Printed Pages : 4

NME-303

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 140312

Roll No.

B. Tech.

(SEM. III) (ODD SEM.) THEORY EXAMINATION, 2014-15

THERMODYNAMICS

Time : 2 Hours] [Total Marks : 50

1 Attempt any FOUR parts :

a) An incompressible gas in the cylinder of 15 cm diameter is used to support a piston, as shown in FIG 1. Manometer indicates a difference of 12 cm of Hg column for the gas in cylinder. Estimate the mass of piston that can be supported by the gas. Take density of mercury as 13.6×10^3 kg/m^3.

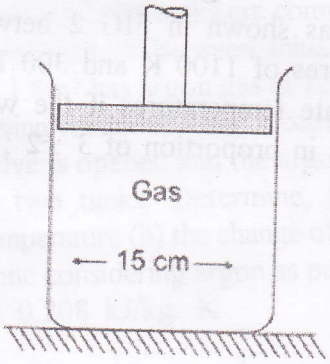

FIG 1

b) What is meant by quasi-static process? Also discuss its physical significance.

c) State Zeroth law of thermodynamics. Explain how the Zeroth law of thermodynamics can be used for temperature measurement.

d) Define the first law of thermodynamics. How the first law of thermodynamics is applied to a closed system undergoing a non-cyclic process?

e) An inelastic flexible balloon is inflated from initial empty state to a volume of 0.4 m^3 with H^2 available from hydrogen cylinder. For atmospheric pressure of 1.0313 bar determine the amount of work done by balloon upon atmosphere and work done by atmosphere.

f) Draw the p-T diagram of pure substance and explain its various regions of the diagram in details.

2 Attempt any TWO parts :

a) I. In a nozzle air at 627°C and twice atmospheric pressure enters with negligible velocity and leaves at a temperature of 27°C. Determine velocity of air at exit, assuming no heat loss and nozzle being horizontal. Take Cp = 1.005 kJ/kg.K for air.

II. Explain the reversible and irreversible processes.

b) Three reversible engines of Carnot type are operating in series as shown in FIG 2 between the limiting temperatures of 1100 K and 300 K. Determine the intermediate temperatures if the work output from engines is in proportion of 3 : 2 : 1.

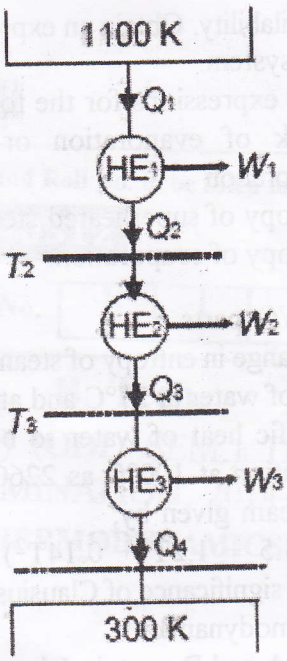

FIG 2

c) State the Kelvin Planck and Clausius statements of 2nd law of thermodynamics. Show the equivalence of Kelvin Planck and Clausius statements of 2nd law of thermodynamics.

3 Attempt any TWO parts :

a) Two insulated tanks are connected through a pipe with closed valve in between. Initially one tank having volume of $1.8m^3$ has argon gas at 12 bar, 40°C and other tank having volume of $3.6m^3$ is completely empty. Subsequently valve is opened and the argon pressure gets equalized in two tanks. Determine, (a) the final pressure & temperature (b) the change of enthalpy and (c) the work done considering argon as perfect gas and gas constant as 0.208 kJ/kg. K

b) Define availability. Obtain an expression for availability of closed system.

c) Derive the expressions for the following :

I. Work of evaporation or external work of evaporation

II. Entropy of superheated steam

III. Entropy of evaporation.

4 Attempt any TWO parts :

a) Find the change in entropy of steam generated at 400°C from 5 kg of water at 27°C and atmospheric pressure. Take specific heat of water to be 4.2 kJ/kg.K, heat of vaporization at 100°C as 2260 kJ/kg and specific heat for steam given by;

$Cp = R\ (3.5 + 1.2T + 0.14T^2)$ J/kg.K

b) Discuss the significance of Clausius inequality and third law of thermodynamics.

c) Two tanks A and B contain 1 kg of air at 1 bar, 50°C and 3 bar, 50°C when atmosphere is at 1 bar, 15°C. Identify the tank in which stored energy is more. Also find the availability of air in each tank.

5 Attempt any TWO parts :

a) Write short notes on the following :

Brake power, Indicated power, Brake specific fuel consumption, Indicated specific fuel consumption, Brake mean effective pressure, Indicated mean effective pressure, Mechanical efficiency, Brake thermal efficiency, Indicated thermal efficiency.

b) In a piston-cylinder arrangement the steam at 1.0 MPa, 80% dryness fraction, and 0.05 m^3 volume is heated to increase its volume to 0.2 m^3. Determine the heat added.

c) Describe simple Rankine cycle with P–V Diagram and any one method of dryness fraction measurement.
