CBCS SCHEME

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17ME33

Third Semester B.E. Degree Examination, July/August 2022
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of thermodynamic handbook is permitted.***

Module-1

1 a. Classify the following as open/closed/isolated system, i) Xerox machine ii) I-C engine iii) Thermo flask iv) Boiler v) Passenger getting out of train. **(05 Marks)**

b. Define the following with examples i) Property ii) Point function iii) Path function iv) Intensive property v) Extensive property. **(05 Marks)**

c. The temperature't' on a linear Celsius scale is related to thermometric property 'P' by the relation $T = A \ln P + B$, where A and B are constants the value of P at ice point and steam point are 1.47 and 5.2 respectively on celcius scale. Determine the temperature 't' corresponding to reading of P at 2.65? **(10 Marks)**

OR

2 a. Define work from thermodynamic point of view and derive the expression for work done in a polytropic process. **(08 Marks)**

b. What are the different types of work done? Derive expression for work done in stretching a wire. **(06 Marks)**

c. If a gas of volume 6000cm^3 and at a pressure 100KPa in compressed quasistatically according to $PV^2 = C$ until the volume becomes 2000cm^3. Determine final pressure and work transfer. **(06 Marks)**

Module-2

3 a. State 1th law of thermodyanamics and show that enthalpy as a property of a system. **(08 Marks)**

b. Define specific heat at constant pressure and constant volume? Find the relation between C_p, C_v and R. **(06 Marks)**

c. Air is flowing in a 0.2m diameter pipe at a uniform velocity of 0.1m/s the temperature and pressure are 27°C and 150KPa respectively. Determine the mass flow rate of air assuming R = 0.287kJ/kg K. **(06 Marks)**

OR

4 a. Define the following i) Thermal reservoir ii) Source iii) Sink. **(06 Marks)**

b. With block diagram derive COP for refrigerator is less than COP of heat pump by unity. **(06 Marks)**

c. A reversible heat pump is used to maintain a temperature of 0°C in a refrigerator when it rejects heat to the surroundings at 25°C the heat removal rate is 1440kJ/min determine COP of the machine and work required? If the required input is supplied by a reversible engine which receiver heat from 380°C and rejects heat to atmosphere determine overall COP the system? **(08 Marks)**

Module-3

5 a. Define reversibility. Explain the factors that causes the irreversibility. **(08 Marks)**

b. State and prove Carnot's theorem. **(06 Marks)**

c. Two reversible engines A and B working on Carnot cycle operate in series such that engine 'A' receives that from source maintained at 600K and rejects heat to an intermediate sink maintained at T_2. Engine B receives heat rejected by engine 'A' through intermediate sink and rejects heat to a sink maintained at 300K. If both the engines have same efficiency determines the intermediate temperature T_2. **(06 Marks)**

OR

6 a. State Clausius theorem. Show that entropy as a property of a system. **(08 Marks)**

b. Find the change in entropy for the following process :
i) Constant volume process ii) Isothermal process. **(06 Marks)**

c. Find the entropy change of 5Kg of a perfect gas whose temperature varies from 150°C to 200°C during constant volume process the specific heat varies linearly with absolute temperature and is represented by relation $C_V = 0.45 + 0.009T$ kJ/.Kg K. **(06 Marks)**

Module-4

7 a. Define the following i) Available energy ii) Unavailable energy iii) Irreversibility iv) Second law of efficiency. **(10 Marks)**

b. A system at 800K receives heat at the rate of 4000kJ/min from a reservoir at 1200K. The temperature of the surrounding is 300K. Assuming that the temperature of the source and the system remain constant during heat transfer obtain i) the net change of entropy during heat transfer ii) Decrease in available energy after heat transfer. **(10 Marks)**

OR

8 a. Define the following : i) Triple point ii) Sublimation iii) Dryness fraction. **(06 Marks)**

b. With neat sketch, explain the working of throttling calorimeter. **(06 Marks)**

c. Determine dryness fraction of the steam sample when tested in a separating and throttling Calorimeter and the following data were noted
i) Pressure of steam sample is 15 bar
ii) Pressure of steam at exit is 1 bar
iii) Temperature of steam at exit if 150°C
iv) Water collected from separating calorimeter in 0.2 Kg/min
v) Discharge collected at exit is 10Kg/min. **(08 Marks)**

Module-5

9 a. Define the following : i) Avogadrd's law ii) Mass fraction iii) Mole fraction iv) Daltons law of partial pressure. **(10 Marks)**

b. A Gas is raised from 30°C to 120°C calculate
i) Molar specific heat at constant pressure
ii) Specific heat at constant pressure
iii) Specific heat at constant volume
iv) Change in enthalpy

Assume molecular weight of gas 40 Kg/Kg mol and gas follows the relation $C_P = \frac{5}{3}R$. **(10 Marks)**

OR

10 a. Derive an expression for the Vander Waal's constant 'a' and 'b' in terms of critical properties. **(08 Marks)**

b. Write a note on : i) Compressibility factor ii) compressibility chart. **(04 Marks)**

c. Determine the specific volume of hydrogen gas when its pressure is 60 bar and temperature is 100K by using i) compressibility chart ii) Vander Waal's equation. **(08 Marks)**

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