Registration No: | | | | | | | | | | |

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B.TECH
BE 2103

1st Semester Back Examination 2015-16
THERMODYNAMICS
BRANCH(S): ALL
Time: 3 Hours
Max Marks: 70
Q.CODE:T855

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) A certain amount of an ideal gas is initially at P_1,T_1.First it undergoes a constant pressure process 1-2 such that $T_2=T_1/4$.Then it undergoes a constant volume process 2-3 such that $T_3=T_1/2$.Calculatethe ratio of final to initial volume.

b) What do you mean by thermodynamic equilibrium?

c) Write two examples of extensive properties.

d) Show that energy of an isolated system is constant.

e) A rigid container of volume $0.5m^3$ contains 1 kg of water at 120 ^OC. What is the state of water?

f) What is steady state of a control volume?

g) What is the work done in a free expansion? Write down the reason.

h) A condenser of a refrigeration system rejects heat at a rate of 120 KW,while its compressor consumes a power of 30KW.Find the coefficient of performance of the system.

i) Show the Carnot's cycle on a T-S chart.

j) A steam turbine receives steam steadily at 10 bar with an enthalpy of 3000KJ/Kg and discharges at 1 bar and enthalpy of 2700KJ/Kg.The work output is 250KJ/Kg.Neglect the changes in K.E and P.E.What is the heat transfer from the turbine casing to the surroundings?

Q2 **a)** Show that for an ideal gasc_p-c_v=R,where all the terms hav unit kJ/kgK. **(5)**

b) Two tanks A and B are connected through a valve which is initially closed.Tank A contains 5kg air at 1bar,47 ^OC and tank B of volume $0.5m^3$ contains air at 5bar,60^OC.Then the valve is opened and remained open until the air in the tanks mixed and came to thermal equilibrium with the surroundings at 25^OC.Find the equilibrium pressure and final masses in the tanks. **(5)**

Q3 **a)** Prove that energy is a property of the system. **(5)**

b) 8 kg of air undergoes an reversible adiabatic process from 2bar,40 ^OC to 10bar.Find a)work transfer b)change in internal energy and c)heat transfer in the process. **(5)**

Q4 **a)** Ten kg of water at 20°C is converted into ice at –10°C at constant atmospheric pressure. Assuming the specific heat of liquid water toremain constant at 4.2 kJ/kgK and that of ice to be half of this value, andtaking the latent heat of fusion of ice at 0°C to be 335 J/kg, calculate thetotal entropy change of the system. **(6)**

b) Calculate the entropy change of the universe when a copper block of 600 g mass and with *Cp*of 150 J/K at 100°C is placedin a lake at 8°C. **(4)**

Q5 **a)** Prove the equivalence between Kelvin- Plank and Clausius statement of second law. **(5)**

b) A reversible heat engine operating between 1000K and 400K used to drive a heat pump which is working between 500K and 300K.Find the heat rejected by both the devices, if heat absorbed by the engine is 140kJ.What is the heat extracted by the heat pump? **(5)**

Q6 **a)** An air turbine forms part of an aircraft refrigerating plant. Air at a prèssure of 295 kPa and a temperature of 58°C flows steadily into the turbine with a velocity of 45 m/s. The air leaves the turbine at a pressure of 115 kPa, a temperature of 2°C, and a velocity of 150 m/s. The shaft work delivered by the turbine is 54 kJ/kg of air. Neglecting changes in elevation, determine the magnitude and sign of the heat transfer per unit mass of air flowing. For air, take Cp = 1.005 kJ/kg K and the enthalpy h = Cp t. **(6)**

b) Derive Euler's equation from the steady flow energy equation for a control volume. **(4)**

Q7 **a)** State and prove Clausius' Theorem. **(5)**

b) 5 kg of water at 45°C is heated at a constant pressure of 10 bar until temperature becomes 300°C. Find the change in volume,enthalpy and internal energy. **(5)**

Q8 Write short notes on any two: **(5 x 2)**

a) Thermal power plant

b) Carnot's Theorem

c) Refrigerator

d) Quasistatic process