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## DEPARTMENT OF SCIENCES III SEMESTER M.Sc. (PHYSICS) END SEMESTER REGULAR EXAMINATIONS, NOVEMBER & DECEMBER 2023 EXPERIMENTAL METHODS IN PHYSICS [PHY 6103] (CHOICE BASED CREDIT SYSTEM - 2020)

Time: 3 Hours

Date: 02 12 2023

MAX. MARKS: 50

Note (i) Answer ALL questions

(ii) Draw diagrams, and write equations wherever necessary

Q. No.		Marks	CO	BL
1A	Explain the following terms (a) Systematic error (b) Random error (c)	3	1	
	Probable error			
1B	Explain Normal distribution. Show that $G(x) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-\overline{x})^2}{2\sigma^2}}$ where $\sigma$ is	4	1	
	the width parameter (standard deviation)			
1C	The current voltage relation of a p-n diode is given by $I=(e^{1000V/T} - 1)$ , where	3	1	
	V is the applied voltage in volts and Temperature in Kelvin. If a student			
	makes an error of $\pm 0.01$ V in measuring the voltage while measuring a			
	current of 5 mA at 300K, calculate the error in the measured value of			
	current?			
2A	Give an example each for the positive displacement pump, momentum	5	2	
	transfer pump and entrapment pump. With a neat diagram, explain any			
	ONE method in detail.			
2B	Explain the basic working principle of a cold cathode ionization gauge.	3	2	
	Mention the range of pressure it can measure.			
2C	Explain the Langmuir-Blodgett technique.	2	2	
3A	Derive an expression for the gauge factor of a strain gauge	5	2	
3B	Write a note on radiation thermometer	3	2	
3C	A quartz crystal with a resonant frequency of 6 MHz is used to monitor the	2	3	
	thickness of silver coating. If a frequency shift of 0.80 kHz is observed for			

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	a particular thickness of the film, calculate the thickness of the coated layer.			
	Density of silver is 10.5 g/cc. Constant of the crystal is 8MHz.m <sup>2</sup> /Kg			
4A	Mentioning the basic assumptions made, derive the four-point probe	5	3	
	equation for an isotropic semi-infinite 3D homogenous bulk material.			
4B	Explain (a) thermal expansion in solids based on the potential energy curve	3	3	
	(b) anomalous expansion in water			
4C	A strip of copper of 150 $\mu$ m thick and 4.5 mm wide is placed in a uniform	2	3	
	magnetic field B of magnitude 0.65 T, with B perpendicular to the strip. A			
	current I of 23 A is then sent through the strip such that a Hall potential			
	difference V appears across the width of the strip. Calculate the potential			
	difference. The number of charge carriers per unit volume of copper is			
	8.47x10 <sup>28</sup> electrons/m <sup>3</sup> .			
5A	List the important interactions that occur when an electron beam strikes the	5	4	
	specimen and explain the conditions under which they occur. Which types			
	of these are used in SEM? Briefly explain interaction volume			
5B	With a neat diagram, explain the working principle of AFM.	3	4	
5C	Helium II ultraviolet photons of frequency 9.8x10 <sup>15</sup> Hz are produced using	2	4	
	a gas discharge lamp which is used for finding the work function of a			
	material examined under ultraviolet photoelectric spectroscopy (UPS). The			
	binding energy of the sodium metal (2p) is 30.81 eV. The valence electrons			
	are ejected from the metal with a kinetic energy of 7.2 eV. Find the work			
	function of sodium metal.			

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