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

Question Paper Code: 54901

B.E./B.Tech. DEGREE EXAMINATION, MAY 2018

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. An isolated system is one in which CO1- R

(a) mass does not cross boundaries of the system, though energy may do so

(b) energy does not cross boundaries of the system, though mass may do so

(c) both energy and mass cross the boundaries of the system

(d) mass crosses the boundary but not the energy

2. Properties of substances like pressure, temperature and density, in thermo dynamic coordinates are CO1- R

(a) path functions (b) point functions (c) cyclic functions (d)real functions

3. At a pressure below the triple point line, CO2- R

(a) the substance cannot exist in the liquid phase

(b) the substance when heated transforms from solid to vapour

(c) both of the mentioned

(d) none of the mentioned

4. For an ideal gas, Z has the value CO2- R

(a) 0 (b) 2 (c) 1 (d) infinity

5. Carnot cycle efficiency is maximum when CO3- R

(a) initial temperature is 0°K (b) final temperature is 0°K

(c) difference between initial and final temperature is 0°K (d) final temperature is 0°C

6. The door of a running refrigerator inside a room was left open. Which of the following statements is correct? CO3- R

(a) The room will be cooled to the temperature inside the refrigerator.

(b) The room will be cooled very slightly.

(c) The room will be gradually warmed up.

(d) The temperature of the air in room will remain unaffected.

7. Which of the following is not a Maxwell equation? CO4- R

(a) $(\partial T/\partial V) = -(\partial p/\partial S)$ (b) $(\partial T/\partial p) = -(\partial V/\partial S)$

(c) $(\partial p/\partial T) = (\partial S/\partial V)$ (d) $(\partial V/\partial T) = -(\partial S/\partial p)$

8. The Gibbs-Duhem equation is given by CO4- R

(a) SdT + Vdp – Σ(n)*d(molal chemical potential)

(b) -SdT + Vdp – Σ(n)*d(molal chemical potential)

(c) SdT + Vdp – Σ(n)*d(molal chemical potential)

(d) -SdT – Vdp – Σ(n)*d(molal chemical potential)

9. In a compressible flow CO5- R

(a) Density is constant (b) Pressure is constant

(c) Temperature is constant (d) Density varies.

10. For same compression ratio and for same heat added CO5- R

(a) Otto cycle is more efficient than Diesel cycle

(b) Diesel cycle is more efficient than Otto cycle

(c) efficiency depends on other factors

(d) both Otto and Diesel cycles are equally efficient

PART – B (5 x 2= 10Marks)

11. Define thermodynamic equilibrium. CO1- R

12. What is compressibility factor? CO2- R

13. What are the assumptions made on heat engine? State Carnot theorem. CO3- R

14. State the importance of clausius clapeyron equation. CO4- R

15. If an aeroplane goes to higher altitudes maintaining the same speed, the Mach number will remain constant. Say true or false. CO5- R

PART – C (5 x 16= 80Marks)

16. (a) A gas undergoes a thermodynamic cycle consisting of the following Processes: CO1- App (16)
(i) Process 1–2: Constant pressure p = 1.4 bar, V1 = 0.028 m^3, W12 = 10.5kJ
(ii) Process 2–3: Compression with pV = constant, U3 = U2
(iii) Process 3–1: Constant volume, U1 – U3 = – 26.4 kJ. There are no significant changes in KE and PE.
(a) Sketch the cycle on a *p–V* diagram
(b) Calculate the network for the cycle in kJ
(c) Calculate the heat transfer for process

Or

(b) A fluid is confined in a cylinder by a spring-loaded, frictionless piston so that the pressure in the fluid is a linear function of the volume (p = a + bV). The internal energy of the fluid is given by the following equation U = 34 + 3.15pV where, U is in KJ, p in KPa, and V in cubic meter. If the fluid changes from an initial state of 170KPa,0.03m^3 to a final state of 400KPa,0.06m^3,with no work other than that done on the piston, find the direction and magnitude of the work and heat transfer. CO1- App (16)

17. (a) A vessel of volume 0.28m^3 contains 10 kg of air at 320 k. Determine the pressure exerted by the air using a) perfect gas equation b) Vander walls equation c) Generalized compressibility chart.(Take critical temperature of air as 132.8 k and critical pressure of air as 37.7 bar. CO2- App (16)

Or

(b) Deduce an expression for ideal gas equation of state from basic principles. CO2- Ana (16)

18. (a) Air flows steadily at the rate of 0.5Kg/s through an air compressor, entering at 7 m/s velocity, 100 KPa pressure and 0.95 m^3/Kg volumes and leaning at 5m/s, 700 KPa and 0.19m^3/Kg. the internal energy of the air leaving is 90 KJ/Kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58 KW. CO3- Ana (16)
(i) compute the rate of shaft work input to the air in KW.
(ii) Find the ratio of the inlet pipe diameter to the outlet pipe diameter.

Or

(b) $0.5m^3$ of air at 5 bar pressure and 100^oC is in a closed system cylinder undergoes a reversible adiabatic expansion till the pressure falls to 1 bar. The gas is expanded at constant pressure till internal energy increases by 1000kJ.Calculate CO3- Ana (16)

(i) the total work done

(ii) heat transfer

(iii) the index of expansion , if the above process are replaced by a single reversible polytropic process giving the same work between the same initial and final states.

19. (a) Derive Maxwell's relations. CO4-App (16)

Or

(b) Evaluate the thermodynamic properties from an equation of state. CO4 -App (16)

20. (a) Explain the effect of Mach number on compressibility. Calculate the percentage deviation due to the assumption of incompressibility when Mach number is equal to 0.5 and specific heat ratio is 1.4. CO5- U (16)

Or

(b) Describe the working of a Turbo jet engine with help of neat sketch. CO5- U (16)