Printed Pages : 3

ME-301

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

PAPER ID : 140304

Roll No.

B. Tech.

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

THERMODYNAMICS

Time : Hours] [Total Marks : 100

1 Attempt any **FOUR** parts : 5×4=20

a) Write short notes on the following :
State, path, closed system, isolated system, extensive and intensive properties.

b) State Zeroth law of thermodynamics. Write equivalence amongst different temperature scales. Also write brief note on each of them.

c) A gas at 65 kPa, 200°C is heated in a closed, rigid vessel till it reaches to 400°C. Determine the amount of heat required for 0.5 kg of this gas if internal energy at 200°C and 400°C are 26.6 kJ/kg and 37.8 kJ/kg respectively.

d) State the Limitations of first law of thermodynamics and Internal Energy.

e) Throttling calorimeter has steam entering to it at 10 MPa and coming out of it at 0.05 MPa and 100°C. Determine dryness fraction of steam.

f) Write short notes on the following :
   I. Critical point
   II. Triple point.

2 Attempt any **TWO** parts : **10×2=20**

a) I. Carbon dioxide passing through a heat exchanger at a rate of 50 kg/hr is to be cooled down from 800°C to 50°C. Determine the rate of heat removal assuming flow of gas to be of steady and constant pressure type. Take Cp = 1.08 kJ/kg K.
   II. Derive the unsteady flow process energy equation.

b) A reversible heat engine runs between 500°C and 200°C temperature reservoirs. This heat engine is used to drive an auxiliary and a reversible heat pump which runs between reservoir at 200°C and the body at 450°C. The auxiliary consumes one third of the engine output and remaining is consumed for driving heat pump. Determine the heat rejected to the body at 450°C as fraction of heat supplied by reservoir at 500°C.

c) Write short notes on the following: Heat reservoir, Heat engine, Heat pump and refrigerator and also Show that coefficient of performance relationship between heat pump and refrigerator.

3 Attempt any **TWO** parts : **10×2=20**

a) State Carnot theorem and explain its corollaries in detail.

b) Discuss different zones on T–V and P-T diagram for steam with help of variation curves.

c) Steam at 1.6 MPa, 300°C enters a flow device with negligible velocity and leaves at 0.1 MPa, 150°C with a velocity of 150 m/s. During the flow heat interaction occurs only with the surroundings at 15°C and steam mass flow rate is 2.5 kg/s. Estimate the maximum possible output from the device.

4 Attempt any **TWO** parts : **10×2=20**

a) A system at 500 K and a heat reservoir at 300 K are available for designing a work producing device. Estimate the maximum work that can be produced by the device if heat capacity of system is given as;
$C = (0.05\ T^2 + 0.10T + 0.085)$ J/K

b) Define 'available energy' and 'unavailable energy'. Differentiate between useful work and maximum useful work in reference to the availability.

c) Determine the entropy change, unavailable energy and available energy for the process in which 2 kg air is heated isobarically so as to cause increase in its temperature from 21°C to 315°C. Take T_0 = 10°C.

5 Attempt any **TWO** parts : **10×2=20**

a) What is meant by spark ignition and compression ignition engines ? Compare SI engines with CI engines.

b) In a closed vessel the 100 kg of steam at 100 kPa, 0.5 dry is to be brought to a pressure of 1000 kPa inside vessel. Determine the mass of dry saturated steam admitted at 2000 kPa for raising pressure. Also determine the final quality.

c) Discuss the effect of pressure of steam at inlet to turbine, temperature at inlet to turbine and pressure at exit from turbine upon Rankine cycle performance.
