Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 21845

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third Semester

Mechanical Engineering

ME 2202/ME 33/ME 1201/080190005/10122 ME 303/AT 2203/
AT 36/10122 AU 302 — ENGINEERING THERMODYNAMICS

(Common to Automobile Engineering)

(Regulations 2008/2010)

(Common to PTME 2202/10122 ME 303 Engineering Thermodynamics for B.E. (Part-Time) Third Semester Mechanical Engineering — Regulations 2009/2010)

Time : Three hours Maximum : 100 marks

(Use of approved thermodynamics tables, Mollier diagram, Psychometric chart and Refrigerant property tables permitted in the Examination)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Show how zeroth law of thermodynamics is used for temperature measurement.

2. Show that the energy of an isolated system remains constant.

3. What are the causes of irreversibility?

4. What is entropy principle?

5. What is normal boiling point?

6. When is reheat recommended in a steam power plant?

7. Why do the specific heats of an ideal gas depend only on the atomic structure of the gas?

8. Define volume expansivity.

9. Define dew point temperature.

10. What is chemical dehumidification?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A mass of gas is compressed in a quasi-static process from 80 kPa, 0.1 m^3 to 0.04 MPa, 0.03 m^3. Assuming that the pressure and volume are related by $pv^{1.35}$ = constant, find the work done by the gas system. (5)

(ii) A milk chilling unit can remove heat from the milk at the rate of 41.87 MJ/h. Heat leaks into the milk from the surroundings at an average rate of 4.187 MJ/h. Find the time required for cooling a batch of 500 kg of milk from $45^\circ C$ to $5^\circ C$. Take c_p of milk to be 4.187 KJ/kgk. (11)

Or

(b) (i) Write the steady flow energy equation for a boiler. (6)

(ii) Air flows steadily at the rate of 0.04 kg/s through an air compressor, entering at 6 m/s with a pressure of bar and a specific volume of 0.85 m^3/kg and leaving at 4.5 m/s with a pressure of 6.9 bar and a specific volume of 0.16 m^3/kg. The internal energy of the air leaving is 88 kJ/kg greater than that of entering air. Cooling water surrounding the cylinder absorbs heat from the air at the rate of 59 W. Calculate the power required to drive the compressor and the inlet and outlet cross-sectional areas. (10)

12. (a) (i) What is a reversed carnot heat engine? (5)

(ii) A heat pump working on a reversed carnot cycle takes in energy from a reservoir maintained at $3^\circ C$ and delivers it to another reservoir where temperature is $77^\circ C$. The heat pump drives power for its operation from a reversible heat engine operating within the higher and lower temperature limits of $1077^\circ C$ and $77^\circ C$. For 100 kJ/s of energy supplied to the reservoir at $77^\circ C$, estimate the energy taken from the reservoir at $1077^\circ C$. (11)

Or

(b) (i) What is available energy and unavailable energy with reference to a thermodynamic cycle? (4)

(ii) A fluid undergoes a reversible adiabatic compression from 0.5 MPa, 0.2 m^3 to 0.05 m^3, according to the law $pv^{1.3}$ = constant. Determine the change in enthalpy, internal energy and entropy and the heat transfer and work transfer during the process. (12)

13. (a) (i) Discuss the different zones of T-V diagram for water when the temperature rises from -20° C to 200° C at 1 atm pressure. (8)

(ii) A Vessel of volume 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 250° C. The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy. (8)

Or

(b) Steam at 90 bar and $480^{\circ}C$ is supplied to a steam turbine. The steam is reheated to its original temperature by passing the steam through reheater at 12 bar. The expansion after reheating takes place to condenser pressure of 0.07 bar. Find the efficiency of the reheat cycle and work output if the flow of steam is 5 kg/sec. Neglect the pressure loss in the system and assume expansions through the turbine are isentropic. Do not neglect pump work. (16)

14. (a) A mass of 0.25 kg of an ideal gas has a pressure of 300 kpa, a temperature of $80^{\circ}C$ and a volume of 0.07 m^3. The gas undergoes an irreversible adiabatic process to a final pressure of 300 kPa and final volume of 0.10 m^3, during which workdone on the gas is 25 kJ. Evaluate c_p and c_v of the gas the increase in entropy of the gas. (16)

Or

(b) The gas neon has a molecular weight of 20.183 and its critical temperature, pressure and volume are 44.5 k, 2.73 Mpa and 0.0416 m^3/kg mol. Reading from a compressibility chart for a reduced pressure of 2 and a reduced pressure of 1.3, the compressibility factor z is 0.7. What are the corresponding specific volume, pressure, temperature and reduced volume? (16)

15. (a) (i) The sling psychrometer reads $40^{\circ}C$ DBT and $28^{\circ}C$ WBT. Calculate, specific humidity, relative humidity, vapour density in air, dew point temperature and enthalpy of mixture per kg of dry air. Assume atmospheric pressure to be 1.03 bar. (12)

(ii) What is wet bulb depression and where is it equal to zero? (4)

Or

(b) (i) Explain adiabatic evaporative cooling. (6)

(ii) Air at $20^{\circ}C$, 40% relative humidity is mixed adiabatically with air at $40^{\circ}C$, 40% relative humidity in the ratio of 1 kg of the former with 2 kg of the latter (on dry basis). Find the condition of air. (10)
