CBCS Scheme

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15ME33

Third Semester B.E. Degree Examination, June/Jul 2018
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing one full question from each module.
2. Thermodynamics data hand book and steam tables are permitted.
3. Missing data may be assumed suitably.

Module-1

1 a. What is the difference between intensive and extensive property? Give examples. **(04 Marks)**

b. What is Quasi static process? Explain its importance in engineering. **(04 Marks)**

c. On some temperature scale 0°C is equivalent to 100°B and 100°C is equivalent to 300°B. Determine the temperature in °C corresponding to 200°B. Convert the temperature obtained in °C to Fahrenheit and Kelvin scale. **(08 Marks)**

OR

2 a. Define work and heat in thermodynamics. Explain why neither is a property. **(06 Marks)**

b. Derive an equation for work in Isobaric and Isochoric processes. **(04 Marks)**

c. A piston compresses a gas in a cylinder during quasi equilibrium process. The pressure in the cylinder varies according to the relationship $PV^{1.4}$ = constant. Initial pressure in the cylinder is 101,325 N/m^2 and the initial volume of the cylinder is $0.01m^3$. Compute the work in compressing the gas to a final volume of $0.005m^3$. **(06 Marks)**

Module-2

3 a. Write the first law of thermodynamics equation for closed system undergoing a non cyclic process and show that internal energy is property. **(06 Marks)**

b. Write the steady flow energy equation for a single entry stream and single exit stream. Indicate the SI unit for each term. **(04 Marks)**

c. Steam expands through a turbine in a steady flow adiabatic process. The mass flow rate of the steam is 1.36 kg/s. The entering state of steam is 34.48 bar and 538°C, while the existing state is 6.896 bar and 294°C. Neglecting the changes in kinetic and potential energies, find the power output for the turbine. Assume C_p for steam as 2.01 kJ/kg K. **(06 Marks)**

OR

4 a. What is a Thermal Reservoir, give example? **(02 Marks)**

b. Show that the efficiency of a reversible heat engine is higher than a irreversible heat engine when both are working between same temperature limits. **(06 Marks)**

c. A heat engine receives half of its heat at a temperature of 1000K and the rest at 500K while rejecting heat to a sink at 300K. What is the maximum possible efficiency of this heat engine? **(08 Marks)**

Module-3

5 a. What is a reversed heat engine? **(02 Marks)**

b. Mention the factors which render a process irreversible. **(06 Marks)**

c. The efficiency of the Carnot engine rejecting heat to a sink at 7°C is 32%. If the heat rejected to the sink is 16.66 kJ/s. What is the power developed by the engine? Also determine the source temperature. **(08 Marks)**

OR

6 a. Derive the two Tds expressions for change in entropy of an Ideal gas. **(08 Marks)**

b. Water is heated from 25°C to 90°C as it flows at a rate of 0.5kg/s through a tube that is immersed in a hot bath at 100°C. Calculate heat transfer, entropy change for water, oil bath and universe. **(08 Marks)**

Module-4

7 a. What is available energy, un available energy? **(03 Marks)**

b. Show that the Joule Thomson coefficient for a gas can be expressed as

$$\mu_h = \frac{1}{C_p}\left[T\left(\frac{\partial V}{\partial T}\right)_P - v\right].$$ **(08 Marks)**

c. Obtain an expression for availability of a non-flow process. **(05 Marks)**

OR

8 a. With the help of P-T diagram define i) Triple point ii) Critical point. **(06 Marks)**

b. Use steam table to determine the unknown properties in the following:

i) P = 1 bar v = 2.41 m^3/kg T = _____

ii) P = 1 MPa, T = 150°C, v = _____

iii) T = 100°C, h_g = 2676 kJ/kg P_s = _____

iv) P = 10 bar, T = 250°C, h = _____. **(04 Marks)**

c. Steam is throttled from a pressure of 15 bar to 1.5 bar. If the steam is dry saturated at the end of expansion, what is the dryness fraction at the beginning. Also calculate the change in entropy during throttling. **(06 Marks)**

Module-5

9 a. Derive the expressions for specific heat at constant pressure and constant volume for mixture of gases. **(08 Marks)**

b. A mixture of gases comprises 30% CO, 15% CO_2 and 55% H_2. Find the gravimetric analysis specific gas constant and molecular weight of the mixture. **(08 Marks)**

OR

10 a. Explain the following:

i) Reduced properties

ii) Law of corresponding state

iii) Gibbs-Daltons law

iv) Compressibility factor. **(08 Marks)**

b. 10 kg of Carbon dioxide is enclosed in a container at a temperature of 100°C and pressure of 1 bar. Compute the volume of the container by

i) Ideal gas equation

ii) Vander Walls equation

iii) Compressibility chart. **(08 Marks)**

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