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Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

M.Tech. (First Semester – Regular/ Supplementary) Examinations, January– 2026

24MTEPC11001 – Advanced Engineering Thermodynamics

(HPTE)

Time: 3 hrs | Maximum: 60 Marks

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

PART – A **(2 x 5 = 10 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	K2
c.	Describe the Maxwell equation and explain their importance in establishing relationship between thermodynamic property.	CO2	K2
d.	Define the term air-fuel ratio. How is it related to the fuel-air ratio?	CO4	K1
e.	Define enthalpy of formation.	CO4	K1

PART – B **(10 x 5 = 50 Marks)**

	Answer ***ALL*** the 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.	10	CO2	K4
	(OR)			
b.	Show that for an inversion curve $(\delta z/\delta p)T = 0$	5	CO1	K4
c.	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
3.a.	Derive the equation $(\delta Cp/\delta p)T = - T (\delta 2V/\delta T2)$	5	CO2	K4
b.	What do you understand by Standard Gibbs Function Change?	5	CO3	K1
	(OR)			
c.	Show that there is no change in temperature when an ideal gas is made to undergo a Joule Thomson expansion.	5	CO3	K2
d.	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
4.a.	A gasoline engine delivers 150 kW. The fuel used in C_8H_{18} (liq) and it enters the engine at 25^{0}C. 150 % of theoretical air is used, and enters at 45^{0}C 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	CO4	K2
	(OR)			
b.	Define Gibbs phase rule for non-reactive system? Explain about degree of freedom.	5	CO3	K2
c.	Write down about Maxwell Boltzmann distribution for different kind of molecular speed.	5	CO4	K1
5.a.	Difference between exergy and energy.	5	CO4	K2

b.	Explain the concept of Helm Holtz free energy.	5	CO6	K2
	(OR)			
c.	Briefly explain Fermi Dirac and Bose Einstein statics	5	CO5	K2
d.	Explain Onsager's reciprocal relation.	5	CO6	K2
6.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	CO5	K3
	(OR)			
b.	Explain thermochemical exergy and chemical energy.	5	CO4	K2
c.	Describe the viral coefficients? When do they become zero?	5	CO6	K2

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