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DEPARTMENT OF SCIENCES, III SEMESTER M.Sc (PHYSICS) END SEMESTER EXAMINATIONS, NOVEMBER 2018

SUBJECT: EXPERIMENTAL METHODS IN PHYSICS [PHY-5105] (REVISED CREDIT SYSTEM-2017)

Time: 3 Hours	Date: 24-11-2018	MAX. MARKS: 50
Note: (i) Answer ALL que	estions	
(ii) Draw diagrams, a	and write equations wherever necess	ary
Physical constants: speed of	of light in vacuum c=3x10 ⁸ m/s; elec	tron charge = 1.6×10^{-19} C;
Electron mass = 9.1×10^{-31} k	ζσ	

1.

- a) With a necessary diagram, explain the working principle of a diffusion pump. What are its drawbacks? [4]
- b) Explain the working principle of a Pirani gauge. What are its limitations? Mention the range of pressures that can be measured by Pirani gauge. [4]
- c) The following observations were made during an experiment to find the value of "g" using simple pendulum. The length l = 0.9 m; time *t* for 20 oscillations = 38 sec. Find the percentage error in the measurement of "g". Given $T = 2\pi \sqrt{\frac{l}{g}}$; Length is measured to an accuracy of 0.01 m and time to an accuracy of 0.2 sec. [2]

2.

a) Using the method of least squares, fit the following equation $y = \frac{x}{a+bx}$ to the data in the following table: [5]

x _i	y _i
1	3.8
3	7.1
5	10.2
8	13.5
12	16.4

b) Write a note on strain gauge transducer. For a metallic bonded strain gauge derive an expression for the gauge factor. [5]

3.

- a) Find the equivalent parallel resistance and capacitance that causes a null deflection in the following bridge. The arm AB has a series combination of resistance $R_1=3.1$ $k\Omega$ and capacitance $C_1=5.2 \ \mu\text{F}$, the arm BC has a resistance of $R_2=25 \ k\Omega$, the arm DC has a resistance of $R_4=100 \ k\Omega$. An ac signal of frequency=2.5 kHz is connected across the terminal BD. [5]
- b) Mentioning the basic assumptions made, derive the four-point probe equation for an isotropic infinite 2D sheet of a homogenous material of thickness 't' [5]

4.

- a) With a neat diagram, explain the working of a vibrating sample magnetometer. [5]
- b) Calculate the resulting kinetic energy of an electron ejected by bombarding a sample with Mg K α rays with a wavelength of 9.9 Å if the binding energy exhibited by the peak in the spectrum is 910 eV. Assume that the work function of the device is 0.5% of the impinging energy source. [3]
- c) Mention the limitation of energy dispersive X-ray analysis technique for the quantification of elemental composition. [2]

5.

- a) Consider a 2m long brass rod and a 1 m long aluminum rod. When the ambient temperature is 22° C, a gap of 1×10^{-3} m separates their ends. Assuming no expansion is possible at the other end of either rods, at what temperature will the two bars touch. Given: linear thermal expansion coefficients of brass and aluminum are 19×10^{-6} /°C and 23×10^{-6} /°C, respectively. [4]
- b) Assuming spherical crystallites, derive an expression of the crystallite size from the powder x-ray diffraction data. [4]
- c) What are the advantages of a variable pressure SEM over conventional high vacuum SEM? [2]