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Engineering Thermodynamics
(Old) (1150)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Answer **any two** full questions from each unit.
5. All questions carry equal marks.
6. Use of mollier chart steam table and non-programmable calculator is allowed.
7. Assume suitable data, wherever necessary.

UNIT – I

1. a) A spherical balloon has 10kg of air at 200kPa and 500k. The balloon material is such that the pressure inside is always proportional to square of its diameter. Find work done when the volume of balloon doubles as it floats to a high attitude ? **10**

b) i) Define and explain Quasi-Static process. **6**
ii) Explain constant volume gas thermometer. **4**

c) i) The resistance of the windings in a certain motor is found to be 100 Ω at a room temperature at 27ºC. When operating at a fuel load under steady conditions the motor is switched off and Resistance of windings found to be 120Ω. The windings are made of copper , whose resistance at tºC is given by $R_t = R_0(1+0.004t)$ where R_0 is resistance at 0ºC. Find the temperature attained by coil during full load. **6**
ii) Convert the following readings of pressure in kPa (Abs). Assume barometer pressure of 750mm of Hg. **4**
i) 55 mm of Hg (Abs). ii) 3.2m of H_2O (gauge)

UNIT – II

2. a) Consider a gas turbine power plant with air as working substance. Air enters at 100 kPa, 20ºC, density 1.19 kg/m^3 and velocity 130m/s through an opening of 0.112 m^3 cross section area. After being compressed, heated and expanded through the turbine the air leaves at 180 kPa, 150ºC and density 1.48 kg/m^3 through an opening of a same size. The power output of entire power plant is 375kW. Internal energy and enthalpy of air given in kJ/kg as u = 0.717T and h=1.004T, where T is temperature on kelvin scale. Find out the net amount of heat transfer to air in kJ/kg. **10**

b) i) State the significance of PMM-I. **4**
ii) Define Internal energy ? Prove that it is the system property. **6**

c) i) Derive the steady flow energy equation on time basis for an open system ? **6**
ii) Apply steady flow energy equation to **4**
i) water pump ii) Hydraulic Turbine.

UNIT – III

3. a) i) Explain reversible process. What are causes of irreversibility of a process ? Discuss "free expansion is irreversible." **6**
ii) What is coefficient of performance ? Prove $CO_{P_{H.P.}} = CO_{P_R} + 1$. **4**

b) A heat pump maintains a marriage hall at 25ºC when atmospheric temperature is 10ºC. The hall can accommodate 160 people. Find out power required to run actual Heat pump if its C.O.P. is one third of the C.O.P of carnot pump acting between same temperature limits. Heat dissipated by a normal human is 450 kJ per hour. **10**

c) Three carnot engines R_1, R_2, R_3 operate in series between two heat reservoirs which are maintained at temperature of 1000k and 300k. Calculate temperature of intermediate heat reservoir if amount of work produce by these engines share a ratio of 5:4:3. **10**

UNIT – IV

4. a) i) State Charle's Law, Avogadro's Law, Dalton's Law of partial pressures. **6**
ii) Prove $C_p - Cv = R$. **4**

b) Air initially at 60 kPa pressure, 800k temperature and 0.1 m^3 volume is compressed isothermally until the volume is 40% of the original. Further, the air is cooled at constant pressure until the volume is halved sketch the process on p-v plane and find total heat transfer and total work transfer. Assume air as an ideal gas with $C_p = 1.005 kJ/kgK$. **10**

c) What is an adiabatic process ? Show it on p-v and t-s planes. Derive an equation for work done during an adiabatic process ? **10**

UNIT – V

5. a) i) Explain with neat sketch working of throttling calorimeter. State it's merits and demerits. **6**

ii) Define degree of superheat, Latent heat and triple point. **4**

b) For 1 kg steam at 8 bar and 0.9 dry, Calculate the final dryness fraction of steam if **10**

i) steam losses heat of 125 kJ at constant pressure.
ii) Temperature of steam falls to 160ºC, at constant volume.
iii) Steam expands to 3 bar pressure in a turbine while producing work of 200 kJ.

c) i) What is critical point ? What are critical point parameters ? Give values of critical point parameters for water ? **10**

ii) In a throttling calorimeter, steam enters at 10 bar. It is exhaled at atmospheric pressure and 110ºC. Find the quality of steam if specific heat of superheated steam is 2.2 kJ/kgK.

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