Code No: 113AB **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, May/June - 2015
THERMODYNAMICS
(Common to ME, AE, AME)

Time: 3 Hours **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 **(25 Marks)**

1.a) What is the difference between a closed system and an open system? [2M]
b) What do you understand by point function and path function? What are exact and inexact differentials? [3M]
c) All spontaneous processes are irreversible. Explain. [2M]
d) What is PMM 1? Why is it impossible? [3M]
e) Explain in brief throttling process and free expansion. How does they differ from each other? [2M]
f) Why do the isobars on Mollier diagram diverge from one another? Why do isotherms on Mollier diagram become horizontal in superheated region at low pressures? [3M]
g) What is mole? State Dalton's law of partial pressure and Avogadro's laws of additive volumes. [2M]
h) State Gibb's theorem and write expressions of average specific internal energy, average specific enthalpy and average specific heats of the mixtures. [3M]
i) Why P-H diagram is used to represent Vapour compression cycle? Draw P-H diagram of actual vapour compression Cycle. [2M]
j) State different types of power cycles. Mention the merits and demerits of Stirling and Ericsson Cycles. [3M]

PART-B **(50 Marks)**

2.a) The resistance of a platinum wire is found to be 11000 ohms at the ice point, 15.247 ohms at the steam point and 28.887 at the sulphur point. Find the constants A and B in the equations.

$$R = R_0\left(1 + At + Bt^2\right)$$

b) What is irreversibility and State the causes of irreversibility.
c) A turbine operates under steady flow conditions, receiving steam at the following state: 1.2 MPa, 180^0C, 2785 kJ/kg, 33.3 m/sec and elevation 3 m. Steam leaves the turbine at the following state: 20 KPa, 2512 kJ/kg, 100 m/sec and elevation 0 m. Heat is lost to the surrounding at the rate of 0.29 kJ/sec. if the rate of steam flow through the turbine is 0.42 kg/sec. what is power output of turbine in kW. [4+2+4]

OR

3.a) A cylinder/ piston contain 100 L of air at 110 kPa, 25^{0}C. The air is compressed in reversible polytrophic process to a final state of 800 kPa, 200^{0}C. Assume the heat transfer is with the ambient at 25°C and determine the polytrophic exponent n and the final volume of air. Find the work done by the air, the heat transfer.

b) During one cycle the working fluid in an engine engages with two work interactions: 15 kJ to the fluid and 44 kJ from the fluid, and three heat interaction two of which are known: 75 kJ to the fluid and 40 kJ from the fluid. Evaluate the magnitude and direction of third heat transfer for the system. [5+5]

4.a) If 20 kJ of heat is added to a Carnot cycle at a temperature of 110^{0}C and 14.5 kJ heat is rejected at 0^{0}C, determine the location of absolute zero on Celsius scale.

b) The amount of entropy generation quantifies the intrinsic irreversibility of a process. Explain.

c) Air flows through an adiabatic compressor at 2 kg/s. the initial conditions are 1 bar and 310 K and the exit conditions are 7 bar and 560 K. Compute the net rate of availability transfer and irreversibility. Take T_0=298 K. [4+2+4]

OR

5.a) In a steam power plant 1 MW is added at 700^{0}C in the boiler, 0.58 MW is taken at out at 40^{0}C in the condenser, and the pump work is 0.02 MW. Find the plant thermal efficiency. Assuming the same pump work and heat transfer to the boiler is given, how much turbine power could be produced if the plant were running in a Carnot cycle?

b) We propose to heat a house in the winter with a heat pump. The house is to be maintained at 20^{0}C at all times. When the ambient temperature outside drops at -10 ^{0}C that rate at which heat is lost from the house is estimated to be 25 kW. What is the minimum electrical power required to drive the heat pump? [5+5]

6.a) A cylinder has a thick piston initially held by a pin as shown in figure 1 below. The cylinder contains carbon dioxide at 200 KPa and ambient temperature of 290K. The metal piston has a density of 8000 Kg/m^3 and the atmospheric pressure is 101 KPa. The pin is now removed, allowing the piston to move and after a while the gas returns to ambient temperature. Is the piston against the stops?

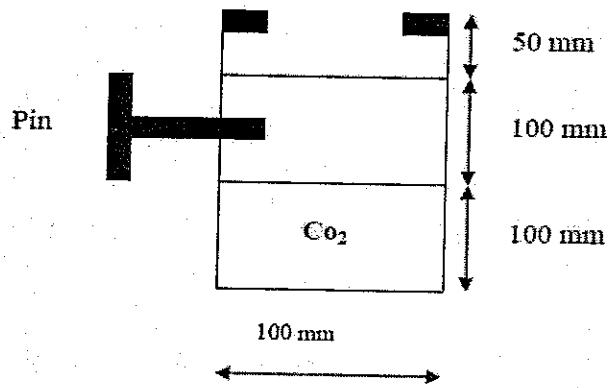

Figure: 1