

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER- IV(NEW) EXAMINATION – SUMMER 2015

Subject Code: 2143406**Date: 26/05/2015****Subject Name: Thermodynamics and Thermal Engineering****Time: 10:30am-1.00pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) What do you mean by quasi-static process? Explain homogeneous and heterogeneous system. **07**
- (b) Define Zeroth law of Thermodynamics. What are the limitations of first law of thermodynamics? **07**
- Q.2** (a) Give and explain the following statements of second law of thermodynamic (i) Clausius statement (ii) Kelvin – Planck statement. Prove that they are equivalent. **07**
- (b) Explain with neat diagram Rankine vapour power cycle. Why Rankine cycle is modified? **07**
- OR**
- (b) What is reversed Carnot heat engine? What are the limitations of Carnot cycle? **07**
- Q.3** (a) Using Maxwell's relation $\left(\frac{\partial p}{\partial T}\right)_v = \left(\frac{\partial s}{\partial v}\right)_T$ derive Clapeyron equation **07**
- $\frac{dp}{dT} = \frac{h_{fg}}{T(v_g - v_f)}$ and explain the utility of this equation in thermodynamics.
- (b) Explain the terms available energy and unavailable energy. Explain why unavailable energy in the universe tends to increase. **07**
- OR**
- Q.3** (a) Define the Joule Thomson coefficient. State the conditions for cooling effect, heating effect and neither cooling nor heating effect. **07**
- (b) Derive the three $T.ds$ equations as stated below: **07**
- (i) $Tds = C_v dT + T\left(\frac{\partial p}{\partial T}\right)_v dv$; (ii) $Tds = C_p dT - T\left(\frac{\partial v}{\partial T}\right)_p dp$
- and $Tds = C_v\left(\frac{\partial T}{\partial p}\right)_v dp + C_p\left(\frac{\partial T}{\partial v}\right)_p dv$
- Q.4** (a) Explain Dalton's law of partial pressure. **07**
- (b) Explain the construction and give the use of generalized compressibility chart. What is significance of compressibility factor? **07**
- OR**
- Q.4** (a) Derive Vander Waal's equation and How does the Vander Waal's equation differ from the ideal gas equation of state? **07**
- (b) Draw and explain PV and TS diagrams of Otto and Diesel Cycles. **07**
- Q.5** (a) The thermal conductivity of a material varies linearly with temperature; derive the one- dimensional, steady state heat conduction equation with internal heat generation by writing the energy balance for a differential volume element in Cartesian coordinate system. **07**

- (b) What do you mean by critical radius of insulation? Deduce the expression for it. **07**
Explain its concept with help of material and surface resistances.

OR

- Q.5** (a) State and prove Kirchhoff's law of radiation. **07**
(b) Define Following: **07**
(i) Critical Reynolds Number (ii) Prandtl Number (iii) Grashof Number (iv) Nusselt Number (v) Stanton Number (vi) Peclet Number (vii) Graetz Number.
