CBCS SCHEME

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18ME33

Third Semester B.E. Degree Examination, June/July 2025
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 Steam table and thermodynamics data hand book is permitted.

Module-1

1 a. With an example, define the terms :
(i) Closed –system
(ii) Open – system
(iii) Path and point function
(iv) Microscopic approach
(v) Intensive properties. **(10 Marks)**

b. A thermocouple with test junction at t °C on gas thermometer scale and reference junction at ice point is given by $e = \left(0.0367\,t + 1.33\times10^{-4}\,t^2\right)$ mV. The millivoltmeter is calibrated at ice and steam points. What will be reading on this thermometer, where the gas thermometer reads 50 °C? **(10 Marks)**

OR

2 a. Explain the Quasi-Static process with neat sketch. **(10 Marks)**

b. The temperature 't' on a thermometric scale is defined interms of a property 'P' by the relation $t = a \ln P + b$, where 'a' and 'b' are constants. The temperature of the ice point and steam point are assigned numbers of '0' and '100' respectively. Experiment gives values of 'P' of 1.86 and 6.81 at the icepoint and steam point respectively. Evaluate the temperature corresponding to a reading of P = 2.5 on the thermometers. **(10 Marks)**

Module-2

3 a. Obtain the expression for displacement work.
(i) Isobaric process (V = C)
(ii) Isochoric – process (P = C)
(iii) Isothermal process (PV = C)
(iv) Polyntropic process (PV^n = C) **(10 Marks)**

b. A Fluid system undergoes non-flow frictionless process changing its volume from 5 m^3 to 2 m^3. The pressure and volume relation during the process is given by, $\left(P = \frac{20}{V} + 2\right)$ N/m^2 where 'V' is in m^3. Determine the work-done during the process. **(10 Marks)**

OR

4 a. Define the first law of thermodynamics and explain the Joule's experiment. **(10 Marks)**

b. A turbine operates under steady flow conditions receiving steam at the following state : pressure is 1.2 MPa, temperature is 188 °C, Enthalpy is 2785 KJ/kg, velocity is 34 m/s and Elevation is 3 m. The steam leaves the turbine at the following state : Pressure is 200 MPa, Enthalpy is 2512 KJ/kg, Velocity is 100 m/s and Elevation is 0 m. Heat is lost to the surroundings at a rate of 0.29 kW. If the steam flow rate is 0.42 kg/s, determine the power output from the turbine. **(10 Marks)**

Module-3

5 a. With block-diagram, state and explain the Kelvin-Planck and Clausius statement of second law of thermodynamics. **(10 Marks)**

b. In a heat engine, the temperature of the source and sink are 700°C and 50°C respectively. The heat supplied is 83.33 kW. Find the power developed by the engine. **(10 Marks)**

OR

6 a. Define Entropy and explain Entropy –A property of the system. **(10 Marks)**

b. A 2 kg of air at 15 bar pressure and 500°C temperature expands isothermally to 5 times its original volume. Calculate (i) The original volume (ii) Final pressure (iii) Change in Entropy. Take R = 0.287 KJ/kg°K **(10 Marks)**

Module-4

7 a. Explain the concepts of availability and unavailability. **(10 Marks)**

b. Explain the concepts of Irreversibility and second law efficiency. **(10 Marks)**

OR

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

b. Steam at 5 bar having dryness fraction of 0.9 expands adiabatically and reversibly to a final pressure of 1 bar. Determine the final condition of steam. **(10 Marks)**

Module-5

9 Explain the following :

(i) Ideal and Real gas.
(ii) Vander Waal's equation.
(iii) Compressibility chart.
(iv) Compressibility factor **(20 Marks)**

OR

10 a. Explain the Dalton's law of partial pressure and Amagat's law. **(10 Marks)**

b. A mixture of gases has the following volumetric composition :
$CO_2 = 12\%$, $O_2 = 4\%$, $N_2 = 82\%$, $CO = 2\%$
Determine the analysis on mass basis, molecular weight of gas mixture and gas constant. Assume ideal gas behavior. **(10 Marks)**

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