Ref. No. : Ex/FTBE/T/311/2018

B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING THIRD YEAR FIRST SEMESTER EXAM 2018

Subject-CHEMICAL ENGINEERING THERMODYNAMICS **Time- 3 hr** **FM-100**

Part - I (50)

Use separate answer script for each part

(Answer question no 1 or 2 and any two from the rest)

1. 4 m^3 of gas are allowed to expand at a constant temperature from an initial absolute pressure of 390000 pa to a final absolute pressure of 200000 pa. Determine the final volume. Discuss the function of different components of refrigeration system. 4+6=10
2. Discuss the working principal of four stroke engine. How can you get the idea of defects in piston ring? 6+4=10
3. What is absorption refrigeration cycle, Discuss with net sketch? Derived an equation for COP of an absorption system. 10+10+20
4. A vapor-compression heat pump system uses R-12 as the working fluid.the refrigerant enters the compressor at 2.5 bar, 0° C and the saturated liquid exits the condenser at 9.5 bar. Determine a) the power input to the compressor. b) The heating capacity of the system. c) Coefficient of performance, d) the isentropic compressor efficiency. Discuss the Linde-Hamposon cycle for Air Liquefaction with T-S diagram. 12+8=20
5. An engine working on the Otto cycle is supplied with air at 0.12 MPa, 30^0C. the compression ratio is 8. Heat supplied is 2100kJ/kg. calculate the maximum pressure and temperature of the cycle, the cycle efficiency, and the mean effective pressure. For air, C_p=1.005, C_v= 0.718, and R=0.287 kJ/Kg K. Discuss Diesel Cycle with net diagram. 14+6=20

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B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING THIRD YEAR FIRST SEMESTER – 2018

Subject: CHEMICAL ENGG.THERMODYNAMICS **Time: Three Hours** **Full Marks: 100**

Use Separate Answer Scripts for Part I and Part II

Part II (Marks-50)

Question No.1 is Compulsory and answer any ***three*** questions from rest

1. i. Find the degrees of freedom for the following system:

Liquid water in equilibrium with a mixture of water vapor and nitrogen

ii. Assumptions and limitations of Raoult's law for VLE. 2+3=5

2. An ideal gas undergoes the following sequence of mechanically reversible process in a closed system

a) From an initial state of 343.15K and 1 bar it is compressed adiabatically to 423.15K

b) It is then cooled from 43.15K to 343.15K at constant pressure.

c) Finally it is expanded isothermally to its original state.

Calculate W,Q,ΔU and ΔH for each of three processes and for the entire cycle. c_V=3/2R and c_P=5/2R 4+4+4+3=15

3. Derive the followings:

i. Clausius-Clapeyron Equation.

ii. Gibbs -Duhem Relations 6+9=15

4. Define:

i. Chemical potential

ii. Fugacity

iii. Activity and activity coefficient 5+5+5=15

5. For the system methanol/methyl acetate the following equations provide a reasonable correlation for the activity coefficients:-

$\ln\gamma_1 = Ax_2^2$, $\ln\gamma_2 = Ax_1^2$ where A=2.771-0.00523T

In addition the following Antoine equations provide vapor pressures:

$$\ln P_1^{sat}/\text{ kPa} = 16.59158 - 3643.31/(T-33.424)$$

$$\ln P_2^{sat}/\text{ kPa} = 14.25326 - 2665.54/(T-53.424)$$

a) Calculate P, y_1,y_2 for T=318.15K and x_1=0.25.

b) Find the azeotropic pressure and composition for T=318.15K. 7.5+7.5=15

6. a) Derive any one Maxwell's equation.

b) Prove that slope of adiabatic curve is steeper than isothermal curve.

c) Calculate the mole fraction of air dissolved in liquid phase in an air-water equilibrium system at 298.5K and 101.33kPa pressure provided the value of Henry's Law constant at 298.15 for air is 72950kPa and mole fraction of water in vapor phase is 0.0312. 5+5+5=15