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

CLASS: BTECH **SEMESTER : III**
BRANCH: MECHANICAL ENGINEERING **SESSION : MO/2025**

SUBJECT: ME24201 THERMODYNAICS

TIME: 3 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)	Comment whether the following quantities can be called as properties or not. (i) $\int Pdv$ (ii) $\int Vdp$ (iii) $\int Pdv + \int Vdp$ (iv) $\frac{V}{t}dp + \frac{P}{T}d$v for PV=RT (v) $\frac{dT}{T} + \frac{P}{T}dV$ for PV=RT	[5]	1	2
Q.1(b)	A piston cylinder device contains 0.8 Kg of steam at 300 °C and 1 MPa. Steam is cooled at constant pressure until one half of the mass condenses. a) Show the process on a T-V diagram. b) Find the final temperature. c) Determine the volume change.	[5]	2	3
Q.2(a)	Make an energy analysis of the (i) Nozzle (ii) Throttling device (iii) Turbine and Compressor	[5]	2	2
Q.2(b)	In a steam power plant, saturated liquid water at 10 kPa enters a feed pump at the rate of 1 kg/s. The feed pump delivers the water to the boiler at a pressure of 3 MPa. Assuming that the pump is adiabatic, estimate the power input to the pump.	[5]	2	3
Q.3(a)	Establish the equivalence of Kelvin-Plank and Clausius statement.	[5]	3	4
Q.3(b)	A reversible power cycle is used to drive a reversible heat pump cycle. The power cycle takes in Q_1 heat units at T_1 and rejects Q_2 at T_2. The heat pump abstracts Q_4 from the sink at T_4 and discharges Q_3 at T_3. Develop an expression for the ratio Q_4/Q_1 in terms of the four temperatures.	[5]	3	4
Q.4(a)	State and prove the Clausius inequality.	[5]	4	2
Q.4(b)	0.2kg of air at 300°C is heated reversibly at constant pressure to 2066K. Find the available and unavailable energies of the hear added. Take T_0=30°C and Cp = 1.0047 KJ/KgK.	[5]	4	3
Q.5(a)	Explain how the Clausius–Clapeyron equation helps in determining the slope of the phase boundary between liquid and vapor phases of a substance.	[5]	4	2
Q.5(b)	Describe the Joule–Thomson coefficient and explain how it indicates whether a gas will cool or heat upon expansion.	[5]	4	2

::::::25/11/2025::::::E