Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. END SEMESTER EXAMINATIONS

22 JANUARY 2022

SUBJECT: CHEMICAL ENGINEERING THERMODYNAMICS - I [CHE 2151]

REVISED CREDIT SYSTEM

Time: 75 min **Max. Marks: 20**

Instructions to Candidates:

- Answer ALL questions & missing data may be suitably assumed

1A	The potential energy of a body of mass 20 kg is 1.8 kJ. What is the height of the body from the ground? If a body of 15 kg is moving at a velocity of 150 m/s, what is its kinetic energy?	**3**
1B	Calculate ΔU and ΔH in J for 2 kmol water, as it is vapourized at the constant temperature of 373 K and constant pressure of 101.3 kPa. The specific volume of the liquid and vapour at these conditions are 1.04×10^{-3} and 1.675×10^{-3} m^3/kmol respectively; 2030 J of heat is added to water for this change.	**3**
1C	A 15 m^3 tank contains 45 kmol of a gas at 210 bar and 935 K. Determine the critical temperature of the gas using generalized compressibility factor method. Given that the critical pressure is 50 bar.	**4**
2A	A Carnot heat engine receives 700 kJ of heat per cycle from a high-temperature heat reservoir at 752°C and rejects heat to a low-temperature heat reservoir at 40°C. Determine (i) The thermal efficiency of this Carnot engine and (ii) The amount of heat rejected to the low-temperature heat reservoir	**3**
2B	The molar volume of an organic liquid at 400 K and 2 bar is 0.15 m^3/mol and its coefficient of expansion is 2.5×10^{-3} K^{-1}. What would be the change in entropy if the pressure is increased to 40 bar at 400 K?	**3**
2C	A vapour compression refrigeration system with ammonia as the working fluid is to operate between 266 K and 300 K. Determine the following: (i) COP, given that the enthalpy of saturated vapour at 266 K = 656 kJ/kg and enthalpy of superheated vapour leaving the compressor = 724 kJ/kg, enthalpy of saturated liquid at 300 K = 144 kJ/kg. (ii) COP, if a temperature approach of 5 K is necessary in the evaporator and condenser and the efficiency of the compressor is 75%. Enthalpy of saturated vapour at 261 K = 652 kJ/kg and the enthalpy of superheated vapour entering the condenser = 758 kJ/kg, enthalpy of saturated liquid at 305 K = 159 kJ/kg.	**4**