

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2021

Subject Code:3171910

Date:10/12/2021

Subject Name:Power Plant Engineering

Time:10:30 AM TO 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.
5. Usage of steam table and Mollier chart is permitted

		MARKS
Q.1	(a) Draw a neat named general layout of modern thermal power plant. List various factors to be considered for site selection of thermal power station	03
	(b) Write down four main circuits of thermal power plant. Describe any one of them briefly with neat sketch.	04
	(c) Explain the principle of working of an electrostatic precipitator with the help of a neat diagram.	07
Q.2	(a) Write short note on Labyrinth packing.	03
	(b) With usual notations derive an expression of estimation of height of chimney and condition of maximum discharge	04
	(c) A steam nozzle is to be designed for a mass flow rate of 8 kg/s of steam from 8 bars and 350 °C to a back pressure of 1 bar. The nozzle efficiency is 0.93 and the frictional losses are assumed to take place in the diverging portion of the nozzle only. Assume a critical ratio of 0.5457. Determine throat and exit area.	07
OR		
	(c) The steam leaves the nozzle of a simple impulse turbine of outlet area 16 cm ² at 920 m/sec. The steam coming out of the nozzle is 0.91 dry at 1.3 bar. The blade inlet and outlet angles are 30° and the blade velocity is 230 m/sec. If the friction factor is 0.8. Find: (i) Nozzle angle (ii) Power developed (iii) Diagram efficiency and (iv) Axial thrust on the blading	07
Q.3	(a) Explain with neat sketch velocity compounded impulse turbine.	03
	(b) Why vacuum is required in condenser? Explain any one method to achieve vacuum in condenser.	04
	(c) The compressor of an open cycle constant pressure gas turbine draws air at pressure 1 bar and temperature 300 K. The pressure of air after compression is 4 bar. The isentropic efficiencies of compressor and turbine are 77 % and 85 % respectively. The A:F ratio is 78:1. Calculate the power developed and thermal efficiency of the cycle for the mass flow rate of air = 2.7 kg/s. Take $C_p = 1$ kJ/kg K and $\gamma = 1.4$ for air and gases both. The calorific value of fuel used is 42 MJ per kg.	07

OR

- Q.3** (a) Explain the principle of fluidized bed combustion with neat sketch. **03**
 (b) Derive an expression for the thermal efficiency of a gas turbine plant, and show that it is independent of the mass of air circulated in it. **04**
 (c) In a closed cycles gas turbine the following data apply, Working substance is air, $C_p = 1 \text{ kJ/kg}$ and $\gamma = 1.4$ **07**
 Ambient temperature = 27°C
 Pressure at compressor inlet = 1 bar
 Maximum temperature = 823°C
 Pressure ratio = 4
 Compressor efficiency = 80%
 Turbine efficiency = 85%
 Heating value of fuel = 41800 kJ/kg
 Heater loss = 10% of heating value
 Find the following:
 (i) Compressor work
 (ii) Heat supplied
 (iii) Turbine work
 (iv) Thermal Efficiency

- Q.4** (a) Discuss the various factors to be considered while selecting the site for nuclear power station. Discuss its advantages and disadvantages **03**
 (b) The maximum load on a thermal power plant of 70 MW capacity is 55 MW at an annual load factor of 60%. The coal consumption is 0.96 kg per unit of energy generated and the cost of coal is Rs. 2 per kg. Find the annual revenue earned if the electrical energy is sold at Rs. 2.5 per kWh. **04**
 (c) Explain with neat sketch construction and working of CANDU type reactor **07**

OR

- Q.4** (a) Write a note on nuclear waste and its disposal. **03**
 (b) A 100 MW thermal power has peak load of 65 MW. The power station supplies load to four town having their maximum demand of 20 MW, 15 MW, 10 MW and 30MW. The annual load factor is 65%. Find:
 (i) Average load on the plant
 (ii) Energy supplied per year
 (iii) Demand factor
 (iv) Diversity factor **04**
 (c) Explain with neat sketch construction and working of pressurized water reactor (PWR). Explain the function of pressurizer in PWR. **07**

- Q.5** (a) Describe the basic principle of photovoltaic and list out its merits over the other solar systems **03**
 (b) Write short note on pollution control technologies including waste disposal options for coal based power plants. **04**
 (c) Explain principle, construction and working of vertical axis Wind turbine. **07**

OR

- Q.5** (a) Explain the necessity of feed water treatment. What are the major impurities present in feed water? Explain in brief. **03**

- (b) Differentiate between single basin and double basin systems with neat sketch. **04**
- (c) Explain principle, construction and working of Fuel cells **07**
