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Question Paper Code: 53073

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2017

Third Semester

Mechanical Engineering

15UME303 - ENGINEERING THERMODYNAMICS

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

(Use of Steam table, Psychrometric chart are permitted)

PART A - (10 x 1 = 10 Marks)

1. Which one of the following is the extensive property of a thermodynamic system?

   (a) volume (b) pressure (c) temperature (d) density

2. First law of thermodynamics refers to conservation of

   (a) mass (b) momentum (c) energy (d) force

3. Second law of thermodynamics defines

   (a) entropy (b) enthalpy (c) efficiency (d) internal energy

4. Availability of a system at any given state is

   (a) a property of the system
   (b) the total energy of the system
   (c) the maximum work obtainable as the system goes to dead state
   (d) the maximum useful work obtainable as the system goes to dead state

5. Which one of the following is the fluid whose properties in all its three phases are made use of thermodynamics?

   (a) ammonia (b) feron-12 (c) helium (d) water

6. Mollier diagram is a plot of

(a) temperature and entropy (b) temperature and enthalpy
(c) pressure and enthalpy (d) enthalpy and entropy

7. Which one of the following parameter is significant to ascertain chemical equilibrium of a system

(a) Clapeyron equation (b) Maxwell relation
(c) Gibbs function (d) Helmholtz function

8. The Clausius Clapeyron equation gives the slope of curve on

(a) P – V plot (b) P – h plot (c) P – T plot (d) T – S plot

9. Dew point is the temperature at which the condensation begins when the air is cooled at constant

(a) volume (b) entropy (c) pressure (d) enthalpy

10. Sensible heat factor is defined as the ratio

(a) sensible heat to latent heat (b) sensible heat to total heat
(c) latent heat to total heat (d) latent heat to sensible heat

PART - B (5 x 2 = 10 Marks)

11. What do you mean by Quasi-static process?

12. What is loss of availability? How is it related to entropy of universe?

13. Mention the improvements made to increase the ideal efficiency of Rankine cycle.

14. What is co-efficient of volume expansion?

15. Define relative humidity and specific humidity.

PART - C (5 x 16 = 80 Marks)

16. (a) In a cyclic process carried out in a closed system the working substance used has Cv = 1KJ/kgK. The cycle starts at 1 bar and $1m^3$. The first process is isochoric at the end of which the pressure is 2 bar. The next process is isobaric where in the volume is doubled. The third process is again isochoric which reduces the pressure back to 1 bar. Finally the cycle is completed by an isobaric process. If the temperature in the beginning of the cycle is 27°C. Calculate the heat transfer, change in internal energy and work done for each process. The gas constant in the working fluid is 287J/kg.

(16)

Or

(b) Fluid with an enthalpy of 3100KJ/kg and a velocity of 60m/sec enters a convergent divergent nozzle. The fluid leaves the nozzle with an enthalpy of 2750KJ/kg. Determine (i) the exit velocity of the fluid
(ii) the mass flow rate through the nozzle if the inlet area is 1000cm^{3}and specific volume at inlet is 0.2m^3/kg
(iii) Find the exit area of the nozzle if the specific volume at exit is 0.5m^3/kg. (16)

17. (a) Two reversible heat engines A and B are arranged in series. A rejects heat directly to B. Engine A receives 200KJ at a temperature of 421°c from the heat source while engine B is in communication with a cold sink at a temperature of 5°c. If the work output of A is twice that of B , find
(i) intermediate temperature between A and B
(ii) efficiency of each engine (iii) heat rejected to the sink. (16)

Or

(b) One kg of ice at 0°c is mixed with 10kg of water at 30°c. Determine the net increase in the entropy and unavailable energy, when the system reaches common temperature. Assume that the surrounding temperature is 10°c. Take specific heat of water is 4.18KJ/kgK. Specific heat of ice is 2.1KJ/kgK. Latent heat is 333.5KJ/kg. (16)

18. (a) One kg of steam at 8.5 bar and 0.95 dryness expands adiabatically to a pressure of 1.5 bar. The law for expansion is $PV^{1.2} = C$. Determine
(i) the final dryness fraction of the steam and
(ii) the change in internal energy during the expansion. (16)

Or

(b) In a Rankine cycle the steam at turbine inlet is saturated at a pressure of 30 bar and the exhaust pressure is 0.25 bar. Determine (i) pump work (ii) turbine work (iii) Rankine efficiency (iv) the condenser heat flow and (v) the dryness at the end of expansion. Assume the flow rate of 10kg/sec. (16)

19. (a) Write down the Daltons law of partial pressure and explain its importance. (16)

Or

(b) Drive Tds equation when (i) T and V independent (ii) T and P independent and (iii) P and V independent. (16)

20. (a) The DBT and WBT of air are 35°c and 23°c respectively when barometer reads 75cm of Hg. Find (i) Relative humidity (ii) Partial pressure of vapour (iii) DPT (iv) density (v) enthalpy. (16)

Or

(b) An office is to be air conditioned for 50 staff when the outdoor conditions are 30°c DBT and 75% RH. If the quantity of air supplied is $0.4m^3$/min/person, find the following

(i) Capacity of the cooling coil in tones of refrigeration.

(ii) Amount of water vapour removed per hour.

Assume that required air inlet condition is 20°c DBT and 60% RH. Air is conditioned first by cooling and dehumidifying and then by heating.

(iii) If the heating coil surface temperature is 25°c, find the by-pass factor of the heating coil. (16)