M18001037

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

Total Number of Pages : 03 **B.TECH**

B.TECH 2ND SEMESTER REGULAR EXAMINATIONS, MAY 2018
BASICS OF THERMODYNAMICS
Subject Code:BBSES1032
Time: 3 Hours
Max Marks : 100

CO1 Explain the basic concepts of system, control volume, thermodynamic properties, thermodynamic equilibrium, temperature, work and heat energy.
CO2 Apply the laws of thermodynamics to refrigerators, heat engines, heat pumps compressors and nozzles etc.
CO3 Interpret and apply the concept of entropy to thermodynamic systems
CO4 Evaluate properties of pure substances, gases and their mixtures and to derive and apply to thermodynamic problems.

PART-A (10X1 = 10 MARKS)

Answer *All* Questions.

a. Measurement of pressure is a [CO1]
a) Macroscopic approach b) Microscopic approach c) Holistic approach d)None of these

b. Specify which of the following can be analyzed by the control volume method? [CO1]
a) Water pump b) Heating of a fluid in a closed rigid vessel
c) Universe d) 2kg of ice

c. Density is a [CO1]
a) Intensive property b) Extensive property c) Magnetic property d) Non thermodynamic property

d. Absolute scale of degree Celsius scale is [CO1]
a) Rankine scale b) Kelvin scale c) Rumor scale d) Fahrenheit scale

e. In an isothermal process, the internal energy of gas molecules [CO2]
a) Increases (b) decreases c) remains constant (d) may increase / decrease depending on the properties of the gas

f. In the polytropic process equation pv^n = constant, if n = 0, the process is termed as [CO2]
a) Constant volume (b) constant pressure (c) constant temperature (d) adiabatic

g. Assume that a reversible heat engine is operating between a source at T1 and a sink at T2. If T2 decreases, the efficiency of the heat engine _____ [CO2]
(a) Decreases (b) increases (c) remains constant (d) none of the above

h. Enthalpy for wet steam is [CO4]
a) h_f b) h_g c) $h_f + xh_{fg}$ d) $h_g + C_{ps}(T_{sup}-T_{sat})$

i. When the working fluid is saturated liquid, the value of dryness fraction is [CO4]
a) 0.5 b) 1.0 c) 0.0 d) 0.99

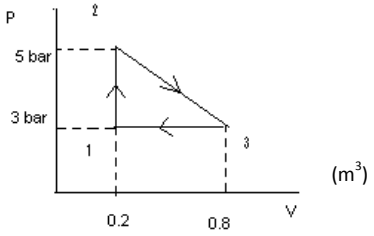
j. PMM2 is the machine which violates _____ [CO2]
a) Kelvin-Planck statement b) Clausius statement c) both a and b d) none of the above

PART-B (15 x 2 = 30 MARKS)

Answer any fifteen questions from the following.

1. Explain what is meant by intensive and extensive properties and give two example of each. [CO1]
2. Mention units of the following (in SI) i) Specific heat. ii) Pressure iii) Work iv) Power. [CO1]
3. The differential of a parameter W_f is given by $dW_f = p\,dv + v\,dp$. Prove that W_f can be considered to be a system property. [CO1]
4. Explain Newton's law of cooling. [CO1]
5. What do you mean by free expansion? [CO1]

6. A tank has a volume of 0.5 m^3 and containing 10kg of an ideal gas having a molecular weight of 24. The temperature is 28^{O}C. What is the pressure? [CO1]
7. Calculate the heat transferred during the cycle shown in the diagram. [CO1]



8. During which process executed by a closed system, work done is same as heat supplied? Answer with reasons. [CO1]
9. Define specific heat at constant pressure and constant volume as differential of thermodynamic properties. [CO2]
10. During an adiabatic process, an ideal gas receives 100 kJ of work. The initial internal energy of the gas is 320 kJ. What is the final internal energy? [CO2]
11. What is a PMM1? Why is it impossible? [CO2]
12. Write down the SFEE for the following components: i) Nozzle and ii) Turbine [CO2]
13. Why direct heating with an electrical resistance heater is thermodynamically inefficient than a heat pump. [CO2]
14. What is the maximum and minimum value of COP for a refrigerator and heat pump? [CO2]
15. Wet steam at 120^{0}c with a quality of 25% has its temperature-raised 20^{0}c in a constant volume process. What is the new quality and pressure? [CO4]
16. Define dryness fraction. What is the value of dryness fraction for wet steam? [CO4]
17. Define Clausius inequality. [CO3]
18. What is degree of superheat? [CO4]
19. Define triple point. What is the temperature of triple point for water? [CO4]
20. Represent the following processes in the P-V and T-s plot: i) Isobaric ii) isochoric [CO3]

PART-C (6 x 5 = 30 MARKS)

Section-i **Answer any Six questions**

1. An investigator designed a temperature scale (X) on two fixed points as 60^{o}N and 300^{o}N. What will be the value of temperature 375 K and 85^{o}F in new scale (X). [CO1]
2. Derive an expression for the work done and heat transfer during an adiabatic process. [CO1]
3. A steam turbine in a power plant develops 2000kW.The heat supplied to the steam in the boiler is 3500kJ/kg, the heat rejected by the steam to the cooling water in the condenser is 1800kJ/kg. The feed pump work required to pump the condensate back into the boiler is 7.5kW. Calculate the mass flow rate of the steam. [CO2]
4. A cyclic heat engine operates between a source temperature of 800^0 C and a sink temperature of 30^0 C. What is the least rate of heat rejection per kw net output of the heat engine? [CO2]
5. A container contains steam at 5 bar, 70 % dryness. If volume is 1.5 m^3, then find the mass of steam in the container and temperature. [CO4]
6. State and prove Carnot's theorem. [CO3]
7. Determine the temperature and quality of steam at pressure of 300 kPa and specific volume of 0.4 m^3. [CO4]
8. Show all the main components of refrigeration cycle with a neat sketch. [CO2]

Section-ii **Answer any Two questions** **(2 x 15 = 30 MARKS)**

1. (a) A monometer is attached to a vessel containing a fluid gives a reading of 5cm of mercury ($\rho = 13600 Kg/m^3$) what will be the manometer reading if water ($\rho = 1000 Kg/cm^3$) is used as the manometric fluid? [CO1][5]

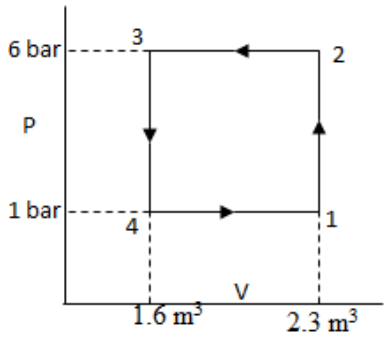
   (b) Fahrenheit and Centigrade thermometers are both immersed in a fluid. Fahrenheit reading is twice (numerically) that of the Centigrade reading. What is the temperature of fluid expressed in Kelvin and Rankine? [CO1] [10]

2. (a) A mass of gas is compressed in quasistatic process from 80kpa, $0.1m^3$ to 0.4Mpa, $0.03m^3$. Assuming that the pressure and volume are related by (pv^n = constant), find the work done by the system. [CO1] [5]

   (b) Derive SFEE for an open system and state the assumptions. [CO2] [10]

3. a) State Kelvin-Planck and Clausius statement. Justify both are equivalent. [CO2] [5]

   (b) 2 kg of air undergoes a cyclic process as shown in P-V diagram. Pressure and volume are given in the diagram. It may be noted that there are two constant volume and two constant pressure processes. Calculate, (i) cyclic integral of work and heat transfer. (ii) The heat transfer during the process 1-2. [CO2] [10]



4. (a) Explain about the steam power plant with a neat sketch. [CO2] [5]

   (b) 10kg of saturated liquid water at 1bar is heated at constant pressure until the temperature becomes 200°C. Calculate: i. The initial and final volumes
   ii. The work done
   iii. The heat transfer [CO4] [10]

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