Register No.: .... Name: ....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2023
MECHANICAL ENGINEERING

(2020 SCHEME)

Course Code : **20MET202**

Course Name: **Engineering Thermodynamics**

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

Use of Steam Tables and Thermodynamic Charts may be permitted

PART A

(Answer all questions. Each question carries 3 marks)

1. Explain the concept of continuum. How density can be defined using this concept?
2. With a neat sketch, explain the concept of thermocouple.
3. Compare Open and Closed systems of thermodynamics.
4. Explain the first law of thermodynamics.
5. State the corollaries of Carnot theorem.
6. Derive the relation between COP of refrigerator and heat pump operating between same temperature thermal reservoirs.
7. Explain saturated vapor and superheated vapor.
8. What is compressibility factor?
9. Explain mass fraction and mole fraction for an ideal gas mixture.
10. What is the significance of inversion curve?

PART B

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

MODULE I

11. a) Write short notes on (2+2+3)
    (i) System
    (ii) Surrounding
    (iii) Thermodynamic equilibrium

    b) With suitable sketches explain the working of constant volume gas thermometer (7)

OR

12. a) Write short notes on (2+2+3)
    (i) Path function
    (ii) Extensive property

(iii) Quasi-static process

b) With suitable sketches explain the zeroth law of thermodynamics and its applications (7)

MODULE II

13. In a gas turbine the gasses enter at the rate of 5kg/s with a velocity of 50 m/s and enthalpy of 900 kJ/kg and leave the turbine with a velocity of 150m/s and enthalpy of 400 kJ/kg. The loss of heat from the gasses to the surroundings is 25 kJ/kg. Assume R=0.285 kJ/kg K and c_p = 1.004 kJ/kg K and the inlet conditions to be at 100 kPa and 27^{o}C. Determine the power output of the turbine and diameter of the inlet pipe. (14)

OR

14. a) Derive the general energy equation for an open system. (7)

b) Describe Joule's experiment with a neat diagram. (7)

MODULE III

15. a) List the statements of the second law of thermodynamics and explain its equivalence. (8)

b) A reversible heat engine operates between two reservoirs at temperatures of 600^{o}C and 40^{o}C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40^{o}C and -20^{o}C. The heat transfer to the heat engine is 2000 kJ and the net work output of the combined engine refrigerator plant is 360 kJ. Evaluate the heat transfer to the refrigerator and the net heat transfer to the reservoir at 40^{o}C. (6)

OR

16. a) Establish the inequality of Clausius. (7)

b) What is Entropy principle? Discuss how it is applicable to mixing of gases. (7)

MODULE IV

17. a) Draw the p-V diagram and p-V-T surface of a water. Explain the salient features. (7)

c) What are reduced properties and compressibility factor? State their significance. (7)

OR

18. a) Derive the expression of law of corresponding states from Van Der Waals equation of state. What is its significance? (8)

b) Sketch and explain the h-s diagram of water (6)

MODULE V

19. Prove that $C_p - C_v = -T \left(\frac{\partial V}{\partial T}\right)^2_p \left(\frac{\partial p}{\partial V}\right)_T$ (14)

OR

20. a) Sate the following
(i) Daltons Law of partial pressure
(ii) Agamat's Law of partial volume (3+3)

b) Derive Clausius Clapeyron equation (8)

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