Ref. No.: Ex/FTBE/BS/B/T/216/2023(S)

B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING SECOND YEAR FIRST SEMESTER SUPPLEMENTARY EXAM 2023

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

Part - I (50)

Use separate answer script for each part

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

1. Discuss the working principal of two stroke engine. What are the benefits of relating COP with temperature? 6+4=10
2. What are the different factors effect the choice of refrigerant? A reversible engine works between three heat reservoir A, B and C. the engine receives equal amount of heat from reservoir A and B at temperature T_A and T_B respectively and rejects heat to a reservoir C at temperature T_C . if the efficiency of the engine is α times the efficiency of a reversible engine operating between two reservoir A and C only, then show that
   $T_A / T_B = 2(1-\alpha)T_A / T_C + (2\alpha-1)$ 10+10+20
3. An air refrigeration open system operating between 0.5 MPa and 50 kPa is required to produce a cooling effect of 2000 kJ/min. the temperature of air leaving the cold chamber is -5^0 C and at leaving the cooler is 30^0C. Neglecting losses and clearance in the composure and expander, determine: a) mass of air circulated per hour, b) compressor work, expander work and the cycle work, c) coefficient of performance and the power required to run the machine. Derived an equation for COP of Bel- Coleman Cycle. ?

   12+8=20
4. An engine working on the Otto cycle is supplied with air at 0.12 MPa, 30^0C. The compression ratio is 7. Heat supplied is 1800 kJ/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. 12+8=20

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Subject : CHEMICAL ENGINEERING THERMODYNAMICS

Time: 3hr **Full Marks: 100**

Part II (Total Marks 50)

Instructions : Use Separate Answer scripts for each part

Answer any <u>five</u> questions from the following: **5x10=50**

1. Deduce the First and Second TdS equation. Prove that dS = Cp.dT/T - R.dP/P 7+3=10

2. a) Define Volume expansivity (β) and Isothermal compressibility K_T.

b) For acetone at 293.15 K and 1 bar

$\beta = 1.487 \times 10^{-3}\ K^{-1}$

$K_T = 62 \times 10^{-6}\ bar^{-1}$

$V = 1.287 \times 10^{-3}\ m^3/kg$

Find

i. The value of $(\delta P/\delta T)_V$

ii. The pressure generated when acetone is heated at constant volume from 293 K and 1 bar to 303 K.

iii. The volume change when acetone is changed from 293 K and 1 bar to 273 K and 10 bar. 4+6=10

3. Prove that

dS=Cp.(dT/T)-R.(dP/P) .....equation (I)

For an ideal gas with constant heat capacities undergoing a reversible adiabatic (Isentropic) process.

$$(T_2/T_1) = (P_2/P_1)^{(\gamma-1)/\gamma}$$

Show that the same equation results from application of equation (I) with ΔS=0 5+5=10

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

b) Prove that slope of adiabatic curve is steeper than isothermal curve. 5+5=10

5. Find out

a) Gibb's Duhem relations

b) Clapeyron equation 6+4=10

6.a) Show the P-V diagram for the following processes:

i. isobaric process

ii. Isochoric process 2+2=4

b) Write the difference between the following;

Intensive property and Extensive property, State function and Path function. 3+3=6