Register No.: …… Name: ……..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (S), SEPT 2022

MECHANICAL ENGINEERING

(2020 SCHEME)

Course Code : **20MET202**

Course Name: **Engineering Thermodynamics**

Max. Marks : **100** **Duration: 3 Hours**

Use of Steam table is allowed.

PART A

(Answer all questions. Each question carries 3 marks)

1. Differentiate between Intensive and Extensive properties.
2. Explain the concept of Continuum.
3. List any three applications of Steady Flow Energy Equation (SFEE).
4. Differentiate between Heat and Work.
5. What is a Thermal Energy Reservoir? Give examples.
6. State the Third law of Thermodynamics.
7. Distinguish between Wet Steam and Dry Steam.
8. What are Reduced Properties?
9. State Dalton's law of Partial pressures.
10. Explain Kay's rule of real gas mixtures.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Explain the working of Constant Volume gas Thermometer with neat diagram. (7)
    b) Explain a quasi-static process, with suitable diagrams and graphs. (7)

OR

12. a) With the aid of a neat diagram explain the Electric resistance Thermometer. (6)
    b) Define the following terms
    (i) Mechanical Equilibrium (ii)Thermal Equilibrium (8)
    (iii)Chemical Equilibrium (iv)Thermodynamic Equilibrium

MODULE II

13. a) Explain Free Expansion. Why displacement work is absent in free Expansion? (7)
    b) Derive Steady flow Energy Equation. (7)

OR

14. a) What is PMM1? Why is it not possible? (4)

b) Air flows steadily at the rate of 0.5kg/s through an air compressor, entering at 7m/s velocity,100kPa pressure and 0.95 m^3/kg volume and leaving at 5m/s,700kPa and 0.19m^3/kg. The internal energy of the air leaving is 90kJ/kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58kW. (10)

(i) Compute the rate of Shaft work input to the air in kW.

(ii) Find the ratio of Inlet pipe diameter to Outlet pipe diameter.

MODULE III

15. a) State and prove Clausius Inequality. (7)

b) Establish the equivalence of Kelvin Planck's and Clausius statements (7)

OR

16. a) What is a Cyclic Heat Engine? (4)

b) A reversible heat engine operates between two reservoirs at temperatures of 873K and 313K. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 313K and 253K.The heat transfer to the heat engine is 2000kJ and the net work output of the combined engine refrigerator plant is 360kJ. (10)

(i) Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 313K.

(ii) Reconsider (i) given that the efficiency of the heat engine and COP of the refrigerator are each 40% of their maximum possible values.

MODULE IV

17. a) What is Virial Expansion? Explain the term Compressibility factor. (7)

b) Explain the law of Corresponding states and its significance to the generalized Compressibility chart. (7)

OR

18. a) Draw the phase equilibrium diagram on p-v coordinates for pure substance and explain. (6)

b) Steam initially at 1.5Mpa, 573K expands reversibly and adiabatically in a steam turbine to 313K. Determine ideal work output of the turbine per kg of steam. (8)

MODULE V

19. a) What are Maxwells equations? Also derive the TDS equations (10)

b) State and explain Amagat's law of additive volumes. (4)

OR

20. a) Explain Joule Kelvin effect with respect to significance of Inversion curve. Show that for an ideal gas, Joule kelvin coefficient is zero. (10)

b) Differentiate between Mole fraction and Mass fraction. (4)

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