CBCS SCHEME

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15ME33

Third Semester B.E. Degree Examination, June/July 2019
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Thermodynamic data hand book and steam table is permitted.

Module-1

1 a. Distinguish between macro and microscopic point of view of thermodynamics. **(05 Marks)**

b. Classify the following into intensive and extensive properties.
i) Molecular weight ii) Enthalpy iii) Refractive index
iv) Quality of steam v) Entropy vi) Roll strength of class. **(03 Marks)**

c. Develop a linear scale '°B' where in ice and normal body temperature are assumed as two fixed points and assigned the values 0°B and 50°B respectively. If temperature of human body on Celsius scale is 36.7°C, obtain the relation between '°B' scale and °C' scale and find out boiling temperature of water in 'B' scale. **(08 Marks)**

OR

2 a. With a suitable example define work from thermodynamic point of view. **(04 Marks)**

b. Prove that heat transfer is a path function. **(04 Marks)**

c. The properties of a closed system changes following the relation between pressure and volume as PV = 3.0, where P is in bar, V is in m^3. Calculate the work transfer, when the pressure increases from 1.5 bar to 7.5 bar. **(08 Marks)**

Module-2

3 a. Using first law of thermodynamics for non-flow system, show that the heat transfer is equal to the enthalpy change of a system during constant pressure process. **(04 Marks)**

b. A housewife on a warm summer day, decided to beat heat by closing the windows and doors in the kitchen and opening the refrigerator door. At first she feels cool and refreshed, but after a while the effect begins to wear off. Evaluate the situation as if relates to 'first law of thermodynamics' considering room including the refrigerators the system. **(04 Marks)**

c. A centrifugal pump delivers 50kg of water per second. The inlet and outlet pressure are 1 bar ad 4.2 bar respectively. The suction is 2.2m below the centre of the pump and delivery is 8.5 above the centre of the pump. The section and delivery pipe diameters are 20cm and 30cm respectively. Determine the capacity of the electric motor to run the pump. **(08 Marks)**

OR

4 a. Define the following :
i) Thermal Energy Reservoir (TER).
ii) COP of Heat pump. **(04 Marks)**

b. What is PMM – 2? Why it is impossible? **(04 Marks)**

c. A fish freezing plant requires 40 tons of refrigeration. The freezing temperature is -35°C, while the ambient temperature is 30°C. if the performance of the plant is 20% of the theoretical reversed Carnot cycle working within the some temperature limits, calculate power required. **(08 Marks)**

Module-3

5 a. Explain the conditions for reversibility. **(03 Marks)**

b. Show that heat transfer through a finite temperature difference is irreversible. **(05 Marks)**

c. Show that the efficiencies of all reversible heat engines operating between the same temperature levels is the same. **(08 Marks)**

OR

6 a. Show that entropy is a property of system. **(05 Marks)**

b. Explain the 'principle of entropy'. **(03 Marks)**

c. 1 kg of ice at -5°C is exposed to the atmosphere, which is at 25°C. The ice melts and comes into thermal equilibrium. Determine the entropy increase of the universe. Take C_p of ice = 2.093kJ/kg°C. Letent heat of fusion of Ice = 333.33 kJ/kg. **(08 Marks)**

Module-4

7 a. What do you understand by the 'thermodynamic dead state? Explain briefly. **(04 Marks)**

b. Prove that, $\eta_{II} = \frac{\eta_I}{\eta_{Carnot}}$. **(04 Marks)**

c. Derive the Maxwell relations and explain their importance in thermodynamics. **(08 Marks)**

OR

8 a. Define the following terms with reference to pure substance.
   i) Saturation temperature
   ii) Latent heat of vaporization
   iii) Critical point
   iv) Tripple point **(02 Marks)**

b. With neat sketch, explain the measurement of dryness fraction of steam by using 'Throttling Calorimeter". **(06 Marks)**

c. Two boilers one with superheater and other without superheater are delivering equal quantities of steam into common main. The pressure in the boilers and main is 20bar. The temperature of steam from a boiler with a superheater is 350°C and temperature of the steam in the main is 250°C. Determine the quality of steam supplied by the other boiler. Take C_{Ps} = 2.5kJ/kgk. **(08 Marks)**

Module-5

9 a. Show that for an ideal gas, $C_p - C_v = R$. **(06 Marks)**

b. A mass of air is initially at 260°C and 700KPa, and occupies 0.028m^3. The air is expanded at constant pressure to 0.084m^3. A polytropic process with n = 1.5 is then carried out, followed by a constant temperature process which completes a cycle. All the process are reversible.
   i) Sketch the cycle in the P-V and T-S plane.
   ii) Find the heat received and heat rejected in the cycle
   iii) Efficiency of cycle. **(10 Marks)**

OR

10 a. State 'Dalton's law of partial pressure'. **(02 Marks)**

b. Define the following terms :
   i) Saturated air ii) Wet bulb temperature
   iii) Specific humidity iv) Dew point temperature. **(06 Marks)**

c. A mixture of gas has the following volumetric analysis. O_2 = 30%,CO_2 = 40%, N_2 = 30%, Determine : i) The analysis on a mass basis ii) the partial pressure of each component, if the total pressure is 100KPa and temperature is 32°C. iii) the molecular weight of mixture. **(08 Marks)**

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