Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013

Subject code: 711001N **Date: 23-12-2013**

Subject Name: Cryogenic Fundamentals

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use charts and tables is permitted.**

Q.1 **(a)** Describe the effects of temperature on Ultimate Strength and Fatigue Strength of S.S.-304, Aluminium, Titanium and Teflon. **07**

(b) Define lattice specific heat. Also determine the lattice specific heat of copper at 80 K if copper has a molecular weight of 63.54 g/mol and Debye temperature for copper is 310 K and C_v/R =1.566. **07**

Q.2 **(a)** Enlist various physical properties of Helium 4 cryogen. Also draw the phase diagram for it. **07**

(b) Enlist several types of insulation that can be used in cryogenic equipments. Also give comparison of Gas filled powders/fibers insulation and Expanded foam insulation. **07**

OR

(b) Describe the analysis to calculate the heat inleak for the double walled vacuum insulated vessel. **07**

Q.3 **(a)** Explain construction and working of vapour-pressure thermometer with neat figure. Also derive the equation for its sensitivity. **07**

(b) Determine the pressure to which hydrogen gas (R=4124 J/kgK, γ = 1.41) must be reduced in order that the heat flux by molecular conduction through the gas be limited to 30 W/m^2. The two surfaces enclosing the gas may be considered as infinite planes at temperature of 300 K and 78 K. The pressure gauge is at 300 K. **07**

OR

Q.3 **(a)** Explain construction and working of Turbine flow meter with figure. **07**

(b) Determine the mean apparent thermal conductivity of MLI between (a) 300 K and 20.5 K (b) 20.5 K and 4.4 K, if the insulation is made up of 25 layers/cm of aluminium foil (ε =0.05) and fiber glass paper (h_c = 85 W/m^{2}K). **07**

Q.4 **(a)** Write short notes on followings superconductive devices. **07**

(a) Cryotrons (b) Tunnel Diodes

(b) A carbon resistance thermometer has the following electric resistance values: 1460 ohms at 4.2 K, 133 ohms at 77.3 K and 100 ohms at 300 K. Determine the constants in the Callendar-van Dusen equation if R_0 = 25 ohms. **07**

OR

Q.4 **(a)** Describe the methodology to measure the liquid level in 10 m^3 LN_2 horizontal stationary storage tank with fixed electric resistance liquid level gauge. **07**

(b) Describe construction and working of a typical Cryo-probe used for treatment of warts with necessary figure. **07**

Q.5 **(a)** Describe about following physiological hazards. **07**

(i) Frostbite (ii) Nitrogen Asphyxiation

(b) Describe about flammability hazards associated with oxygen. **07**

OR

Q.5 **(a)** Describe the precautions to be taken during handling liquid nitrogen for industrial application. **07**

(b) Describe chemical propulsion system with necessary figure. **07**

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