U.S.N | | | | | | | | | | |

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Mechanical Engineering

Semester End Examination; Dec. - 2014

Basic Thermodynamics

Time: 3 hrs *Max. Marks: 100*

***Note** : i) Answer **FIVE** full questions, selecting **ONE** full question from each Unit.*
ii) Assume suitable missing data if any.

Unit - I

1. a. Distinguish between: (i) Open and closed system (ii) Point and Path function (iii) Intensive and Extensive properties (iv) Diathermic and Adiabatic walls. 8

   b. Define the following: (i) Thermodynamic state (ii) Quasi static process (iii) Thermodynamic equilibrium. 6

   c. A new scale 'N' of temperature is divided in which the Ice point is assigned 100º N and the steam point is assigned 400º N. Establish the relationship between the N-scale and Celsius scale. 6

2 a. Define the work on thermodynamic basis and derive an expression for displacement work for a polytropic process. 8

   b. Mention the similarities between work and heat. 4

   c. A cylinder contains 1kg of certain fluid at an initial pressure of 16 bars. The fluid is allowed to expand reversibly behind a piston according to the law PV^2 = constant, until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston comes back to the original portions. Heat is then supplied reversibly with the piston firmly locked in portion until the pressure rises to original value of 16 bar. Calculate the network, for an initial volume of $0.05m^3$. 8

Unit - II

3 a. Show that energy is a property of the system. 6

   b. Define the specific heat at constant volume and constant pressure. 4

   c. A closed system in a process following the pressure volume relations as $P = \frac{5}{V} + 1.5$ where 'p' is in bar and 'V' is in m^3. During the process volume changes from 0.15 m^3 to 0.05 m^3 and the system rejects 45 kJ of heat. Calculate: (i) change in internal energy (ii) change in Enthalpy 10

4 a. Write down the S.F.E.E for a flow process and explain the various terms in that equation. 6

   b. State I law of thermodynamic for a closed system in cyclic and non-cyclic process. 4

   c. Air enters adiabatic horizontal nozzle at 400ºC, 50 m/s and 0.2 m^3/kg. Exit at 80º and 1.02 m^3/kg. The inlet area is 240 cm^2. Find the area of cross section of nozzle at exit. Assume 10

Unit - III

5 a. Define the following: (i) Purl substance (ii) Triple point (iii) Critical point (iv) Degree of saturation (v) sub cooled liquid. 10

b. Draw the P.T. diagram of water, indicating all salient point. 4

c. Find the specific volume, enthalpy and internal energy of wet steam at 18 bar and dryness of 0.85. 6

6 a. With a neat sketch explain the measurement of dryness fraction of steam by using "Separating – throttling colorimeter". 8

b. Draw h-s diagram of water, indicating all salient points. 4

c. Find the Enthalpy and Entropy of steam when the pressure is 2 MPa and the specific volume is 0.09 m^3/kg. 8

Unit - IV

7 a. Show that of all heat engines working between two given thermal reservoirs the carot engine is the most efficient one. 8

b. Mention the factors that render a process Irreversible. 4

c. Two Carnot engines works in series, with the heat rejected by the first being the heat input to the second engine. Source and sink temperature are 600 K and 300 K. Determine the intermediate temperature for the following cases. 8

(i) If both the engines develops equal power

(ii) If the efficiencies of both the engines are same.

8 a. Mention the two statements of II law of thermodynamics and show that both the statements are equal. 10

b. A reversible heat engine operates between 600ºC and 40ºC reservoirs. The engine drives a reversible refrigerator, which operates between 40º and -20ºC. The heat transfer to the engine is 2000 kJ and network output from the combined system is 360 kJ. Calculate the heat transfer to the refrigerator and net heat transfer to the reservoir at 40ºC. 10

Unit - V

9 a. State and prove Clausius' Theorem. 8

b. One kg of Ice at -5ºC is exposed to the atmosphere which is at 20ºC. The ice melts and comes into thermal equilibrium with the atmosphere. Determine the entropy increase of the universe. 10

c. Define entropy of a system. 2

10 a. Show that entropy is a property of a system. 6

b. Explain the concept of Entropy principle. 6

c. 2 kg of hot water at 90º C is mix with 3 kg of cold water at 30ºC in an adiabatic chamber. Determine the entropy change of mixture. 8

* * * * *