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Question Paper Code : 10157

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2012.

Third Semester

Automobile Engineering

AT 2203/112301/AT 36/ME 1201/10122 AU 302/080190005 — ENGINEERING THERMODYNAMICS

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Any missing data can be suitably assumed.

Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart and refrigeration tables are permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define quasi-static process.

2. What is PMM1? Why it is impossible?

3. Give the conditions for reversibility.

4. What is meant by dead state?

5. Draw the P-T diagram for pure substances.

6. Define degree of superheat.

7. State Dalton's law of partial pressure.

8. What is the significance of compressibility factor?

9. Differentiate between relative and specific humidity.

10. What do you understand by evaporative cooling?

PART B — (5 × 16 = 80 marks)

11. (a) A system contains 0.15 m^3 of air at 4 bar and 150 °C. A reversible adiabatic expansion takes place till the pressure falls to 1.01 bar. The gas is then heated at constant pressure till the enthalpy increases by 62 kJ. Calculate the total work and heat transfer and change in entropy. Draw the process on P-v and T-s diagrams.

Or

(b) (i) Derive the steady flow energy equation applied to compressor and nozzle. (12)

(ii) Prove that internal energy is a property. (4)

12. (a) (i) 1200 kJ of heat is supplied to an engine from a source of 20 °C, the sink temperature is 2 °C. Which of the following cycle represents reversible, irreversible or impossible cycle?

(1) 275 kJ heat is rejected to sink

(2) 825 kJ heat is rejected

(3) 350 kJ heat is rejected. (8)

(ii) Show that a violation of the Kelvin-Planck statement of the second law implies a violation of the Clausius statement (8)

Or

(b) (i) State and prove the Carnot's principle. (8)

(ii) A Carnot engine delivers 100 kW of power by operating between temperature reservoirs at 100°C and 1000°C. Calculate the entropy change of each reservoir and the net entropy change of the two reservoirs after 20 min of operation. (8)

13. (a) Steam initially at 0.3 MPa, 250 °C is cooled at constant volume.

(i) At what temperature will it become saturated vapour?

(ii) What is the quality at 80°C?

(iii) What is the heat transferred per kg of steam in cooling from 250°C to 80 °C?

Or

(b) In a reheat cycle, the initial steam pressure and the maximum temperature are 150 bar and 550°C respectively. If the condenser pressure is 0.1 bar and the moisture at the condenser inlet is 5%, and assuming ideal processes, determine

(i) The reheat pressure

(ii) The cycle efficiency and

(iii) The steam rate.

14. (a) 0.5 kg of helium and 0.5 kg of nitrogen are mixed at 20 °C and at a total pressure of 100 kPa. Find

(i) The total volume of the mixture

(ii) The partial volume of the components

(iii) The partial pressure of the components

(iv) The mole fraction of the components

(v) Specific heats of the mixture.

Or

(b) (i) Derive the first and second TdS Equations. (8)

(ii) Explain and derive Clausius Clapeyron equation. (8)

15. (a) (i) Air at 20°C, 40% RH is mixed adiabatically with air at 40°C, 40% RH in the ratio of 1 kg of the former with 2 kg of the latter (on dry basis). Find the final condition of air. (12)

(ii) Draw the psychrometric chart and show any two psychrometric processes on it. (4)

Or

(b) (i) A sling psychrometer reads 40 °C dbt and 36 °C wbt. Find the humidity ratio, relative humidity, dew point temperature, specific volume and enthalpy of air. (10)

(ii) Explain the process of cooling dehumidification of air. (6)

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