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

Question Paper Code: 54901

B.E./B.Tech. DEGREE EXAMINATION, APRIL 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. Heat capacity is _____ CO1- R

   (a) Derived property (b) Intensive property (c) Extensive property (d) None of these

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

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

3. Joule Thomson coefficient is _____for an ideal gas CO2- R

   (a) Zero (b) One (c) Negative (d) Positive

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. The concept of cyclic operations to study the principles of second law of thermodynamics is _____ law. CO3- R

   (a) Zeorth (b) First (c) Second (d) Third

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. _____ predicts the dependence of equilibrium pressure on temperature when two phases of a given substance coexist. CO4- R

(a) Helmholtz (b) Gibbs (c) Clapeyron equation (d) None of the above

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. Porous plug is an example of _____process. CO5- R

(a) Throttling (b) Threshold (c) Adiabatic (d) Isothermal

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. Differentiate path & state function. CO1- U

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

13. What is the change in entropy when 1 kmol of an ideal gas at 335 K and 10 bar is expanded irreversibly to 300 K and 1 bar? Cp=29.3 kJ/kmol K. CO3- Ana

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

15. What is multi stage compression? What are its advantages? CO5- R

PART – C (5 x 16= 80Marks)

16. (a) An elevator with a mass of 3 tons rest at a level of 15m above the base of an elevator shaft .It is raised to 125m above the base of the shaft and strikes a spring and comes to rest. Calculate CO1- App (16)

(a) The potential energy of the elevator in its initial and final position.

(b) Work required to raise the elevator.

(c) The velocity and kinetic energy of the elevator before it strikes the spring.

(d) The potential energy of the compressed spring.

(e) If the elevator and the spring are considered as a system, calculate the energy of the systems at the different conditions mentioned above. State your assumptions and explain the inference.

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) 1 kilo mol CO_2 occupies a volume of 0.381 m^3 at 313 K. Compare the pressures given by CO2- App (10)

(a) Ideal gas equation

(b) Van der Waals equation

Take the Van der Waals constants to be a=0.365 Nm^4/mol^2 and b=4.28x10^{-5} m^3/mol

(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) Hydrocarbon oil is to be cooled from 425K to 340K at a rate of 5000kg/h in a parallel flow heat exchanger. Cooling water at a rate of 10,000kg/h at 295K is available. The mean specific heats of the oil and water are respectively 2.5kJ/kg K and 4.2kJ/kg K. CO3 Ana (16)

(a) Determine the total change in entropy. Is the process reversible?

(b) If a reversible Carton engine is to be operated receiving the heat from the oil rejecting the heat to the surroundings at 295kJ/kg K, how much work would be available?

19. (a) Derive the Maxwell's equation from the basic definition of internal energy and reference properties. 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) Compare the thermal efficiency for Diesel cycle and Rankine cycle used for the analysis of internal combustion engines and steam power plant. CO5- Ana (16)

Or

(b) Explain convergent–divergent flow through nozzles and deduce the equation for the critical pressure ratio. CO5- Ana (16)