Enrolment Number: _____

PARUL UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
B.TECH MIDSEM EXAMINATION
3rd SEMESTER
ACY-2022-23 (ODD SEM)

Subject Name (Code): Thermodynamics(203109211) **Branch: Mech/Auto**

Date: 03/08/2022 **Time: 02:30PM to 04:00PM** **Total Marks: 40**

Sr. No.		Marks
Q.1	(A) One line Questions	
	1) Quasi-static process	
	(a) is infinitely slow process (b) experiences thermodynamic equilibrium at every small point on its path	
	(c) reversible process (d) All of these	
	2) A cyclic heat engine does 50kJ of work per cycle. If efficiency of engine is 75%, the heat rejected per cycle will be	
	(a) 60.6kJ (b) 16.6kJ	
	(c) 66.6kJ (d) 200kJ	
	3)Which of the following is microscopic form of energy?	
	(a) Kinetic Energy (b) Potential Energy	
	(c) Internal Energy (d) All of these	
	4) A carnot refrigerator operates between temperature -10 °c and 30 °c. Determine its co-efficient of performance.	
	(a) 7 (b) 8.575	
	(c) 6.575 (d) 9	
	5) Match the following group 1 items with group 2 items and select the correct option.	
	(1) PMM1 (A) Heat pump	
	(2) PMM2 (B) Violates the statement that total energy of the universe is constant	
	(3) Reversible heat engine (C) Violates Kelvin-Planck statement	
	(4) Carnot cycle (D) Reversible process	
	(a) (1)-(A), (2)-(B), (3)-(C), (4)-(D) (b) (1)-(B), (2)-(D), (3)-(C), (4)-(A)	
	(c) (1)-(B), (2)-(C), (3)-(A), (4)-(D) (d) (1)-(C), (2)-(D), (3)-(B), (4)-(A)	
	(B) Compulsory Question	05
	1) What is the highest possible theoretical efficiency of a heat engine operating with a hot reservoir of furnace gases at 2100°C when the cooling water available is at 15°C ?	
	2) Define Efficiency of Heat Engine	
	3) For a Reversible Cycle Heat Ratio is Function of _____	
	4) Write down the statement of Clausius Inequality	

5) A heat engine produces work equivalent to 80 kW with an efficiency of 40 percent. Determine the heat transfer rate to and from the working fluid.

Q.2 Attempt any four(Short Questions) 12

(1) Write down Kelvin-Planck and Clausius statements of 2nd Law of thermodynamics.

(2) Show that the COP of a heat pump is greater than the COP of refrigerator by unity.

(3) State Carnot's theorem & Explain Limitations of Carnot Cycle.

(4) State first law for a closed system undergoing (i) cycle and (ii) a change of state

(5) Ex[lain Causes of Irreversibility

Q.3 Attempt any two 08

(1) Prove that entropy is the property of system..

(2) In an air compressor air flows steadily at the rate of 0.5 kg/s through an air compressor. It enters the compressor at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m3/kg and leaves at 5 m/s with a pressure of 7 bar and a specific volume of 0.16 m3/kg. The internal energy of the air leaving is 90 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 60 kJ/s. Calculate :

(i) The power required to drive the compressor ;

(ii) The inlet and output pipe cross-sectional areas.

(3) A house requires 2×10^5 kJ/h for heating in winter. Heat pump is used to absorb heat from cold air outside in winter and send heat to the house. Work required to operate the heat pump is 3×10^4 kJ/h. Determine :

(i) Heat abstracted from outside ;

(ii) Co-efficient of performance

Q.4 (A) What do you mean Steady flow process? Write the Steady Flow Energy Equation (SFEE) for the open system and obtain the expression of; 1) Velocity of fluid at exit of "Nozzle" 2) Work done by the "Steam turbine 05

(B) (i) A reversible heat pump is used to maintain a temperature of 0°C in a refrigerator when it rejects the heat to the surroundings at 25°C. If the heat removal rate from the refrigerator is 1440 kJ/min, determine the C.O.P. of the machine and work input required. 05

(ii) If the required input to run the pump is developed by a reversible engine which receives heat at 380°C and rejects heat to atmosphere, then determine the overall C.O.P. of the system.

OR

(B) A fluid system, contained in a piston and cylinder machine, passes through a complete cycle of four processes. The sum of all heat transferred during a cycle is – 340 kJ. The system completes 200 cycles per min. Complete the following table showing the method for each item, and compute the net rate of work output in kW. 05

Process	Q (kJ/min)	W (kJ/min)	ΔE (kJ/min)
1—2	0	4340	—
2—3	42000	0	—
3—4	– 4200	—	– 73200
4—1	—	—	—