QP Code: RJ23MTECH019 | Reg. No | | | | | | | | | | | AY 23

GIET UNIVERSITY, GUNUPUR – 765022

M. Tech (First Semester) Examinations, January – 2024

MPCTE1010 – Advanced Engineering Thermodynamics

(Heat Power and Thermal Engineering)

Time: 3 Hrs | Maximum: 70 Marks

(The figures in the right hand margin indicate marks.)

PART – A **(2 x 10 = 20 Marks)**

Q.1. Answer all questions	CO#	Blooms Level
a. Define Thermodynamic Probability in relation to entropy.	CO2	K1
b. A 1-m^3 tank is filled with a gas at room temperature (20°C) and pressure (100 kPa). How much mass is there if the gas is a. air, b. oxygen ?	CO1	K1
c. A closed vessel contains 0.1 m^3 of saturated liquid and 0.9 m^3 of saturated water vapor in equilibrium at 200 kPa. Determine the percent vapor on a mass basis.	CO1	K2
d. Explain the concept of Helm Holtz free energy.	CO2	K2
e. Describe the Maxwell equation and explain their importance in establishing relationship between thermodynamic property.	CO2	K2
f. Define the term air-fuel ratio. How is it related to the fuel-air ratio?	CO4	K1
g. Define enthalpy of formation?	CO4	K1
h. Explain thermochemical exergy and chemical energy.	CO4	K2
i. Describe the viral coefficients? When do they become zero?	CO2	K1
j. If we say a particular energy level is 10 fold degenerate, then what do you understand from that?	CO3	K1

PART – B **(10 x 5=50 Marks)**

Answer ***ANY FIVE*** questions	Marks	CO#	Blooms Level
2. a. A pressure vessel has a volume of 1 m^3 and contains air at 1.5 MPa and 195^{0}C.The air is cooled to 25^{0}C by heat transfer to the surrounding at 25^{0}C. Calculate the availability in the initial and final state and irreversibility of the process. Take P_0 = 100 kPa.	5	CO2	K3
b. Air at 300 kPa and 200^{0}C is in a piston cylinder arrangement with a volume of 0.1 m^3. It is now compressed in polytropic process with exponent n = 1.2 to a final temperature of 300^{0}C. Calculate the heat transfer for the process.	5	CO2	K3

3.a.	Show that there is no change in temperature when an ideal gas is made to undergo a Joule Thomson expansion.	5	CO1	K2
b.	Determine the change in entropy of 0.5 kg of air compressed polytropically from 1bar to 0.8 MPa and 800 K following index 1.2. Take Cv=0.718kJ/kg-K.	5	CO2	K2
4a.	A gasoline engine delivers 150 kW. The fuel used in C_8H_{18} (liq) and it enters the engine at 25^0C. 150 % of theoretical air is used, and enters at 45^0C the products of combustion leave the engine at 750 K and the heat transfer from the engine is 250 kW. Determine the fuel consumption in kg per hour if complete combustion is achieved.	10	CO2	K2
5.a.	Show that for an inversion curve $(\delta z/\delta p)T = 0$	5	CO1	K4
b.	If the thermodynamic variables are P, V, T then prove that $(\delta P/\delta V)T\ (\delta V/\delta T)P\ (\delta T/\delta P)v = -1$.	5	CO1	K4
6. a.	Derive the equation $(\delta Cp/\delta p)T = - T\ (\delta^2V/\delta T^2)$.	6	CO2	K4
b.	What do you understand by Standard Gibbs Function Change?	4	CO1	K1
7.a.	Briefly explain Fermi Dirac and Bose Einstein statics.	5	CO1	K2
b.	Explain Onsager's reciprocal relation.	5	CO1	K2
8. a.	Methane is reversibly compressed at 230 K in a steady state steady flow (sssf) device from 150 bar to 1000 bar. Using the fugacity charts, determine work done in kJ/Kmol. Critical pressure is 46.4 bar and critical temperature is 190.7K.	10	CO2	K2

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