Registration no: | | | | | | | | | | |

Total Number of Pages: 2 **M.TECH**
HTPC201

2nd Semester Back Examination –2017-18
Advanced Engineering Thermodynamics
BRANCH(S): HEAT POWER & THERMAL ENGG, HEAT POWER ENGG, THERMAL ENGG, THERMAL POWER ENGG

Time: 3 Hours
Max marks: 70
Q Code:C628

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

Q1 **Answer the following questions:** **(2 x 10)**

a) When the Cp of a substance is equal with Cv
b) State Gouy- Stodola theorem of irreversibility
c) What is adiabatic flame temperature and why we study it?
d) What is the internal energy of the diatomic N_2 gas?
e) Explain how degree of freedom is defined by using phase rule for non-reacting system.
f) What is the basic difference between Energy states and Energy levels ?
g) Explain how degree of freedom is defined by using phase rule for non-reacting system.
h) What do you mean by compressibility factor and what is the value of it for ideal gas?
i) Define Thermodynamic Probability in relation to entropy.
j) What do you mean by equipartition of energy?

Q2 **a)** What do you mean by Maxwell-Boltzmann statistics, Fermi Dirac and Bose – Einstein statistics? And distinguish them. Highlight the "Pauli Exclusion Principle" **(7)**

b) Absolute temperature of any system increases with its energy. Justify. **(3)**

Q3 One kilo mole of carbon at 25^0C and 0.1 MPa Pressure reacts with 1 kmol of oxygen at 25^0C and 0.1 MPa Pressure to form an equllibrium mixture of CO_2, CO and O_2 at 3000 K, 0.1 MPa Pressure, in a steady state process. Determine the equilibrium composition and the heat transfer for this process. **(10)**

	M	$\overline{h}^0_{f,298}$ *KJ/Kmol*	*T* *K*	$\overline{h} - \overline{h}^0_{f,298}$ *KJ/Kmol*	$\overline{S}^0_{T,}$ *KJ/(Kmol K)*
CO_2	44.01	-393522	3000	152853	334.170
CO	28.01	-110527	3000	93504	273.607
O_2	31.999		3000	98013	284.466

Q4 **a)** A computer chip dissipates 2 kJ of electric work over time and rejects that as heattransfer from its 50°C surface to 25°C air. How much entropy is generated in thechip? How much if any is generated outside the chip? **(4)**

b) 80 kg of water at 100°C are mixed with 50 kg of water at 60°C, whilethe temperature of the surroundings is 15°C. Determine the decrease inavailable energy due to mixing. **(6)**

Q5 **a)** State and explain the Duhem's theorem. What is its significance in establishing the state of the System? **(5)**

b) Show that for equllibrium between phases of a pure substance the fugacities in both phases should be equal **(5)**

Q6 **a)** Derive the Classius-Clapeyron equation $T\frac{dP_{sat}}{dT} = \frac{h_{fg}}{v_{fg}}$ **(5)**

b) Please show, By the help of Partition functions and their properties **(5)**

$$Z = \ln Z^{l} + \ln Z^{ll}$$

Where Z is the partition function for the total system

Z^{l}&Z^{ll} are the partition function of weakly non interacting parts

Q7 **a)** Using the formulation of irreversible thermodynamics, write the equations for two coupled transport processes. Describe onsager'scriterian on how to choose appropriate forces and fluxes. **(6)**

b) Explain Onsager's reciprocal relation. **(4)**

Q8 **Write Short Notes (Any Two)** **(5 x 2)**

a) Entropy maximum Vs. Energy minimum principle

c) Fermi Dirac and Bose – Einstein statistics

d) The Seebeck effect Vs The Thomson effect