KUMARAGURU
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Register Number: ……..

B.E DEGREE EXAMINATIONS: DEC 2014

Regulation 2009

Third Semester

MEC105: ENGINEERING THERMODYNAMICS

(Common to AUTO/ME)

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. During throttling process
   a) Internal energy does not change
   b) Pressure does not change
   c) Entropy does not change
   d) Enthalpy does not change
2. A gas which obeys kinetic theory perfectly is known as
   a) Real gas
   b) Perfect gas
   c) Diatomic gas
   d) Mono atomic Gases
3. The change of entropy, when heat is absorbed by the gas is
   a) Zero
   b) Positive
   c) Negative
   d) Positive or Negative
4. In a reversible cycle, the entropy of the system
   a) Increases
   b) Decreases
   c) Does not change
   d) First increases and then decreases
5. Rankine cycle efficiency of a good steam power plant may be in the range of
   a) 15 to 20%
   b) 35 to 45%
   c) 70 to 80%
   d) 90 to 95%
6. Internal latent heat is given by
   a) $h_{fg}-(pv_g/J)$
   b) $h_g-(pv_g/J)$
   c) $h_{sup}-(pv_f/J)$
   d) $h_{fg}+(pv_g/J)$
7. Gibbs function is given by
   a) G=h-Ts
   b) G=h-Tp
   c) G=T-hs
   d) G=T-hp

8. The ratio of the mole number of a component to the mole number of the mixture is called

a) Mass fraction b) Partial pressure

c) Mole fraction d) Molar mass

9. In an unsaturated air the state of a vapour is

a) Wet b) Superheated

c) Saturated d) Unsaturated

10. The relative humidity, during sensible heating,

a) Can increase or decrease b) Increases

c) Decreases d) Remains constant

PART B (10 x 2 = 20 Marks)

11. What is Quasi-static process?
12. What is the convention for positive and negative work?
13. What do you meant by “Clausius Inequality”?
14. Why Carnot cycle cannot be realized in practice?
15. If water is at 65°C at 1 atm, What is the state of water? What is its specific enthalpy?
16. Name the processes involved in Rankine cycle with the help of T-S diagram.
17. State the assumptions made in kinetic theory of gases.
18. State “Dalton’s law of partial pressure”.
19. Define the term degree of saturation.
20. Define bypass factor (BPF) of a heating coil.

PART C (5 x 14 = 70 Marks)

21. a) A mass of air is initially at 260°C and 700kPa and occupies $0.028m^3$.The air is expanded at constant pressure to $0.084m^3$. A polytropic process with n=1.5 is then carried out, followed by a constant temperature process. All the processes are reversible.

(i) Sketch the cycle in the p-V and T-s planes.

(ii) Find the heat received and heat rejected in the cycle.

(iii) Find the efficiency of the cycle.

(OR)

b) (i) In an isentropic flow through nozzle, air flows at the rate of 600 kg/hr. At inlet to the nozzle, pressure is 2 MPa and temperature is 127°C. The exit pressure is 0.5 MPa. Initial air velocity is 300 m/s. Determine (i) Exit velocity of air (ii) Inlet and exit area of nozzle. (7)

(ii) 1 kg of gas at 1.1 bar, 27°C is compressed to 6.6 bar as per the law $pv^{1.3}$=constant. Calculate work and heat transfer, if (7)

(1) When the gas is ethane(C_2H_6) with molar mass of 30 kg/ k mol and C_p of 2.1 kJ/kgK

(2) When the gas is argon(Ar) with molar mass of 40 kg/ k mol and C_p of 0.52 kJ/kgK

22. a) Two reversible heat engines A and B are arranged in series. A rejecting heat directly to B engine receives 200kJ at a temperature of 421°C from a hot source, while engine B is in communication with a cold sink at a temperature of 4.4°C. If the work output of A is twice that of B, find (i) The intermediate temperature between A and B (ii) The efficiency of each engine (iii) The heat rejected to the cold sink.

(OR)

b) A household refrigerator is maintained at a temperature of 275 K. Every time the door is opened, warm material is placed inside, introducing an average of 420 kJ, but making only a small change in the temperature of the refrigerator. The door is opened 20 times a day, and the refrigerator operates at 15% of the ideal COP. The cost of work is Rs.2.50 per kWhr. What is the bill for the month of April for this refrigerator? The atmosphere is at 303 K.

23. a) A cyclic steam power plant is to be designed for a steam temperature at turbine inlet of 633K and an exhaust pressure of 8kPa. After isentropic expansion of steam in the turbine, the moisture content at the turbine exhaust is not to exceed 15%. Determine the greatest allowable steam pressure at the turbine inlet, and calculate the Rankine cycle efficiency for these steam conditions. Estimate also the mean temperature of heat addition.

(OR)

b) A rigid tank of 0.03m^3 capacity contains wet vapour at 80kPa. If the wet vapour

mass is 12 kg, calculate the heat added and the quality of the mixture when the pressure inside the tank reaches 7 MPa.

24. a) Explain and derive the (i) Joule-Thomson co-efficient (ii) Clausius Clapeyron equation.

(OR)

b) (i) Derive Maxwell's equations. (7)

(ii) Prove $Tds=C_v\,dT+T\,(\partial p/\partial T)_v\,dV$. (7)

25. a) Atmospheric air at 1.0132 bar has a DBT of 32°C and a WBT of 26°C. Compute (i) The partial pressure of water vapour, (ii) The specific humidity, (iii) The dew point temperature, (iv) The relative humidity, (v) The degree of saturation, (vi) The density of air in the mixture, (vii) The density of water vapour in the mixture and (viii) The enthalpy of the mixture. Use thermodynamic table only.

(OR)

b) (i) Air at 20°C, 40% relative humidity is mixed adiabatically with air at 40°C,40% RH in the ratio of 1kg of former with 2kg of latter(on dry basis). Find the final condition (humidity and enthalpy) of air. (7)

(ii) Explain adiabatic saturation process. (7)

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