Question Paper

Exam Date & Time: 27-Apr-2018 (09:30 AM - 12:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES SECOND B.Sc (APPLIED SCIENCES) END-SEMESTER THEORY EXAMINATIONS APRIL - 2018 DATE : 27 APRIL 2018 TIME : 9:30AM TO 12:30PM Chemical Engg.Thermodynamics - I [ICHM 122]

Marks: 100

Duration: 180 mins.

Answer 5 out of 8 questions.

Missing data, if any, may be suitably assumed and the same is indicated.

1)		Explain the following terms.	(12)
	A)	 (i) cyclic and non-cyclic process (ii) internal energy and enthalpy (iii) intensive and extensive properties (iv) unstable and stable equilibrium 	
	В)	Derive the mathematical form of first law of thermodynamics for non-flow processes.	(8)
2)	A)	With a neat V-T diagram, explain the variation of volume with temperature at different pressure values.	(12)
	B)	Calculate the molar volume for methane vapour at 300 K and 600 bar by using the Redlich-Kwong equation. The critical temperature and pressure of methanol are 191.1 K and 46.4 bar. Use iterative procedure.	(8)
3)	A)	Discuss the importance of two correction factors added in the van der Waals equation.	(8)
	B)	Discuss law of two parameter and three parameter states for finding the compressibility factor.	(6)
	C)	Vapours are more compressible compared to liquids. Discuss with the help of P-V diagram.	(6)
4)		An ideal gas undergoes the following reversible processes:	(14)

	A)	 (a) From an initial state of 343 k and 1 bar it is compressed adiabatically to 423 K (b) It is then cooled to 343 K at constant pressure (c) Finally, it is expanded to its original state isothermally. Calculate ΔU, ΔH, W and Q for each step as well as for the 	
		entire cycle. Assume $C_v = (3/2)R$	
	В)	Derive the van der Waal equation in terms of compressibility factor.	(6)
5)	A)	With the help of simplified diagrams, explain Carnot principle first postulate.	(10)
	В)	An inventor claims to have developed a heat pump with a COP of 6 which maintains the cold space at -23° C when operating in a surrounding temperature of 37° C. Justify the claim. Derive the equation used.	(10)
6)	A)	Derive the expression between reversible and irreversible processes starting from Clausius inequality.	(8)
	B)	Discuss how entropy is effected by temperature with the help of an example.	(8)
	C)	Heat capacity at constant pressure is always greater than heat capacity at constant volume. Discuss why?	(4)
7)	۵)	Derive all the four Maxwell's relations for energy properties.	(12)
	B)	Prove the relation between heat capacities of the substance $C_P - CV = \beta^2 VT/k$	(8)
8)	A)	Discuss the vapor compression cycle (by using throttle valve) with relevant flow diagram and T-S diagram. Derive the equations for finding the coefficient of performance.	(14)
	В)	What are the practical problems encountered in Rankine cycle of steam power plant. How these problems are solved.	(6)

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