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

Question Paper Code : 50854

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017

Third Semester

Mechanical Engineering

ME 6301 – ENGINEERING THERMODYNAMICS

(Common to Automobile Engineering/Mechanical Engineering/Mechanical and Automation Engineering)

(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A (10×2=20 Marks)

1. State Zeroth law of thermodynamics.

2. What is a steady flow process ?

3. What are thermal energy reservoirs ?

4. List the causes of entropy increase.

5. Differentiate between saturated liquid and compressed liquid.

6. What is binary vapour cycle ?.

7. Define compressibility factor.

8. State Clausis Clapeyron equation.

9. Write the Avogadro's law.

10. Define Dry bulb and Wet bulb temperature.

PART – B (5×13=65 Marks)

11. a) Discuss the following steady-flow engineering devices with SFEE equations.
    i) Nozzles and Diffusers. (6)
    ii) Compressors and Turbines. (7)

(OR)

b) A stationary mass of a gas is compressed without friction from an initial state of 0.3 m^3 and 0.105 MPa to a final state of 0.15 m^3 and 0.105 MPa, the pressure remaining constant during the process. There is a transfer of 37.6 kJ of heat from the gas during the process. How much does the internal energy of the gas change ?

12. a) i) Describe the Carnot cycle and examine the Carnot principles, idealized Carnot heat engines, refrigerators and heat pumps. (8)

ii) Determine the expressions for the thermal efficiencies and coefficients of performance for reversible heat engines, heat pumps and refrigerators. (5)

(OR)

b) i) Establish the inequality of Clausis. (5)

ii) A certain water heater operates under steady flow conditions receiving 4.2 kg/s of water at 75°C temperature, enthalpy 313.93 kJ/kg. The water is heated by mixing with steam which is supplied to the heater at temperature 100.2°C and enthalpy 2676 kJ/kg. The mixture leaves the heater as liquid water at temperature 100°C and enthalpy 419 kJ/kg. How much steam must be supplied to the heater per hour ? (8)

13. a) Steam initially at 1.5 MPa, 300°C expands reversibly and adiabatically in a steam turbine to 40°C. Determine the ideal work output of the turbine per kg of steam.

(OR)

b) Explain mercury-water binary vapour cycle.

14. a) Derive Maxwell's equations and write down the first and second Tds equations.

(OR)

b) Explain Joule-Kelvin effect. What is inversion temperature ?

15. a) A certain gas has Cp = 1.968 and Cv = 1.507 kJ/kg K. Find its molecular weight and the gas constant. A Constant volume chamber of 0.3 m^3 capacity contains 2 kg of this gas at 5°C. Heat is transferred to the gas until the temperature is 100°C. Find the work done, the heat transferred and the changes in internal energy, enthalpy and entropy.

(OR)

b) Explain the following Air-conditioning process.

i) Sensible cooling and sensible heating process. **(5)**

ii) Cooling and dehumidification process. **(5)**

iii) Evaporative cooling. **(3)**

PART – C **(1×15=15 Marks)**

16. a) The food compartment of a refrigerator is maintained at 4°C by removing heat from it at a rate of 360 kJ/min. If the required power input to the refrigerator is 2 kW, determine

(a) the coefficient of performance of the refrigerator and

(b) the rate of heat rejection to the room that houses the refrigerator.

(OR)

b) Consider a room that contains air at 1 atm, 35°C and 40 percent relative humidity. Using the psychrometric chart, determine :

(a) The specific humidity

(b) The enthalpy

(c) The wet bulb temperature

(d) The dew-point temperature and

(e) The specific volume of the air.