Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
M.E –Ist SEMESTER–EXAMINATION – JULY- 2012

Subject code: 711001N   **Date: 05/07/2012**
Subject Name: Cryogenic Fundamentals
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.**

Q.1	**(a)**	Explain the effect of temperature in cryogenic range of 0 to 250 K on Ultimate and Yield strength of following materials.	**07**
		(i) S.S. 304 (ii) Carbon steel and (iii) Teflon	
	(b)	Explain briefly the significance of cryogenics applications for space technology.	**07**
Q.2	**(a)**	Determine the time required to boil 1 litre of liquid at its normal boiling point for (i) LH$_2$ (ii) LO$_2$ and (iii) LN$_2$, if heat transfer rate to the flask is 4 watts.	**07**
	(b)	Describe briefly about various commercial pressure transducers used for pressure measurements at low temperature.	**07**

OR

	(b)	Determine the thermal conductivity of helium gas at 80 K and 101.3 kPa using the kinetic theory of gases relationship. The mean free path of the helium gas at this state is 42 nm, the specific gas constant is 2.077 kJ/kgK and the specific heat at constant volume is 3.113 kJ/kgK.	**07**
Q.3	**(a)**	Define Superconductivity. Discuss about the properties which are change either abruptly of gradually when a material makes the transition from the normal to the superconducting state.	**07**
	(b)	Explain following in brief with figure.	**07**
		(i) Ortho-hydrogen and Para-hydrogen	
		(ii) Lamda point for Helium 4.	

OR

Q.3	**(a)**	Explain construction and working of Vapour Pressure Thermometer with neat figure. Also state its limitations.	**07**
	(b)	A platinum resistance thermometer has resistance of 100 Ω at 273.15 K. Find the corresponding temperature when the resistance is 50 Ω and the sensitivity of the thermometer at this point. Take constants A=3.946×10^{-3}/ ^{0}C B= -1.108×10^{-6}/ ^{0}C^2 and C=3.33×10^{-12}/ ^{0}C^4	**07**

Q.4 (a) Discuss about the precautions to be taken during handling of cryogens. **07**

(b) A turbine flow meter has six blades with a thickness of 2.5 mm and a blade angle of 45^0. The meter bore diameter is 75 mm, the rotor blade-tip diameter is 70 mm and the rotor hub diameter is 35 mm. If the rotational speed of the rotor is 1.5 rev/s, determine the volumetric flow rate and mass flow rate for liquid nitrogen at 80 K. **07**

OR

Q.4 (a) Give the advantages and disadvantages of following insulations. **07**

(i) Multilayer insulation   (ii) Opacified powder insulation.

(b) For a 2.44 m inside diameter Liquid oxygen horizontal storage vessel, the hydrostatic pressure indication on a hydrostatic liquid level gauge is 20 kPa. If the fluid in the vessel is under a pressure of 101.3 kPa, determine the liquid level and the sensitivity of the liquid level gauge. **07**

Q.5 (a) Explain working principal of capacitance type fluid quality measurement meter with neat figure. **07**

(b) A liquid nitrogen container consists of two concentric spheres. The inner sphere has an outside diameter of 2.0 m and the outer sphere has an inside diameter of 2.5 m. the ullage volume is assumed to be 10 %. Temperature of the outer shell is 300 K. The space between the concentric spheres is filled with evacuated perlite powder having thermal conductivity of 1.0 mW/mK. What is the rate of evaporation of liquid from just the heat leak through the insulation? **07**

OR

Q.5 (a) Determine the mean apparent thermal conductivity of a multilayer insulation between 300 K and 77 K. The layer density of insulation is 25 layers per centimeter. If the emissivity of aluminium foil is 0.05 and the spacer of fiberglass has solid conductance of 85 mW/m^{2}K. **07**

(b) Explain construction and working of Magnetic Thermometer having sensing element of paramagnetic material. **07**

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