Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E / B. Tech/ B. Arch (Full Time) END SEMESTER ARREAR EXAMINATIONS – APRIL / MAY 2024
MECHANICAL ENGINEERING
VII Semester
ME5701 ENERGY CONVERSION TECHNIQUES
(Regulation 2019)

Time: 3 Hours | Max. Marks 100

PART- A (10 x 2 = 20 Marks)

(Answer ALL Questions)

Q.No	Questions	Marks
1.	Draw the PV diagram of brayton cycle.	2
2.	State the significance of critical point in Rankine cycle.	2
3.	What is thermoelectric effect?	2
4.	Define Nernst effect.	2
5.	Mention any two types of fuel cells.	2
6.	What are the application areas of a fuel cell?	2
7.	Which parameter is used to assess the performance of a cogeneration system? Mention its formula.	2
8.	Illustrate the difference between topping cycle and bottoming cycle cogeneration system with an example.	2
9.	Mention any four materials to store sensible thermal energy.	2
10.	State the application areas of hydrogen.	2

PART- B (5 x 13 = 65 Marks)

Q.No	Questions	Marks
11.	(a) With a neat schematic (involving various elements) including PV and TS diagram, explain the various processes involved in Bell Coleman cycle.	13
	OR	
	(b) With a neat schematic (involving various elements) including PV and TS diagram, explain the various processes involved in Brayton cycle.	13
12.	a) Enumerate the working principle of a MHD generator with a neat sketch? Also state its limitations.	13
	OR	
	b) Enumerate the working principle of thermoelectric refrigerator with a neat sketch? State its advantages and disadvantages.	13
13.	a) Explain the construction, working, merits and demerits of a proton exchange membrane (PEM) fuel cell.	13
	OR	
	b) Explain the construction, working, merits and demerits of an alkaline fuel cell.	13
14.	a) In a combined gas turbine – steam turbine power plant, the exhaust gas from the open cycle gas turbine is the supply gas to the steam generator of the steam cycle at which additional fuel is burned in the gas. The pressure ratio for the gas turbine is 7.5., the air inlet temperature is 15 °C and the maximum cycle temperature is 750 °C. Combustion of additional fuel raises the gas temperature to 750 °C and the gas	13

	leaves the steam generator at 100 °C. The steam is supplied to the turbine at 50 bar, 600°C and the condenser pressure is 0.1 bar. The total power output of the plant is 200 MW. The calorific value of the fuel burned is 43.3 MJ/kg. Neglecting the effect of the mass flow rate of fuel on the air flow, determine (a) the flow rates of air and steam required, (b) the power outputs of the gas turbine and steam turbine, (c) the thermal efficiency of the combined plant. Take c_p = 1.11 kJ/kg K and γ = 1.33 for combustion gases and c_p = 1.005 kJ/kg K and γ = 1.4 for air. Neglect the pump work.	
	OR	
	b) In a Steam Turbine Cogeneration system, steam enters the turbine at 7 MPa and 500°C. Some Steam is extracted from the turbine at 500 kPa for process heating. The remaining steam continues to expand to 5 kPa. Steam is then condensed at constant pressure and pumped to the boiler pressure of 7 MPa. At times of high demand for process heat, some steam leaving the boiler is throttled to 500 kPa and is routed to the process heater. The extraction fractions are adjusted so that steam leaves the process heater as a saturated liquid at 500 kPa. It is subsequently pumped to 7 MPa. The mass flow rate of the steam through the boiler is 15 kg/s. Disregarding any pressure loss and heat loss in the piping and assuming the turbine and the pump to be isentropic, determine a) the maximum rate at which process heat can be supplied b) the power produced and the utilization factor when no process heat is supplied and c) the rate of process heat supply when 10 percent of the steam is extracted before it enters the turbine and 70 percent of the steam is extracted from the turbine at 500 kPa for process heating.	**13**
15.	a) With a neat schematic sketch of a simple flywheel, explain its working principle and derive the expression for energy stored.	**13**
	OR	
	b) With a neat schematic sketch, explain the rock bed sensible heat thermal energy storage system.	**13**

PART- C (1 x 15 = 15 Marks)

(Q.No. 16 is Compulsory)

Q. No	Questions	Marks
16 (i)	Draw the PV / TS diagram and mention the thermodynamic process associated with the following thermodynamic cycles: a) Rakine cycle, b) Atkinson cycle, c) Ericsson cycle and d) Lenoir cycle.	**15**