Registration no: | | | | | | | | | | |

Total Number of Pages: 02

B.TECH
BE2103

2nd Semester Back Examination 2015-16
THERMODYNAMICS

BRANCH: ALL
Time: 3 Hours
Max Marks: 70
Q.CODE: W568

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) What do you mean by flow work? Calculate amount of work required to introduce 10 liters of water to a pipe line, where water is flowing at a pressure of 6 bar.

b) State Zeroth Law of thermodynamics & what is its outcome?

c) What is PMM1? Explain it with a suitable example.

d) A system has two reversible engines, connected in series having efficiency 0.8 and 0.9. Calculate the efficiency of the system.

e) Show that for an ideal gas, the slope of the constant volume line on T-S diagram is more than that of the constant pressure line.

f) 4 Kg of water at 40°C are mixed with 6 Kg of water at 100°C in a steady flow process. Calculate the temperature of the resulting mixture.

g) A reversible engine operating between a high temperature source and low temperature sink have efficiency of 40%, is reversed to work as a heat pump. Calculate COP of the heat pump.

h) Prove that amount heat transferred in a constant pressure process is equal to change in enthalpy.

i) What are the main causes of irreversibility of a system ?

j) Write down the integrating factor of quasi static displacement work.

Q2 A large insulated vessel divided into two chambers A & B by a partition wall. Chamber A having a volume of $0.2m^3$ contains oxygen at 5 bar & 127°C where as chamber B having a volume of $0.1\ m^3$ contains oxygen at 3 bar & 227°C. Calculate the resultant pressure & temperature in the container after removal of the partition wall between A & B. **(10)**

Q3 **a)** A vertical cylinder with freely floating piston contains 0.1 Kg of air at 1.2 bar and a small electric resistor. The current of 1.5 amps from a 12 volt battery is passed through the resistor for 90 seconds, the piston sweeps a volume of 0.01 m^3. Assume piston and cylinder are insulated and air behaves as an ideal gas. Find the rise in temperature of air. **(5)**

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

Q4 **a)** Two air, one at 1 bar 27°C and velocity 30 m/s and other at 5 bar,227°C and 50 m/s velocity, mix in equal proportion in a chamber from which heat at the rate of 100 kj/kg is removed. The mixture is then passed through the adiabatic nozzle. Find the velocity of the stream issuing out of the nozzle. The temperature of the air leaving the nozzle is 27°C. **(7)**

b) Show that there is no change in temperature observed when ideal gas flows through a throttle valve. **(3)**

Q5 **a)** Show that the effective way to increase the efficiency of Carnot engine is to decrease the sink temperature rather than increasing the source temperature. **(4)**

b) An inventor claims to have developed a refrigeration unit which maintains at -10°C in the refrigerator which is kept in a room where the surrounding temperature is 25°C and which has COP of 8.5. How do you evaluate his claim? **(6)**

Q6 **a)** A closed vessel of 0.3 m^3 in capacity contains steam at 8.0 bar and 200°C. (i) Determine mass of the steam in the vessel. (ii) The vessel is cooled till it becomes just dry and saturated. What will be the pressure of the steam in the vessel at this stage? (iii) The vessel is cooled further to 158.85°C. Determine the pressure and the condition of the steam. **(8)**

b) Define critical point of a pure substance. **(2)**

Q7 **a)** An ideal gas 0.15 m^3 in volume and at a pressure of 21 bar and 337°C expands isothermally till its volume becomes 6 times of its original. Thus gas is cooled at constant volume till the temperature becomes 32°C and finally compressed back to its original condition. Find the work done during the cycle. If this cycle operated 20 times per second , determine the power developed by the system. **(8)**

b) What is thermodynamic equilibrium? **(2)**

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

a) Different modes of heat transfer.

b) Equivalence of Kelvin-plank statement.

c) Measurement of high temperature

d) Derivation of steady flow energy equation.