	In Sem Examination-II Summer2024		
	Exam Seat No.:		
	Academic Year: 2023-2024	Semester: IV	
	Name of Programme: B. Tech	Pattern: 2022	
	Name of Course: Thermodynamics	Course Code: CHE222014	
	Max. Marks: 30	Duration: 1:00 H	

Instructions: Candidates should read carefully the instructions printed on the Question Paper
and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 1 page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required but justify it.
4. Draw the neat, labelled diagrams, wherever necessary.
5. The last columns indicate the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

Question No. 1 Attempt following Question

a)	Define a thermodynamic system and discuss the types of systems used in engineering applications. Provide examples for each type.	(4)	CO1
	OR		
b)	What is First Law of Thermodynamics. Derive the mathematical expression of the First Law of Thermodynamics for a non-flow process.	(4)	CO1
c)	Define Heat Capacity. Prove that the heat supplied is equal to change in internal energy for a constant volume process and the change in enthalpy for a constant pressure process.	(5)	CO1
	OR		
d)	What is meant by an equilibrium state in thermodynamics? Discuss the types of equilibrium with examples.	(5)	CO1
e)	Nitrogen gas is confined in a cylinder and the pressure of the gas is maintained by a weight placed on the piston. The mass of the piston and the weight together is 50 kg. The acceleration due to gravity is 9.81 m/s^2 and the atmospheric pressure is 1.01325 bar. Assume frictionless piston. Determine i) The force exerted by atmosphere, the piston, and the weight on the gas if the piston is 100 mm in diameter. ii) The pressure of the gas. iii) If the gas is allowed to expand pushing up the piston and the weight by 400 mm, what is the work done by gas in kJ?	(6)	CO1
	OR		

f) Water a 200 kPa and 82^{o}C (355 K), enters a straight pipe with a velocity of 3 m/s, where it is heated by flue gases from outside. Steam leaves the system at 100 kPa and 150^{o}C (423 K), with a velocity of 200 m/s. Find the heat that must be supplied per kg of water flowing. (6) CO1

Given data: H for water = 343.3 kJ/kg, H for steam = 2776.3 kJ/kg.

Question No. 2 Attempt following Question

a) Derive the ideal gas law equation PV = nRT. (4) CO2

OR

b) Show that work done in constant temperature process = RT ln (P_1/P_2). (4) CO2

c) One Kilo mol CO_2 occupies a volume of 0.381 m^3 at 313 K. Calculate the pressure given by ideal gas equation and van der Waals equation. Take the van der Waals constants to be a = 0.365 Nm^4/mol^2 and b = 4.28 × 10^{-5} m^3/mol. (5) CO2

OR

d) Give the Kelvin- Planck statement and the Clausius statement of the Second Law of Thermodynamics and show that they are equivalent. (5) CO2

e) An ideal gas is undergoing a series of three operations: The gas is heated at constant volume from 300 K and 1 bar to a pressure of 2 bar. It is expanded in a reversible adiabatic process to a pressure of 1 bar. It is cooled at constant pressure of 1 bar to 300 K. Determine the heat and work effects for each step. (Assume C_p = 29.3 kJ/kmol K and γ (gamma) = 1.4) (6) CO2

OR

f) Explain the physical significance of the critical point using PV diagram. (6) CO2

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