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

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

2nd Semester Regular/Back Examination – 2015-16
Advanced Engineering Thermodynamics

Time: 3 Hours
Max marks: 70
Q code:W803

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: (2 x 10)

a) Energy has quality as well as quantity –justify the statement
b) Explain through a suitable example the difference between the first and second law efficiencies.
c) Learning out of frustration is low entropy learning. Justify?
d) What do you mean by compressibility factor and what is the value of it for ideal gas?
e) An increase in pressure raises the boiling point of a liquid. Substantiate it.
f) If we say a particular energy level is 10 fold degenerate, then what do you understand from that?
g) Explain how degree of freedom is defined by using phase rule for non-reacting system.
h) What do you mean by fugacity?
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) What are the conditions for mechanical stability, Thermal stability and chemical stability? (3)

Q3 a) Please show, By the help of Partition functions and their properties (6)

$$Z = Z^{l} Z^{ll}$$

Where Z is the partition function for the total system

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

b) Using Maxwell relation, Prove $C_p > C_V$ (4)

Q4 a) Is it possible to perform an irreversible process with a closed system yet having entropy change nil? (4)

b) Enclosed in a perfectly insulated and smooth piston-cylinder assembly is a 20 kg mass of air. And it is then allowed to expand adiabatically from (6)

500 kPa, 353K till its volume is doubled and temperature becomes equal to 278 K- the temperature of the surroundings. Determine the

a) maximum work availability
b) change in availability due to this expansion process
c) irreversibility

Q5 a) Write down about Maxwell-Boltzmann distribution of different kind of molecular speeds. (3)

b) Determine the Fugacity of pure water for the following case. Assume Fugacity coefficient 0.74 (7)

a) Saturated Vapour at 100^{O}C
b) Saturated liquid at 100^{O}C
c) Compressed liquid at 100^{O}C and 200bar
d) Superheated vapour at 100^{O}C and 0.5 bar
e) Saturated Vapour at 350^{O}C.
f) Super cooled Vapour at 90^{O}C, 1bar. Assume ideal gas as vapour

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

b) Determine the sublimation pressure of water vapour at -60^{0}C using data from steam table. (5)

Q7 a) Explain Onsager's reciprocal relation. Using the formulation of irreversible thermodynamics, write the equations for two coupled transport processes. Describe Onsager's criterion on how to choose appropriate forces and fluxes. (10)

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

a) Entropy maximum Vs. Energy minimum principle
c) Gibbs Free Energy Vs. Helmholtz Free Energy principle
d) Joule- Thomson Coefficient