B.E.(with Credits)-Regular-Semester 2012 - Mechanical Engineering Sem IV

ME402 - Engineering Thermodynamics

P. Pages : 2 **GUG/W/16/3923**

Time : Three Hours * 4 0 3 8 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Assume suitable data wherever necessary.
3. Illustrate your answers wherever necessary with the help of neat sketches.
4. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
5. Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
6. Use of non programmable calculator is permitted.

1. a) Explain thermodynamic system and its types giving suitable examples. **5**

b) Distinguish between the following giving examples. **6**
i) Intensive & Extensive properties.
ii) Closed system & open system.

c) Explain "Thermodynamic equilibrium" of a system and state its significance. **5**

OR

2. a) State the Zeroth law of thermodynamics and state its significance. **6**

b) The temperature "t" on a thermodynamic scale is defined in terms of a property "k" by the relation $\boxed{t = a\,\ell n\,k + b}$ **10**

Where a & b are constants. The values of "K" are found to be 1.84 & 6.79 at the ice point and steam point, the temperatures of which are assigned the number 0 & 100 respectively. Determine the temperature corresponding to a reading of "K" = 2.43 on the thermometer.

3. a) Explain the following statements of second law of thermodynamics. **6**
i) Kelvin – Plank statement &
ii) Clausius statement.

b) The pressure & volume relation during a non. Flow reversible process is given by **10**
$P = \left(V^2 + \frac{8}{V}\right)$BAR . The volume changes from $V_1 = 6m^3$ to $V_2 = 2m^3$. Calculate the work done. The heat rejected during the process is 200 KJ. Determine the change in internal energy and the change in enthalpy.

OR

4. a) State "Avogadro's Hypothesis" and from it determine the value of universal gas constant. **5**

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

c) Explain the first law of thermodynamics for → **6**
i) Closed system undergoing a cycle.
ii) Closed system undergoing a change of state.

5. a) A domestic food refrigerator maintains a temperature of -12ºC. The ambient air temperature is 35ºC. If heat leaks into the freezer at the continues rate of 2KJ/sec. Determine → least power necessary to pump this heat out continuously. **10**

b) i) Define specific heats. Derive relationship between Cp and Cv. **6**
ii) Differentiate between point function & path function.

OR

6. a) Two boilers A and B are delivering equal quantities of steam into a common main. Boiler A. Fitted with a superheater delivers a steam at 15 bar and 300ºC and boiler B deliver steam at 15 bar. The pressure & temperature of steam in the main are 15 bar and 225ºC. Determine the quality of steam supplied by the boiler B. take $Cp = 2.1KJ/Kg'k$ for superheated steam. **10**

b) Define the following terms : **6**
i) Dryness Fraction
ii) Latent Heat
iii) Degree of superheat.

7. a) Explain construction & working of throttling calorimeter with neat sketch. State its limitations. **8**

b) Why Carnot Cycle is not possible in practice? **4**

c) Explain principle of increase in Entropy. **4**

OR

8. a) A vessel of $1m^3$ capacity contains steam at 10 bar & 0.92 dry. Steam is blown OFF until the pressure drops to 5 bar. The value is then closed. Determine the weight of steam blown OFF. **8**

b) With the help of p – v and T – S diagram derive **8**

$$\eta_{otto} = 1 - \frac{1}{r^{v-1}}$$

9. a) An air standard diesel cycle has a compression ratio of 14. The pressure at the beginning of the compression stroke is 1 bar & the temperature is 27ºC. The maximum cycle temperature is 2227ºC. Determine the cut OFF ratio & the thermal efficiency of the cycle. **8**

b) An Engine working on a otto cycle is supplied with air at 0.1 MPa, 35ºC. The compression ratio is 8. Heat supplied is 2100 KJ/kg. Calculate the maximum pressure & temperature of cycle, cycle efficiency (η) & mean effective pressure (mep). **8**

{ for air $Cp_{air} = 1.005\,KJ/kg'k$ & $Cv_{air} = 0.718\,KJ/kg'k$ }

$R = 0.287\,KJ/kg'k$

OR

10. a) A diesel engine has a compression ratio of 14 & cut OFF takes place at 6% of the stroke. Find the air std. efficiency. **8**

b) A Hot air engine works on Brayton cycle with initial & Final pressures of air at 3 bar & 1 bar respectively. If the temperature before isentropic compression & isentropic expansion are 298ºK & 923ºK Determine → **8**

i) Heat supplied per Kg of air. ii) Heat rejected per Kg of air.
iii) Work done per Kg of air. iv) η of the engine (Efficiency)

take $Cp = 1KJ/kg'k$, $Cv = 0.715\,KJ/kg'k$.

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