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

CLASS: BTECH **SEMESTER : III**
BRANCH: PIE **SESSION : MO/2022**

SUBJECT: ME289 THERMAL AND FLUID ENGINEERING

TIME: 3:00 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Define system and surroundings.	[2]	1	1
Q.1(b)	Describe the quasi-static process with a neat sketch.	[3]	1	2
Q.1(c)	Derive an expression for the $p \cdot dV$ work for a process with $p \cdot V^n = C$. What would be the work done in case of a free expansion of the gas?	[5]	1	3
Q.2(a)	Define enthalpy and write an expression for the same.	[2]	1	1
Q.2(b)	Examine whether energy is a property of the system or not.	[3]	1	4
Q.2(c)	In a gas turbine, the gas enters at the rate of 5 kg/s with a velocity of 50 m/s and enthalpy of 900 kJ/kg and leaves the turbine with a velocity of 150 m/s and enthalpy of 400 kJ/kg. The loss of heat from the gases to the surroundings is 25 kJ/kg. Assume for gas R = 0.285 kJ/kg K and C_p = 1.004 kJ/kg K and the inlet conditions to be at 100 kPa and 27°C. Determine the power output of the turbine and the diameter of the inlet pipe.	[5]	1	5
Q.3(a)	Explain with neat sketches, the different modes of heat transfer along with the expressions (derivation not required).	[5]	2	2
Q.3(b)	Water flows at 50°C inside a 2.5-cm-inside-diameter tube such that h_i = 3500 W/m$^2\cdot$°C. The tube has a wall thickness of 0.8 mm with a thermal conductivity of 16 W/m$^2\cdot$°C. The outside of the tube loses heat by free convection with h_o = 7.6 W/m$^2\cdot$°C. Calculate the overall heat transfer coefficient and heat loss per unit length to surrounding air at 20°C.	[5]	2	5
Q.4(a)	Describe the following: 1. The continuum concept of a fluid 2. The Lagrangian description of fluid flow 3. The Eulerian description of fluid flow	[6]	4	2
Q.4(b)	The velocity vector in a fluid flow is given as $\vec{V} = 4x^3\hat{i} - 10x^2y\hat{j} + 2t\hat{k}$. Find the velocity and acceleration of a fluid particle at (2, 1, 3) at time t = 1.	[4]	4	5
Q.5(a)	Derive Bernoulli's equation from Euler's equation. Also, state the assumptions made while deriving Bernoulli's equation.	[5]	5	5
Q.5(b)	The water is flowing through a pipe having diameters of 20 cm and 10 cm at sections 1 and 2, respectively. The rate of flow through the pipe is 35 liters/s. Section 1 is 6 m above the datum and section 2 is 4 cm above the datum. If the pressure at section 1 is 39.24 N/cm^2, find the intensity of pressure at section 2.	[5]	5	5

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