Code No: 5221AA **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Semester Examinations, February - 2016
ADVANCED THERMODYNAMICS
(Thermal Engineering)

Time: 3hrs **Max.Marks:75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART – A

5 × 5 Marks = 25

1.a) Show that adiabatic mixing of two fluids is irreversible? [5]
b) Represent water injection, steam injection and adiabatic saturation on the psychrometric chart? [5]
c) What do you understand by phase equilibrium? Explain with suitable examples. [5]
d) Explain the working principle of a binary vapour power cycle with the help of a neat diagram. [5]
e) Write the applications of Thermodynamic devices. [5]

PART - B

5 × 10 Marks = 50

2.a) Derive the maximum work obtainable from two finite bodies which are maintained at temperatures of T_1 and T_2 ?
b) If ambient temperature is 278 K on a winter day and 1 kg of water at 90^0 C available, how much work can be obtained? Take C_v of water=4.2 KJ/kg-K. [4+6]

OR

3.a) Derive Mayor's relation.
b) A 30 kg of water at 370 K is mixed with 40 kg of water at 310 K under constant Pressure conditions. Calculate the decrease in available energy? Take ambient temperature as 300 K. [4+6]

4.a) Define i) Relative Humidity ii) Dew point Temperature.
b) What is the amount of work required to separate 1 mole of air at 300 K and 1 atm pressure (assumed composed of 1/5 0_2 and 4/5 N_2) into oxygen and nitrogen each at 300 K and 1 atm pressure? [4+6]

OR

5.a) Define Joule Thomson Co efficient with the help of a neat diagram? What are its applications?
b) A cylinder capacity of 0.1 m^3 is filled with 1.35 kg of ammonia at 2 MPa pressure. Determine the temperature of the ammonia content? Take $a=422.55\times10^{-3}$ Pa $(m^3\ mol^{-1})^2$, $b= 37\times10^{-6}\ m^3\ mol^{-1}$? [4+6]

6.a) Define adiabatic flame temperature and how it is estimated.

b) Determine the chemical exergy of i) carbon ii) hydrogen iii) methane in KJ/kg in respect of the environment in which the gas phase obeys the ideal gas model. Take ambient temperature as 300 K and take standard dry air volumetric composition. [4+6]

OR

7.a) What is Gibbs function of formation? Explain.

b) Determine adiabatic flame temperature when liquid octane at 298 K is burned with 300% theoretical air at 298 K in a steady flow process? [4+6]

8.a) With the help of a neat diagram explain the working principle of a cogeneration power plant?

b) A vapor compression refrigeration system with R-12 as a refrigerant has a capacity of 20 TR operating between -28^0 C and $+26^0$ C respectively. The refrigerant is sub cooled by 4^0 C before entering the expansion valve and the vapor is super heated by 5^0 C before leaving the evaporator. The refrigerator has 6 cylinders single acting compressor with stroke equal to 1.25 times the bore. It has a clearance of 3% of the stroke volume. Determine i) Theoretical power required ii) COP iii) Volumetric efficiency iv) Bore and Stroke of the cylinder. The speed of the compressor is 1000 RPM. Take C_{Pl} = 0.963KJ/Kg-K, C_{Pv} =0.615KJ/Kg-K respectively. [4+6]

OR

9.a) With the help of a neat diagram explain the working principle of a combined cycle power plant?

b) R-22 is compressed in a centrifugal compressor between a condenser and evaporator temperatures of 35^0 C and -15^0 C. The small-stage efficiency is 0.8. Determine the specific work, adiabatic discharge temperature and polytropic efficiency? [4+6]

10.a) Explain the principle and applications of fuel cell.

b) Explain the principle and applications of Thermoionic power generation. [4+6]

OR

11.a) Explain the principle and applications of photo voltaic cell.

b) Explain the principle and applications of Magneto hydrodynamic generator with a neat diagram? [4+6]

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