CBCS SCHEME

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17ME33

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
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 Data Handbook is permitted.

Module-1

1 a. Define the following with examples :
i) Open system ii) Closed system iii) Isolated system
iv) Path function v) Point function. **(10 Marks)**

b. In 1709, Newton proposed a linear temperature scale where ice point and normal human body temperature are assumed as two fixed points of 0°N and 12°N respectively. The temperature of human body on the Celsius scale is 36°C. Obtain relation between Newton scale and Celsius scale. **(10 Marks)**

OR

2 a. Obtain the expression for displacement work
i) Isothermal process ii) Polytropic process
iii) Isobaric process iv) Isochroric process.
Draw the P-V diagram for each process. **(10 Marks)**

b. Determine the total work done by a gas system following expansion process as shown below: Fig Q2(b).

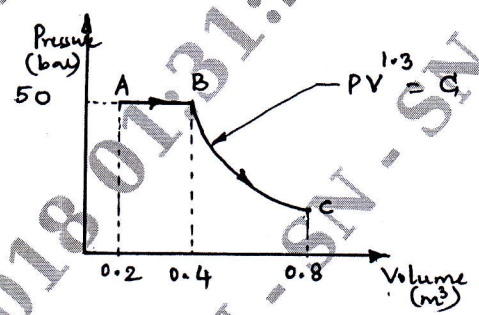

Fig Q2(b) **(10 Marks)**

Module-2

3 a. Apply steady flow energy equation to each of following :
i) Boiler ii) Nozzle iii) Centrifugal pump iv) Throttling device v) Turbine. **(10 Marks)**

b. A Piston and cylinder machine contains a fluid system which passes though a complete cycle of four process. During a cycle, the sum of all heat transfers is -170kJ. The system completes 100 cycles per min. Complete the following table showing the method for each item and compute the net rate of work output in kW. **(10 Marks)**

Process	Q (kJ/ min)	W (kJ/min)	ΔE (kJ/min)
a – b	0	2170	?
b – c	21000	0	?
c – d	– 2100	?	– 36600
d – a	?	?	?

OR

4 a. Prove that Kelvin – Planck statement and Clausius statements of second law of thermodynamic are equivalent. **(08 Marks)**

b. State Carnot's theorem. **(02 Marks)**

c. A reversible heat engine operates between two reservoirs at temperature of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40° and -20°C. The heat transfer to the heat engine is 2000kJ and net work output of combined engine refrigerator plant is 360kJ. Evaluate the heat transfer to the refrigerant and net heat transfer to the reservoir at 40°C. **(10 Marks)**

Module-3

5 a. Explain how free expansion and friction makes the process irreversible. **(08 Marks)**

b. What is internal and external irreversibility? **(04 Marks)**

c. Show that entropy is a property of a system. **(08 Marks)**

OR

6 a. State and prove Clausius inequality. **(10 Marks)**

b. 0.5 Kg of air initially at 27°C is heated reversibly at constant pressure until the volume is doubled and is then heated reversibly at constant volume untill the pressure is doubled. For the total path, find the work transfer, heat transfer and change of entropy. **(10 Marks)**

Module-4

7 a. Explain the concept of Available and Unavailable energy. **(04 Marks)**

b. Write a note on Maxwell relations. **(06 Marks)**

c. A vessel of volume $0.04m^3$ contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of liquid present is 9Kg. Find the pressure, mass, specific volume, enthalpy, entropy and internal energy. **(10 Marks)**

OR

8 a. With a neat sketch, explain the working of combined separating and throttling calorimeter. **(10 Marks)**

b. Steam at 0.8MPa, 250°C and flowing at the rate of 1Kg/s passes into a pipe carrying wet steam at 0.8MPa, 0.95 dry. After adiabatic mixing, the flow rate is 2.3 Kg/s. Determine the condition of steam after mixing, Neglect the velocity of steam in the pipeline. **(10 Marks)**

Module-5

9 a. State and explain i) Dalton's Law ii) Amagat's law. **(08 Marks)**

b. Define the following : i) Dry bulb temperature ii) Wet bulb temperature
iii) Specific humidity iv) Relative humidity **(04 Marks)**

c. A mixture of gases has the following volumetric composition
$CO_2 = 12\%$
$O_2 = 4\%$
$N_2 = 82\%$
$CO = 2\%$
Calculate : i) the gravimetric composition
ii) Molecular weight of mixture
iii) R of mixture **(08 Marks)**

OR

10 a. Derive Vander Waal's constant interms of critical properties. **(08 Marks)**

b. Explain the following : i) Compressibility factor
ii) Law of corresponding states. **(04 Marks)**

c. Determine the mass of Nitrogen contained in a $35m^3$ vessel at 200 bar and 200 K by using
i) Ideal gas equation ii) Compressibility chart. **(08 Marks)**