Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –Ist SEMESTER–EXAMINATION – JULY- 2012

Subject code: 711101N **Date: 05/07/2012**

Subject Name: Advanced Thermodynamics and Heat Transfer

Time: 2:30 pm – 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Usual notations are used**

Q.1 **(a)** Define (i) compressibility factor (ii) reduced co-ordinates. Explain with neat sketch general compressibility chart. **07**

(b) Explain in detail different types of Phase Equilibrium diagram on p-T surface, h-s surfaces, and T-s surfaces **07**

Q.2 **(a)** Differentiate clearly between the following:

(i) Diathermal wall and adiabatic wall,

(ii) Isolated and closed systems and

(b) Establish the equivalence of Kelvin-Plank and Clausius statements. **07**

OR

(b) Derive the two *T.ds* equations as stated below: **07**

$$Tds = C_p dT - T\left(\frac{\partial v}{\partial T}\right)_p dp \; and \; Tds = C_v\left(\frac{\partial T}{\partial p}\right)_v dp + C_p\left(\frac{\partial T}{\partial v}\right)_p dv$$

Q.3 **(a)** Establish the general differential equation in Cylindrical co-ordinates for 3-D unsteady heat conduction.. **07**

(b) The temperature distribution across a wall, 1 m thick at a certain instant of time is given as: $T(x) = 900 - 300x - 50x^2$,Where T is in degree Celsius and x is in meters **07**

The uniform heat generation of 1000 W/m^3 is present in wall of area 10 m^2 having the properties $\rho = 1600\, kg/m^3, k = 40\, W/m.K$ and $C = 4\, kJ/kg.K$

1. Determine the rate of heat transfer entering the wall $(x = 0)$ .and leaving the wall $(x = 1m)$
2. Determine the rate change of internal energy of the wall

OR

Q.3 **(a)** What is lumped capacity? What are the assumptions for lumped capacity analysis? **07**

(b) What are Heisler Charts? Explain their significance in solving transient conduction problems. **07**

Q.4 **(a)** What do you understand by high grade energy and low grade energy? Explain it with examples. **07**

(b) What do you understand by entropy transfer? Why is entropy transfer associated with heat transfer and not with work transfer? **07**

OR

Q.4 **(a)** What is Reynold analogy? Describe the relation between fluid friction and heat transfer. **07**

(b) Define Grashof number. Explain its significance in natural convection heat transfer **07**

Q.5 **(a)** State and explain Stefan Boltzmann law. Derive an expression for total emissive power of a blackbody. **07**

(b) Explain Kirchhoff's law. **07**

OR

Q.5 **(a)** What is Wien's displacement law? Derive an expression for its relation. **07**

(b) State and explain Lambert's cosine law of radiation.. **07**

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