
Apr	400	August	2400	Dec	1000

Plot the hydrograph and determine the following

i) Average flow ii) power developed under a head of 160 m. if overall efficiency is 80 %. Iii) Capacity of storage required for one year.

Neglect losses due to evaporation, seepage etc. assume each month 30 days.

Q.30 Draw the hydrograph if the average inflow rate of a river is as follows.

Month	Inflow q (m3/s)	Month	Inflow q (m3/s)	Month	Inflow q (m3/s)
Jan	1600	May	800	Sept	1600

Feb	1200	June	1200	Oct	800
Mar	800	July	3000	Nov	800
Apr	800	August	3000	Dec	1000

Determine the storage capacity for a constant demand of 1100 m3/s . Also find the number of additional month, this storage capacity can be utilized if there is no rain fall.

Q.31 Draw the flow duration curve and mass curve if the average inflow rate of a river are as follows

Month	Inflow q (m3/s)	Month	Inflow q (m3/s)	Month	Inflow q (m3/s)
Jan	1600	May	800	Sept	1600
Feb	1200	June	1200	Oct	800
Mar	800	July	3000	Nov	800
Apr	800	August	3000	Dec	1000

From mass curve determine the storage capacity for a constant demand of 1100 m3/s.

Q.32 A Pelton wheel of 3 m runner works under a head of 800 m. it runs at 60 rpm. The discharge rate in to runner is 3 m3/s. find i) input power to runner ii) shaft power from runner having mechanical efficiency of 92 %. Iii) net power output if generated is 96 % efficient iv) specific speed of turbine v) no of turbines needed to generate 100 MW.

Unit No. 4 – Diesel and Gas Turbine Power plant

Q.1 Draw the schematic diagram for complete diesel power plant showing all the systems used & explain the working.

Q.2 Discuss the advantages & disadvantages of diesel engine power plant.

Q.3 Why the starting of diesel plant is more difficult? What different methods are used for starting diesel engine? Which method is common and why?

Q.4 State the site selection factors for diesel engine power plant.

Q.5 Discuss various losses related to diesel engine power plant.

Q.6 Explain the performance operating cause for diesel power plant.

Q.7 Discuss the selection of engine size for diesel engine power plant.

Q.8 What are the different fields where use of diesel power plant is essential?

Q.9 What is the present trend in diesel research?

Q.10 Derive the equation of thermal efficiency of Brayton cycle.

Q.11 Explain with a neat sketch combined cycle power plant

Q.12 What is combined power plant? What are its advantages over conventional power plant? Sketch gas and steam combined power plant

Q.13 Draw Brayton cycle for open cycle gas turbine" in (P- V) and (T - S) diagrams.

Q.14 Derive expression for efficiency in terms of pressure ratio.

Q.15 A four stroke engine develops 80 kW at full load having mechanical efficiency of 80%. Find the IP and FP. If the engine is run at constant speed so that friction losses may be assumed to be constant, find the mechanical efficiency at 75%, 50% and 25% of the full load. Draw your conclusions.

Q.16 A four stroke diesel engine consumes 20 kg/hr. When the engine develops an output of 80 kW. Calculate the break and indicated specific fuel consumption if the mechanical efficiency of the engine is 80%. Also, determine the brake and indicated thermal efficiencies if the calorific value of the fuel is 45000 kJ/kg.

Q.17 A four cylinder 4 stroke cycle engine having cylinder diameter 100 mm and stroke 120 mm was tested at 1600 rpm and following readings were obtained: Fuel consumption=0.27 liters/ minute, specific gravity of oil=0.74 BP=31.4kW, Mechanical efficiency=80% , calorific value of the fuel=44000 kJ/kg. Determine i) BSFC ii) IMEP iii) Brake thermal efficiency

Q.18 A two stroke diesel engine develops 400 kW output with a mechanical efficiency of 0.82. The rate of fuel consumption is 2.4 kg/minute and the air-fuel ratio used in the engine is 18:1. The heating value of the fuel is 41,500 kJ/kg. Find i) IP ii) FP iii) Brake thermal efficiency iv) Indicated thermal efficiency and v) fuel and air consumption per hour.

Q.19 As open cycle gas turbine plant uses heavy oil as fuel. The maximum pressure and temperature in the cycle are 5 bar and 650°C. The pressure and temperature of the air entering into compressor are 1 bar and 27°C. The exit pressure of the turbine is 1 bar. Assuming isentropic efficiencies of the compressor and turbine to be 80% and 85% respectively. Find the thermal efficiency of the cycle. Overall air fuel ratio

used is 60:1 Take Cp (for air and gas) = 1 kJ kg K , for air and gas ɤ= 1.4

Q.20 A gas turbine power operates between temperature limits of 295 K and 1085 K. Find i) Optimum pressure ratio for cycle if plant is to be operate for maximum power output ii) Compressor work (iii) Turbine work

Q.21 A gas turbine installations works on Brayton cycle between the temperatures. 35°C and 715°C. For the maximum work to be developed, calculate (a) temp the end of compression, (b) pressure ratio and (c) the thermal efficiency

Q.22 In a gas turbine power plant air enters in compressor at 200C and 1 bar. The maximum temperature of cycle is limited to 700'0C and maximum pressure ratio is limited to 6. The effectiveness of regenerator is 0.7. Assuming following data find :i) A: F ratio. ii) Thermal efficiency of cycle. Calorific value of fuel used 35000 kJ/kg. Cp of air 1 kJ/kgK and ɤ = 1.4.Sketch the flow diagram and represent cycle on T-S plot.

Unit No. 5- Non Conventional Power Plant

Q.1 Write short notes on: 1. geothermal power plant 2. MHD 3.Classification of wind mills.

Q.2 Describe the basic principle of photovoltaic power. List out its merits over the other system. What are the main hurdles in the development of this mode of power generation?

Q.3 Discuss the parameter to be consider for site selection of wind power plant

Q.4 Explain single basin and double basin tidal power plant

Q.5 What is function of PV system? What are advantage and disadvantages?

Q.6 Write short note on 1) Fuel cell 2) Geothermal Power plant

Q.7 What are the basic requirements for locating a wind power plant? Which factor affects the size of wind power plant?

Q.8 Explain flat plate and parabolic solar collector with neat sketch

Q.9 What is OTEC? What is the minimum requirement to operate the OTEC? Explain close cycle OTEC with typical layout.

Q.10 How is electricity generated from geothermal energy? What are advantages and disadvantages?

Q.11 Explain with neat sketch of solar pond and solar flat plat collector.

Q.12 Explain with neat sketch of Hybrid and Tidal power plant.

Q.13 What are the different challenges in commercialization of non-conventional power plant?

Q.14 What are the concentrating type collector systems? Discuss their advantages.

Q.15 What are high temperature solar thermal power plant ? discuss the working of central receiver tower power plant

Q.16 Write the difference between renewable and nonrenewable resource of energy

Q.17 What are the challenges in commercialization of non-conventional energy in India

Q.18 Explain the working of VAWT with neat sketch

Q.19 What is MHD? Explain open cycle MHD System with typical layout.

Q.20 Write the difference between Concentrating collector and non-concentrating solar collector

Unit No. 6- Instrument and Economics of Power Plant

Q.1 Explain the Principle of economic scheduling

Q.2 What are the elements which contribute the cost of electricity?

Q.3 What is a load curve? What is its use in distribution of electrical energy?

Q.4 Explain with neat sketch load curve and load duration curve.

Q.5 Enlist the protective equipment and explain the working of circuit breaker in power plant.

Q.6 Write a short note on: Switch Gear & Power Transformer

Q.7 Explain with neat sketch construction and working of power transformer

Q.8 Define & Explain 1) Connected load 2) Average load 3) Demand factor 4) Load factor

Q.9 Differential between fix cost and operating cost. list the components of each of them

Q.10 The capital cost of hydro power station of 100MW capacity is Rs. 10,000/kW. The annual depreciation charges are 15% of the capital coat. A royalty of Rs. 2/kW per year and Rs. 0.3/kWh generated is to be paid for using the river water for power generation. The maximum demand on power station is 70MW and annual load factor is 0.6. The annual salaries, maintenance charges are Rs. 10^7. If 20% of this expense is also chargeable as fixed charges, calculate the generation charge in two - part tariff.

Q.11 The following common load data is available in share for a base load power station and stand by power station. Base load station annual output = $150*10^6$ KWh Stand by station annual output = $15*10^6$ KWh Base load station capacity = 50MW Standby station capacity = 22MW Maximum demand on base load station = 35MW Maximum demand on standby station = 20MW Determine the following for both power stations: i) Load factor II) Capacity factor

Q.12 From following data calculate cost of generation per unit delivered from the power

plant. Installed capacity of power plant = 200 Mw Annual load factor = 0.4 Capital cost of power plant = Rs. 280 Lacks Annual cost of fuel, Oil, Salaries & taxation = Rs. 60 Lacks Interest and depreciation = 13%

Q.13 A power plant of 210 MW installed Capacity have the following particulars: Capital cost = Rs. 18000/Kw installed Interest and depreciation = 12 % Annual Load Factor = 60% Annual Capacity Factor = 54% Annual running Charges = Rs $200*10^6$ Energy consumed by power plant auxiliaries = 6% Calculate 1. Cost of power generation per kWh 2. The reserve capacity.

Q.14 The peak load in a power plant is 60 MW. The load having maximum demand of 30 MW, 20 MW, 10 MW and 14 MW are connected to the power plant. The capacity f the power plant is 80 MW and annual load factor is 0.50. Estimate, i) average load on the power plant 2) energy supplied per year 3) demand factor.

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