Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (CHEMICAL ENGINEERING)

MAKEUP EXAMINATIONS, JAN 2017

SUBJECT: CHEMICAL ENGINEERING THERMODYNAMICS-I [CHE 2104]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

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

1A.	Explain briefly the following with examples: (i) internal energy and enthalpy (ii) state and path function (iii) Gibbs and Helmholtz free energy (iv) open and isolated system	**12**
1B.	Calculate the volume of methanol vapour at 500 K and 10 bar using the Redlich-Kwong equation (iterative procedure). The critical temperature and critical pressure of methanol are 512.6 K and 81 bar.	**08**
2A.	With the help of PT diagram, discuss the variation of vapour pressure of a substance with temperature.	**08**
2B.	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.	**08**
2C.	Define perpetual motion machine with respect to first law and second law of thermodynamics.	**04**
3A.	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 effect. Assume Cp= 20.986 kJ/kmol K.	**09**
3B.	Derive the expression for first law of thermodynamics for a flow process.	**09**
3C.	State third law of thermodynamics from statistical approach.	**02**
4A.	With diagrams, explain Kelvin-Planck and Clausius statement based on heat engine and heat pump.	**05**
4B.	A Carnot refrigerator consumes 200 W power in summer when the ambient temperature is 40^0C. The rate at which energy is lost as heat is estimated at 15 W per degree Celsius temperature difference between the ambient and the cold space. Determine the cold space temperature, if the refrigerator is operating continuously.	**05**

4C.	Starting from the fundamentals, derive all the four Maxwell's relations.	**10**
5A.	Derive the expression between heat capacities $\frac{C_p}{C_v} = \left(\frac{\partial V}{\partial P}\right)_T \left(\frac{\partial P}{\partial V}\right)_S$	**06**
5B.	Discuss with a neat flow diagram, the Reheat cycle of steam power plant. Also discuss the TS diagram.	**10**
5C.	Discuss any four properties of the refrigerant.	**04**