BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: B.TECH. **SEMESTER: III**
BRANCH: PIE **SESSION: MO/2022**

SUBJECT: ME289 THERMAL AND FLUID ENGINEERING

TIME: 2 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 25.
2. Candidates attempt for all 25 marks.
3. Before attempting the question paper, be sure that you have got the correct question paper.
4. The missing data, if any, may be assumed suitably.
5. Tables/Data handbook/Graph paper etc. to be supplied to the candidates in the examination hall.

				CO	BL
Q1	(a)	Define a system, surrounding and universe along with the sketch.	[2]	1	1
Q1	(b)	How would you interpret work done and temperature changes in context to the path as well point functions?	[3]	2	3
Q2		It is required to melt 5 tonnes/h of iron from a charge at 15°C to molten metal at 1650°C. The melting point is 1535°C, and the latent heat is 270 kJ/kg. The specific heat in solid state is 0.502 and in liquid state (29.93/atomic weight) kJ/kg·K. If an electric furnace has 70% efficiency, find the kW rating needed. If the density in molten state is 6900 kg/m^3 and the bath volume is three times the hourly melting rate, find the dimensions of the cylindrical furnace if the length to the diameter ratio is 2. The atomic weight of iron is 56.	[5]	3	4
Q3	(a)	What is a steady flow process?	[1]	2	2
	(b)	A turbo compressor delivers 2.33 m^3/s at 0.276 MPa, 43°C which is heated at this pressure to 430°C and finally expanded in a turbine which delivers 1860 kW. During the expansion, there is a heat transfer of 0.09 MJ/s to the surroundings. Calculate the turbine exhaust temperature if changes in kinetic and potential energy are negligible.	[4]	2	4
Q4	(a)	Define the thermal efficiency of a heat engine cycle. Can this be 100% if proper care is taken?	[2]	1	2
Q4	(b)	Explain clearly, the equivalence of Kelvin-Plank and Clausius statements.	[3]	3	4
Q5		A reversible heat engine operates between two reservoirs at temperatures of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40°C and -20°C. The heat transfer to the engine is 2000 kJ and the net work output of the combined engine refrigerator plant is 360 kJ. Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C.	[5]	5	5

:::::: 30/09/2022 ::::::M