Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

III SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: CHEMICAL ENGINEERING THERMODYNAMICS-I [CHE 207]

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data, if any, may be suitably assumed.

1A.	Distinguish between the following terms. (i) State and path function (ii) Gibbs and Helmholtz free energy (iii) Classical and statistical thermodynamics (iv) reversible and free expansion	**12**
1B.	Define the perpetual motion machine with respect to first and second law of thermodynamics.	**04**
1C.	Heat is not a substance, it is a form of energy. Justify the statement with the help of Joule's experiment.	**04**
2A.	Starting from the van der Waals equation, derive the expression for critical volume, critical temperature and critical pressure in terms of van der Waals constants a and b and thus derive the van der Waals equation in reduced form.	**11**
2B.	Starting from the Redlich-Kwong equation, calculate the molar volume for methanol vapour at 500 K and 10 bar. Given the critical temperature and critical pressure of methanol are 512.6 K and 81 bar. Use iterative procedure	**06**
2C.	Heat capacity value at constant pressure is always greater than heat capacity value at constant volume. Discuss.	**03**
3A.	Explain the principle of corresponding states with two parameter and three parameter correlation.	**04**
3B.	Liquids are considered to be incompressible when compared to vapours. Justify the statement by taking the example of P-V diagram.	**06**
3.C	With the help of all simplified diagrams, state and prove Carnot principle second postulate.	**10**

4A.	In a particular engine cylinder one mole of an ideal gas ($\gamma = 1.4$) is compressed from 25^0C and 0.1 MPa till its volume is reduced to 1/12 of the original value. The process of compression can be approximated to follow the relation $PV^{1.25}$ = constant. Determine the work and heat interactions. Also calculate the final temperature and pressure of the gas.	**06**
4B.	Show that for a gas obeying van der Waals equation of state, $C_p - C_v = R / (1- 2a(V- b)^2/ (RTV^3))$ where a and b are van der Waals constants.	**07**
4C.	Using the Mnemonic diagram, discuss the rules for obtaining fundamental property relations and Maxwell's relations.	**07**
5A.	With a neat diagram, discuss the working principle of ideal gas temperature scale.	**08**
5B.	Discuss the equivalence of Kelvin-Plank and Clausius Statement with respect to heat engine and heat pump.	**08**
5C.	Internal energy is a state function. Discuss. Why?	**04**
6A.	Explain four desirable properties of refrigerant.	**04**
6B.	Explain with a neat flow diagram, the Reheat cycle of steam power plant. Discuss the TS diagram and obtain the equation for thermal efficiency.	**12**
6C.	The transfer of energy to a low temperature leads to a greater degradation than that resulted by the transfer of the same quantity to a high temperature. Discuss.	**04**