R20 Regulation *Subject code:3P3CD*

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous, Accredited by NAAC with 'A' Grade)

B.Tech III Semester Regular/Supplementary Examinations, March/April 2023

THERMODYNAMICS

(Mechanical Engineering)

Maximum Marks: 70 Date:04.04.2023 Duration: 3 hours

Note: 1.This question paper contains two parts A and B.
2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.
3. Part B consists of 5 Units. Answer any one full question from each unit.
4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks (10x2M=20 Marks)

1 Define Intensive and Extensive properties.
2 State Zeroth law of thermodynamics.
3 Differentiate Availability and Irreversibility
4 What is a Gibbs function?
5 Write a short note free expansion process.
6 What do you mean by phase change.
7 What is Avogadro's Law?
8 What is mole fraction?
9 Define mean effective pressure.
10 Draw p-v and T-s diagrams of Atkinson Cycle.

Part-B

Answer All the following questions. (5X10M=50Marks)

11 (a) What do you understand by path function and point function? What are exact and inexact differentials? 5M

(b) Explain what you understand by thermodynamic equilibrium. 5M

OR

12 (a) What do you understand by macroscopic and microscopic viewpoints? 5M

(b) What is constant volume gas thermometer? Why is it preferred to a constant pressure gas thermometer? 5M

13 (a) State the first law of thermodynamics and write the first law equation. 5M

(b) Establish the equivalence of Kelvin-Planck and Clausius statements. 5M

OR

14 State and Prove Clausius Inequality. 10M

15 (a) Draw the phase equilibrium for a pure substance on h-s and T-s plot with relevant constant property lines. 5M

(b) What do you understand by triple point? Give the pressure and temperature of water at its triple point. 5M

OR

16 (a) What is a throttling process? Explain. 5M

(b) A nozzle is a device for increasing the velocity of a steadily flowing steam. At inlet to a certain nozzle, the fluid parameters are: enthalpy=2850kJ/kg; velocity=50 m/s ; area=0.1 m^2 and specific volume is 0.18 m^3/kg. At the discharge end the enthalpy is 2650 kJ/kg and the specific volume is 0.49 m^3/kg. Determine the velocity of fluid at exit from the nozzle, mass flow rate of fluid, and the exit area of the nozzle. The nozzle is horizontal and there is negligible heat loss from it. 5M

17 (a) Express the vander wall's constant in terms of critica properties. 5M

(b) A mass of 0.25 kg of an ideal gas have a pressure of 300 kPa, a temperature of 80°C, and a volume of 0.07m3. The gas undergoes an irreversible adiabatic process to a final pressure of 300 kPa and final volume of 0.10 m^3, during which the work done on the gas is 25 kJ. Evaluate the C_p and C_v of the gas and the increase in entropy of the gas 5M

OR

18 (a) How is the partial pressure in a gas mixture related to the mole fraction? 5M

(b) A stationary mass of gas is compressed without friction from an initial state of 0.3m^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. 5M

19 (a) Differentiate the Stirling and Ericsson cycles on p-v and T-s planes 5M

(b) Compare Otto, Diesel and Dual cycles with P-V and T-S plots. 5M

OR

20 An engine working on the Otto Cycle is supplied with air at 0.1 MPa, 35°C. The compression ratio is 8. Heat supplied is 2100 KJ/kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and the mean effective pressure. For air (c_p= 1.005kJ/kg K c_v=0.718kJ/kg K and R= 0.287 kJ/kgK. 10M