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

Total Number of Pages: 02 **M.TECH**
HTPC201

2nd Semester Back Examination 2016-17

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:Z469

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) Write down the degree of freedom for mono atomic, diatomic and triatomic gas.
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 you heat some cold liquid water to T^0 (Ambient Temperature). Does it imply that you increase its availability?
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)

Q2 a) Is it possible to perform an irreversible process with a closed system yet having entropy change nil? (3)

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 500 kPa, 353K till its volume is doubled and temperature becomes equal to 278 K- the temperature of the surroundings. Determine the (7)

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

Q5 a) What is the molar specific heat at constant volume in terms of "R" (3)

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. (7)

Q6 a) Verify Maxwell's 4th relation using steam at 250°C /300 kPa (5)

b) Show that there is no change in temperature when an ideal gas is made to undergo a Joule Thomson expansion. (5)

Q7 Explain Onsager's reciprocal relation. 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. (10)

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

a) Entropy maximum Vs. Energy minimum principle

c) Maxwell Velocity distribution

d) The Vander Waals gas