CRG

Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

Makeup JAN 2023

III SEMESTER B.TECH. END SEMESTER EXAMINATIONS

~~13 December 2022~~ Makeup 2023

SUBJECT: CHEMICAL ENGINEERING THERMODYNAMICS - I [CHE 2151]

REVISED CREDIT SYSTEM

Time: 3 h **Max. Marks: 50**

Instructions to Candidates:

- Answer ALL questions & missing data may be suitably assumed

1A	State Zeroth law of thermodynamics.	**2**
1B	The potential energy of a body of mass 10 kg is 1.5 kJ. What is the height of the body from the ground? If a body of 10 kg is moving at a velocity of 50 m/s, what is its kinetic energy?	**3**
1C	A spherical ballon of diameter 0.5 m contains a gas at 1 bar and 300K. The gas is heated and the balloon is allowed to expand. The pressure inside the balloon is found to vary linearly with the diameter. What is the work done by the gas when pressure inside reaches 5 bar?	**5**
2A	A system consisting of some fluid is stirred in a tank. The rate of work done on the system by the stirrer is 2.25 hp. The heat generated due to stirring is dissipated to the surroundings. If the heat transferred to the surroundings is 3400 kJ/hr, determine the change in internal energy.	**3**
2B	A steam power plant produces 50 MW of net work while burning fuel to produce 150 MW of heat energy at the high temperature. Determine the cycle thermal efficiency and the heat rejected by the cycle to the surroundings?	**3**
2C	A gas which occupies a volume of 0.2 m^3 at a pressure of 1 bar is expanded to a final pressure of 7 bar. The pressure of the gas varies according to the relation $P = 1200 V + b$, where P is in kPa, V is in m^3 and b is a constant. Calculate the work done by the gas.	**4**
3A	What are the assumptions involved in Ideal-gas equation?	**2**
3B	140 kg of nitrogen at a pressure 4.052×10^5 Pa is stored in a cylinder of volume 30 m^3. It is desired to keep the gas temperature below 25°C. Does the cylinder need cooling if nitrogen behaves like an ideal gas	**3**
3C	One kilomol CO_2 occupies a volume of 0.381 m^3 at 313 K. Calculate the pressures given by van der Waals equation. Take van der Waals equation constants a = 0.365 Nm^4/mol^2 and $b = 4.28 \times 10^{-5}$ m^3/mol.	**5**
4A	A 40 kg steel casting ($C_P = 0.5$ kJ kg^{-1} K^{-1}) at a temperature of 723 K is quenched in 150 kg of oil ($C_P = 2.5$ kJ kg^{-1} K^{-1}) at 298 K. If there are no heat losses, what is the change in entropy of (i) the casting, (ii) the oil, and (iii) both considered together?	**5**
4B	Determine the increase in entropy of solid magnesium when the temperature is increased from 300 K to 800 K.	**3**

	$C_P = 26.04 + 5.586 \times 10^{-3}$ T J/mol K	
4C	State Third law of thermodynamics.	**2**
5A	To maintain the temperature of a solution at 261 K, 1000 kJ of heat per minute is continuously removed from it. The surrounding temperature is 288 K. What is the least amount of power (hp) necessary to accomplish this?	**3**
5B	Briefly describe any four properties of refrigerant considered for choosing them for an industrial applications	**2**
5C	For a simple compressible systems, derive Maxwell equations	**5**