Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (CHEMICAL ENGINEERING)

ENDSEM EXAMINATIONS, NOV 2017

SUBJECT: CHEMICAL ENGINEERING THERMODYNAMICS-I [CHE 2104]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A.	Explain briefly the following with examples: (i) cyclic and non-cyclic process (ii) intensive and extensive properties (iii) Heat and work (iv) Gibbs and Helmholtz free energy	**06**
1B.	The saturation pressure of ammonia at 321.55 K is 1.95 MPa. Determine the molar volumes of saturated liquid using the RK equation of state (iterative procedure). The values of critical temperature and critical pressure are 405.5 K and 112.7 bar.	**04**
2A.	With a neat diagram, explain the working principle of ideal gas temperature scale.	**03**
2B.	Heat capacity value at constant pressure is always greater than heat capacity value at constant volume. Justify the statement.	**02**
2C.	With the help of V-T diagram, discuss the variation of molar volume of a substance with temperature at different pressures.	**05**
3A.	With the help of all the diagrams, discuss the equivalence of Kelvin-Plank and Clausius statement with respect to second law of thermodynamics.	**3.5**
3B.	Discuss any four factors arising from microscopic view that contribute to the total internal energy of a substance?	**04**
3C.	The vapour pressure of benzene is given by Antoine equation as $\log_{10} P = A - \frac{B}{t+C}$ Where P is in Torr and t is in ^{o}C. The values of Antoine constants A, B and C are given. Calculate the accentric factor. (Given A= 6.87987 B= 1196.76 C=219.161 Tc=562.1 K, Pc= 49.24 bar, 1 Torr = 0.0013332 bar).	**2.5**
4A.	An insulated tank A of volume 1 m^3 initially contains air (ideal gas) at 10 MPa and 300 K. This tank is connected through a valve to another insulated tank of volume 9 m^3 which is evacuated. The valve in between the two tanks is opened till the pressure in both the tanks equalizes and then closed. Determine the pressure of the air in each tank immediately after the valve is closed. Assume that the air left in tank A has	**03**

	undergone adiabatic expansion.	
4B.	Derive the expression $C_p - C_v = \frac{\beta^2 VT}{K}$ for showing the relationship between heat capacity at constant pressure and constant volume.	**3.5**
4C.	Derive Gibbs Helmholtz equation for showing the effect of temperature on Gibbs free energy.	**3.5**
5A.	Explain the third law of thermodynamics from statistical approach.	**1.5**
5B.	Discuss with a neat flow diagram, the air-refrigeration cycle. Also discuss the TS diagram. Derive the expression for coefficient of performance.	**06**
5C.	The efficiency of Rankine cycle can be improved by increasing the pressure in the boiler. But this leads to excess proportion of liquid in the exhaust from the turbine. Discuss in brief, how do you solve the above the problem using Reheat cycle?	**2.5**