A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 54901

B.E./B.Tech. DEGREE EXAMINATION, NOV 2019

Fourth Semester

Chemical Engineering

15UCH401- CHEMICAL ENGINEERING THERMODYNAMICS-I

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Zeroth law of thermodynamics is concerned with ___. CO1- R

   (a) extent of change in a process (b) entropy change

   (c) crystalline substance (d) thermal equilibrium

2. The system unaffected by the changes in its environment is _____ system. CO1- R

   (a) Closed (b) Open (c) Isolated (d) Mechanical

3. There is no heat interaction between the system and the surroundings in a _____ process CO2- R

   (a) isobaric (b) isothermal (c) adiabatic (d) isochoric

4. All gases at same reduced pressure and temperature have same compressibility factor and all deviate from the ideal behavior to the same extent CO2- R

   (a) Hess's law (b) Principle of corresponding states

   (c) Heat of formation (d) None of the above

5. Entropy is a _____ function CO3- R

   (a) point (b) state (c) Maxwell (d) path

6. The absolute is zero for a perfect crystalline substance at absolute zero of temperatures CO3- R

   (a) Heat (b) Mass (c) Enthalpy (d) Entropy

7. The Helmholtz free energy (A) of a system is defined as ___ where H is enthalpy, S is entropy, U is internal energy and T is the temperature — CO4- R

(a) A = H – T S (b) A = U – T S (c) A = U + P V (d) A = U + H S

8. Un measurable quantities are replaced by measurable quantities by — CO4- R

(a) Clapeyron equation (b) Maxwell's equation

(c) Equation of state (d) Ideal gas equation

9. Throttling is an example for _____ process. — CO5- R

(a) isochoric (b) isoenthalpy (c) polytropic (d) isobaric

10. 1 ton of refrigeration is _____ kJ/h — CO5- R

(a)12000 (b) 12660 (c) 3516.67 (d) 4184

PART – B (5 x 2= 10 Marks)

11. What are state function and path function? Give examples. . — CO1- U

12. Give the physical significance of the virial coefficients. — CO2- R

13. State Carnot's theorem. Give its physical meaning — CO3- Ana

14. Provide any two assumptions made in the derivation of Clausius- Clapeyron equation from the Clapeyron equation? — CO4- R

15. Define isentropic work and efficiency in a compression process — CO5- R

PART – C (5 x 16= 80Marks)

16. (a) (i) Explain the following terms in the scope of thermodynamics with examples: — CO1- U — (8)

(a) intensive and extensive properties

(b) reversible and irreversible processes.

(ii) Nitrogen gas is confined in a cylinder and the pressure of the gas is maintained by a weight placed on the piston. The mass of the piston and the weight together is 50 kg. The acceleration due to gravity is 9.81 m/s^2 and the atmospheric pressure is 1.01325 bar. Assume frictionless piston. — CO1- App — (8)

Determine:

(i) the force exerted by the atmosphere, the piston, and the weight on the gas if the piston is 100 mm in diameter and

(ii) the pressure of the gas.

Or

	(b)	(i) A cylinder fitted with a piston has a volume 0.1 m^3 and contains 0.5 kg of steam at 500 kPa. How much heat is to be supplied to bring the temperature of the steam to 823 K keeping the pressure constant? What is the work done in the process?	CO1- App	(8)
		(ii) Explain the reversible and irreversible process with neat sketch.	CO1- U	(8)
17.	(a)	(i) Discuss the P – V – T behavior and thermodynamic state of a pure water fluid as a function of pressure and volume	CO2- App	(10)
		(ii) Show that Cp-Cv =R for an ideal gas	CO2-App	(6)
		Or		
	(b)	Explain the constant pressure, constant volume and constant temperature processes involving ideal gases	CO2-Ana	(16)
18.	(a)	Develop the expression for first law of thermodynamics for steady state flow process	CO3-U	(16)
		Or		
	(b)	(i) A steel casting at a temperature 725 K and weighing 35 kg is quenched in 150 kg oil at 275 K. If there are no heat losses, determine the change in entropy. The specific heat (C_P) of steel is 0.88 kJ/kg K and that of oil is 2.5 kJ/kg K	CO3-Ana	(8)
		(ii) Draw the schematic representation of a heat engine and explain the thermodynamic cycles involved	CO3-U	(8)
19.	(a)	Derive all Maxwell relations and explain the relationship between characteristics function and thermodynamic parameters.	CO4- U	(16)
		Or		
	(b)	Write the importance of Gibb's- Helmholtz equation? How would you obtain an equation for the free energy as a function of temperature?	CO4- U	(16)

20.	(a)	(i) Develop the general equations of balance for the duct flow of compressible fluids.	CO5- Ana	(8)
		(ii) Discuss the Rankine cycle for the production of power from heat in a steam power plant.	CO5- Ana	(8)
		Or		
	(b)	Explain the steps involved in the heat and power generation using jet engines and rocket engines.	CO5- Ana	(16)