PRN No.	

PAPER CODE "U213-2114 (R?)

December 2023 (REEXAM)

SY (SEMESTER - I)

COURSE NAME: THERMODYNAMICS   BRANCH: MECHANICAL

(PATTERN 2020)

COURSE CODE: MEUA21204

Time: [2 Hrs]

[Max. Marks: 60]

(*) Instructions to candidates:
1) **Figures to the right indicate full marks.**
2) **Use of scientific calculator is allowed**
3) **Use suitable data wherever required**
4) **All questions are compulsory. Solve any two sub questions each from each Question 1 ,2, 3,4,5,and 6 respectively**

Q. No.	Question Description	Max. Marks	CO mapped	BT Level
Q.1	a) Air at 100 kPa and 280 K is compressed steadily to 600 kPa and 400 K. The mass-flow rate of air is 0.02 kg/s and heat losses of 16 kJ/kg occurs during the process. Assuming the changes in potential and kinetic energies are negligible, Estimate the necessary power input to the compressor.	[5]	1	3
	b) A non-flow system undergoes a frictionless process according to a law p = (4.5/v) + 2, where p is in bar and the volume v is in m^3/kg. During the process, the volume changes from 0.12 m^3/kg to 0.04 m^3/ kg and the temperature increases by 133°C. The change in internal energy of the fluid is given as du = Cv dT, where Cv = 0.71 kJ/kg K and dT is temperature change. Estimate (a) heat transferred, and (b) change in enthalpy. Assume a fluid quantity of 10 kg.	[5]	1	3
	c) A refrigerator has food articles with its door closed. In one hour the internal energy of food article decreases by 4000 KJ while the refrigerator consumed 1.2 kWh of electrical energy. Find the net heat transferred during the process.	[5]	1	3
Q2	a) The COP of the Carnot Refrigerator is 6 when it maintained the temperature of 270 K in the evaporator. Determine the condenser temperature and refrigerating effect if the power required to run the refrigerator is 7.5 Kw.	[5]	2	3
	b) A domestic food freezer maintains a temperature of –15°C. The ambient temperature is 30°C. The heat leaks into the freezer at 1.75 kJ/s. Calculate the power necessary to pump this heat out?	[5]	2	3

			[5]	2	3
	c) A heat pump maintains a space at 22°C on a day, when the outdoor air temperature is 0°C. The heating requirement of the space is 100,000 kJ/h and power consumed by the pump is 5 kW. Calculate COP of the heat pump. Also, calculate the maximum COP (Carnot).				
Q3.	a) Discuss the concept of principle of entropy and prove entropy is s property of the system		[5]	3	2
	b) Discuss the available energy and unavailable energy of heat reservoir working on the reversed Carnot cycle.		[5]	3	2
	c) State and explain Clausius inequality.		[5]	3	2
Q.4	a) Show that Air standard efficiency of Otto cycle is given by the following relation: $$\eta_{Otto} = 1 - \frac{1}{r^{\gamma-1}}$$ Where r = compression ratio and γ = Isentropic index		[5]	4	3
	b) A steam power plant works between pressures of 40 bar and 0.05 bar. If the steam supplied is dry saturated and the cycle of operation is Rankine cycle, find (a) Cycle efficiency (b) Specific steam consumption		[5]	4	3
	c) A steam power plant operates on the Carnot cycle using dry steam at 17.5 bar. The exhaust takes place at 0.075 bar into condenser. The steam consumption is 20 kg/min. Calculate: (a) Power developed in the cycle, (b) The efficiency of the cycle		[5]	4	3
Q.5	a) Steam of mass 10 kg and pressure 1000 kPa and 0.85 dry, is heated at constant pressure till the volume is doubled. Determine heat added in the cycle.		[5]	5	3
	b) Determine the amount of heat which should be supplied to 2 kg of water at 25 °C to convert it into steam at 5 bar and 0.9 dry.		[5]	5	3
	c) Find the enthalpy of 1 kg of steam at 12 bar when at Saturated liquid condition, Dry saturated condition, 22 % dry condition, 50 % dry condition and Steam is superheated to 250 °C.		[5]	5	3
Q.6)	a) Compare Fire tube and Water tube Boiler on the basis position of flue gases and water, location of furnace, Working pressure, type of use and requirement of space.		[5]	6	2

b) Discuss the procedure of preparation of Heat Balance sheet for Boiler. Also discuss the significance of it in thermal power plant.	[5]	6	2

c) Illustrate the example of Boiler Mounting and accessories based on the following functions.
   i) Preheating of water supplied to boiler
   ii) Preheating of air supplied to boiler furnace.
   iii) Superheating of steam supplied to steam turbine
   iv) Maintaining water level in Boiler drum
   v) Maintaining of steam pressure in Boiler drum
	[5]	6	2

Note: [BT level – 1: Remember   2: Understand   3: Apply   4: Analyze   5: Evaluate   6: Create]