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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

 $(10\times2=20 \text{ Marks})$ 

- 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.

(8)

#### PART - B

 $(5\times13=65 \text{ Marks})$ 

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

(OR)

- b) A stationary mass of a gas is compressed without friction from an initial state of 0.3 m³ and 0.105 MPa to a final state of 0.15 m³ 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.
  - 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?
- 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<sup>3</sup> capacity contains 2 kg of this gas at  $5^{\circ}$ C. Heat is transferred to the gas until the temperature is  $100^{\circ}$ 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.

(0)

ii) Cooling and dehumidification process.

(0)

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.