Diamond Harbour Women's University

M. Sc 2nd Year 4th Semester Examination 2021

Subject: Physics

Paper: PHY/Th/4S/401-A/2021 (Advanced Electronics)

Time: 2 Hours Full Marks: 40

The figures in the margin indicate full marks.

Answer two questions from each group

(Use separate Answer Script for each group)

Group A

1. a) State the law of mass action in semiconductor. Write down the variation of density of states of an electron with energy for 'n' dimensions.

b) Calculate the energy eigen value of an electron in presence of uniform magnetic field (**B**) and hence draw the variation density of states with and without **B**. **(2+1)+(5+2)=10**

2. a) Mention the methods to measure the mobility of majority and minority carriers of a semiconductor.

b) Explain briefly the experimental technique for the measurement of mobility of minority carriers.

c) Draw the circuit diagram of a common source n channel JFET amplifier. Discuss its small signal operation.

d). An n channel JFET gives a saturation voltage V_{Dsat} = 4V for V_{GS} = -1V. Another n channel JFET gives V_{Dsat} = 6.5V for the same V_{GS}. Compare the pinch-off voltages of the two JFETs. **2+3+3+2=10**

3. a) 2. A silicon JFET has the following parameters at 300 K, electron density $N_d = 1 \times 10^{17} cm^{-3}$, hole density $N_a = 1 \times 10^{19} cm^{-3}$, relative dielectric constant $\epsilon_r = 11.80$, channel height $a = 0.2 \times 10^{-4}\ cm$, channel length $L = 8 \times 10^{-4}\ cm$, channel width $Z = 50 \times 10^{-4}\ cm$, electron mobility $\mu_n = 800 \frac{cm^2}{V.s}$, drain voltage $V_d = 10V$, gate voltage $V_g = -1.5V$

Compute i). the pinch-off voltage in volts.

ii). the pinch-off current in mA.

iii). built in voltage in V.

iv). the drain current in mA. e. the saturation drain current at $V_g = 0$. f. the cut-off frequency.

b). What is multi-channel FET?

c). A certain p channel MOSFET has the following parameters, doping concentration $N_d = 3 \times 10^{17} cm^{-3}$, relative dielectric constant $\epsilon_r = 11.80$, relative dielectric constant of SiO_2 $\epsilon_{ir} = 4$, insulator depth $d = 0.01\ \mu m$, operating temperature 300 K.

Calculate the surface potential for strong inversion. Compute the insulator capacitance. Determine the threshold voltage. **4+2+4=10**

Group B

4. a). An IMPATT diode has the following parameters, carrier drift velocity $v_d = 2 \times 10^7 cm/s$, Drift region length (L) = 6 μm, maximum operating voltage V_{0max} = 100V, maximum operating current = 200 mA, efficiency (η) =15% and break down voltage (V_{bd}) = 90V.

Compute i) the maximum CW output power in watt.

ii) the resonant frequency.

b). An n-type Gunn diode has the following parameters, electron drift velocity $v_d = 2.5 \times 10^5 m/s$, negative electron density $|\mu_n| = 0.015 \frac{m^2}{V.s}$, relative dielectric constant $\varepsilon_r = 13.1$. Determine the criterion for classifying mode of operation.

c). Show that the values of numerical aperture (N.A) and dispersion of an optical fiber have dependence on the refractive index of core and cladding. **(2+2)+3+3 = 10**

5. a). At 300 K, an ideal Si p-n junction solar cell has a short-circuit current of 2 A and an open-circuit voltage of 0.5 V. How does the maximum output power of the solar cell change if the temperature rises to 400 K?

b). Show that the thickness of absorber layer in photodetector has inversely dependence with the output current.

c) Explain any three major loss mechanism of a LED. To overcome these losses what kind of precautions will be favourable? **3+2+(3+2)= 10**

6. a). An ideal photodiode is made of a material with a bandgap energy of 2.35 eV. It operates at 300 K and is illuminated by monochromatic light with wavelength of 400 nm. What is its maximum efficiency?

b). What is the short-circuit current delivered by a 10 cm by 10 cm photocell (with 100% quantum efficiency) illuminated by monochromatic light of 400 nm wavelength with a power density of 1000 W/m2.

c). "In a Gunn diode the negative resistance originates from negative mobility". Does the statement is true? Explain. **3+3+4=10**

Suy P...

Diamond Harbour Women's University

M.Sc 2nd Year 4th Semester Examination 2021

Subject: Physics

Paper: PHY/Th/4S/401-B/21 (Advanced Condensed Matter Physics)

Time: 2 Hours Full Marks: 40

The figures in the margin indicate full marks.

Answer two questions from each group

(Use separate Answer Script for each group)

Group A

1. a). What is de Haas-Van Alphen effect.

b). Electrical resistivity of copper and nickel at room temperature are 1.65×10^{-8} and 14×10^{-8} Ωm respectively. If quantum treatment is applied to these materials, find the electronic contribution to thermal conductivities of these materials.

c). What are the Brillouin zones? How are they related to the energy of an electron in a metal?

d). Deuterons, the nucleuses of heavy hydrogen, are accelerated in a cyclotron. Determine the cyclotron frequency, if the value of magnetic field strength in the cyclotron makes 1.5 T and the mass of deuterons is $3.3 \cdot 10^{-27}$ kg. Determine the cyclotron radius for particles, which leave the cyclotron with a kinetic energy of 16 MeV. How many times does the deuteron cross between "D" electrodes (also called "dees"), if the electrical potential difference between the two dees is 50 kV?

2+3+2+3=10

2. (a) Find out the normal mode frequencies of a diatomic linear chain.

(b) What is called dynamic matrix? On which parameters it depends?

(c) In Neutron scattering on which factors does the scattering amplitude depend?

6+(1+1)+2=10

3. (a) Write down the Hamiltonian for a many-electron atomic system. What is the one-electron approximation? Is the approximation valid for all atomic systems? If not why?

(b) Apply the Hartree method to find out the ground state energy of a many-electron system. Why Hartree-Fock method is needed to improve the result obtained by the Hartree method?

(1+1+1+1)+(4+2)=10

Group-B

4. (a) Explain AC Josephson effect. Show that the supercurrent of superconducting pairs across the junction oscillates with a frequency

$$\omega = \left(\frac{2eV}{\hbar}\right)$$ Terms have their usual meanings.

(b) Derive Ginzberg-Landau equation of superconducting phase transition. Hence obtain the value of the order parameter deep inside the superconductor.

(1+4)+(3+2)=10

5. (a) Show that the Photoconductivity of a pure crystal is given by $\sigma = n_0 e\sqrt{L},$ where L is the number of photons incident on the crystal per unit volume and n_o is the number of charge carriers at equilibrium.

What is trap center? How the above expression for photoconductivity (σ) is modified due to the introduction of N number of trap center into the crystal?

(b) Show that because of field penetration, the critical field of a superconducting slab of thickness t is of the order of $B_c\,(1+\frac{\lambda}{t})$, where B_c is the critical field for the bulk sample.

(Assume that the free energy difference between the normal and the superconducting states is independent of the specimen size.)

(3+1+3)+3=10

6. (a) Prove that the magnetic flux linking a superconducting ring is quantized according to $\phi = n(\frac{h}{2e})$, where φ is the flux and n is an integer.

(b) What is meant by a Frenkel defect in a crystal lattice? How it is different from schottky defect? Show that number of Frenkel defects in equilibrium at a given temperature is proportional to $(NNi)^{1/2}$, where N be the atoms and Ni be the interstitial atoms.

(c) How do entropy and specific heat vary with temperature for a superconductor?

3+(1+1+3)+2=10

Surjo Pal

DHWU

M.Sc. (2-Year) 4th Semester Examination, 2021

Subject: Physics

Paper: PHY/ThE/402

High Energy Particle Physics

Full Marks: 40 **Time: 2 Hours**

The figures in the margin indicate full marks.

Answer any two questions from each group

Group-A

1. a) Draw the Feynman diagram of Compton scattering and obtain an expressions for the amplitude.
b) Will a free proton decay into a neutron, a positron, and an electron neutrino? If yes, why? If not, why not?
c) What are the strangeness quantum numbers of $|K^0\rangle$ and $|\overline{K}^0\rangle$? Show that $|K^0\rangle$ and $|\overline{K}^0\rangle$ are not the eigenstates of the operator $-CP$? Construct the eigenstates of CP by linear superposition of $|K^0\rangle$ and $|\overline{K}^0\rangle$. Find the corresponding eigenvalues? [C and P stand for charge conjugation and parity operators respectively.]
d) What are quark content and charge of the hadron Ω_c? $3+1+4+2=10$

2. a) The decay mode $\omega \rightarrow \pi^0 + \gamma$ is allowed but $\omega \rightarrow \pi^0 + 2\gamma$ is forbidden. Explain
b) At $t = 0$, a pure beam of ν_e starts its journey from a source and after travelling a distance L in time t transforms into ν_μ. Assuming mass eigen states of the neutrinos to be ν_1 and ν_2 with masses m_1 and m_2 respectively, show that the probability of finding ν_μ at time t is:
$P_{\nu_e \rightarrow \nu_\mu}(\nu_e, 0; \nu_\mu, t) = sin^2 2\theta \, sin^2\left[\frac{\Delta m^2{}_{12}}{4E} \times L\right]$; where notations have their usual meaning. (Consider ultra-relativistic limit for neutrinos)
c) Find the nature of interactions of the following decay processes
(i) $\Sigma^0 \rightarrow \overline{K}^0 + n$ & $(ii) \Sigma^0 \rightarrow K^- + p$. Hence estimate $\frac{\Gamma_{\overline{K}_0 n}}{\Gamma_{K^- p}}$.
Given $\Sigma^0(1915\ MeV)$ is an electrically neutral baryon with $I = 1, I_3 = 0$.
Which invariance principle is used in this context? $2+4+4=10$

3. a) Using Young tableaux method for $SU(3)$ group, show that $3 \otimes \overline{3} = 8 \oplus 1$.
b) In quark model, baryons consist of three quarks and mesons consist of a quark and an anti-quark pair. Can we construct a bound state with either four quarks

$(qqqq)$ or a combination of two quarks and an anti-quark $(qq\bar{q})$? Give reasons in support of your answer.

c) State and explain CPT theorem. Hence, show that CPT invariance leads to equality of charges of particle and antiparticle with opposite signatures.

d) Find the number of gauge bosons for the gauge group:
$SU(3) \otimes SU(2)_L \otimes SU(2)_R \otimes U(1)$. Which larger group does have the same number of gauge bosons?

2 + 2 + (2 + 2) + 2 = 10

Group-B
(Answer any two)

4. Consider the Lagrangian for a vector field A_μ with a mass term :

$$\mathcal{L} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + m_A^2 A_\mu A^\mu$$

a) Show that $\mathcal{L}$ is not gauge invariant unless $m_A = 0$

In Higgs mechanism, to generate $m_A \neq 0$ from a gauge invariant theory consider the Lagrangian for a massless vector field A_μ and a complex scalar field ϕ with charge $q_\phi e$:

$$\mathcal{L} = (\mathcal{D}_\mu\phi)^\dagger(\mathcal{D}^\mu\phi) + \frac{\mu^2}{2}\phi^\dagger\phi - \frac{\lambda}{4}(\phi^\dagger\phi)^2 - \frac{1}{4}F_{\mu\nu}F^{\mu\nu}$$

where the covariant derivative is $\mathcal{D}_\mu = \partial_\mu - iq_\phi e A_\mu$ and $\mu^2, \lambda > 0$.

b) Show that $\mathcal{L}$ is invariant under the local gauge transformations
$\phi(x) \to e^{-iq_\phi\alpha(x)}\phi(x)$ and $A_\mu(x) \to A_\mu(x) - \frac{1}{e}\partial_\mu\alpha(x)$
where $\alpha(x)$ is the parameter of the gauge transformation.

Since the vacuum corresponds to the minimum energy state, one can expand the theory about the minimum at $|\phi| = \frac{v}{\sqrt{2}}$. Assuming,

$$\phi = \left(\frac{v + h(x)}{\sqrt{2}}\right)e^{\frac{i\eta(x)}{v}}$$

where $h(x)$ and $\eta(x)$ are the real scalar fields corresponding to fluctuations about the vacuum.

c) Express $\mathcal{L}$ in terms of these fields and find the masses of $h(x)$ and $\eta(x)$. Show that η can be removed from the theory with suitable choice of gauge transformation and $\mathcal{L}$ now describes the theory of a massive vector boson A_μ and one real scalar field h. Determine m_A.

2 + 3 + 5 = 10

Sujo Pa

5. a) Write down the SM gauge group explaining notations. Show that the vacuum state of the SM is not invariant under the individual gauge groups of the SM. Which gauge symmetry remains unbroken after the spontaneous symmetry breaking? Identify that symmetry.

b) Identify the matter fields and gauge fields of the SM. Which field gives masses to all the particles in the SM?

c) Can the SM Lagrangian give rise to a vertex containing, W^+W^-Z? Explain.

d) Show that $\overline{\Psi}P_R = \overline{\Psi}_L$, where notations have their usual meaning.

4 + 2 + 2 + 2 = 10

6. In Parton Model the relation between structure functions and the quark distribution functions are given by: $F_2(x) = 2xF_1(x) = x\sum_q e_q^2 q^p(x)$. Here, x denotes the Bjorken scaling parameter.

a) Write down the expressions for $F_2^{ep}(x)$ and $F_2^{en}(x)$ assuming isospin symmetry, where $F_2^{ep}(x)$ stands for structure function for the electron-proton scattering and $F_2^{en}(x)$ denotes the same for the electron-neutron scattering.

b) Integrate $F_2^{ep}(x)$, $F_2^{en}(x)$ over x to find f_u and f_d which denote the fraction of the proton momentum carried by $u, \bar{u}$ quarks and $d, \bar{d}$ quarks respectively. The definitions of f_u and f_d are given as $f_u = \int_0^1 [xu(x) + x\bar{u}(x)]\, dx$ and $f_d = \int_0^1 [xd(x) + x\bar{d}(x)]\, dx$ respectively.

c) On the basis of experimental inputs from SLAC, $\int_0^1 F_2^{ep}(x)dx \approx 0.18$ and $\int_0^1 F_2^{en}(x)dx \approx 0.12$ evaluate f_u and f_d. What conclusions can be drawn from the results?

d) How do the sea quarks originate inside the proton? Show that in the low energy limit, $\frac{F_2^{ep}(x)}{F_2^{en}(x)} \to 1$.

e) Account for the origin of Bjorken scaling violation. 2 + 2 + 2 + 2 + 2 = 10

CG coefficient Table:

1/2×1/2	1, +1	1, 0	0, 0	1, −1
+1/2 +1/2	1			
+1/2 −1/2		1/2	1/2	
−1/2 +1/2		1/2	−1/2	
−1/2 −1/2				1

1/2×1/2	1, +1	1, 0	0, 0	1, −1
+1/2 +1/2	1			
+1/2 −1/2		1/2	1/2	
−1/2 +1/2		1/2	−1/2	
−1/2 −1/2				1

DHWU

M.Sc. (2nd Year) 4th Semester Examination, 2021

Subject: Physics

Paper: Phy/ThE/4S/403 (Nuclear Physics Elective)

me: 2 Hours Full Marks: 40

Answer any 4 questions taking two from each group.

nswers to the questions should be written in the candidates own words as far as practicable.

Group – A

1. (a) For a deuteron nucleus assume that in addition to the square well potential V_0 there exists a spin dependent part given by

$$V_{\text{spin}} = \frac{V_1(r)}{\hbar^2}\vec{S}_p \cdot \vec{S}_n.$$

Given that the binding energy of a deuteron nucleus in the triplet state is $E_T = -2.2$ Mev and assuming the energy of the unbound virtual singlet state $E_S \approx 0$ obtain an estimate of the strength of the spin-dependent part of the nuclear potential.

(b) Given the wave function of a deuteron nucleus is

$$u(r) = \begin{cases} A\sin kr, & r < r_0 \\ Ce^{-\kappa r}, & r > r_0 \end{cases}$$

by assuming $kr_0 \approx \pi/2$, show that the mean square radius of deuteron is

$$< r^2 > = \frac{\kappa}{1 + r_0\kappa}\left[r_0^3\left(\frac{1}{3} + \frac{2}{\pi^2}\right) + \frac{1}{\kappa}\left(\frac{2\kappa^2 r_0^2 + 2\kappa r_0 + 1}{2\kappa^2}\right)\right].$$

[6+4=10]

(Here all symbols have their usual meanings)

2. (a) Explain what is meant by nuclear form factor. Assuming $\int_{\mathbb{R}^3} \rho(\vec{r}) d^3\vec{r} = 1$ calculate the nuclear form factor for the following spherically symmetric charge distribution

$$\rho(r) = \rho_0\left(1 + \frac{r}{a}\right)e^{-r/a}.$$

Sketch the charge distribution.

(b) Derive an expression for the magnetic moment of odd-odd nuclei. [6+4=10]

3. (a) Obtain an expression for the intrinsic quadrupole moment of a uniform ellipsoidal charge distribution. Using the approximation $1.2A^{1/3}$ for the radius (in fm) of a nuclei of mass number A determine the eccentricity for ${}_1H^2$ if the measured valued of its quadrupole moment is $Q_0 = 0.00282 \times 10^{-24} e - cm^2$.

(b) The experimental observed value for the magnetic moment of ${}_3Li^7$ is $\mu_{exp} = 3.2564\mu_N$ and the spin is $J = 3/2$. By computing the theoretical values of the magnetic moments of ${}_3Li^7$ determine its ground state. The nuclear magnetic moments and g-factors are given below

	$\mu_s(measured)$	$g_s(measured)$	g_l
proton	2.7926	5.5852	1
neutron	−1.9129	−3.8258	0

[(4+3)+3=10]

Group – B

4. (a) Defining Gamow–Teller operator as

$$O_{GT} = G_A \sum_{j=1}^{A} \sigma(j)\tau_{\mp}(j),$$

show that the transition strength between an initial state ($|i>$) and final state ($|f>$) of a nucleus can be expressed as

$$S_{\pm} = G_A^{-2} \sum < i|O^{*}_{GT} O_{GT}|i >,$$

where the symbols carry their usual meanings. Henceforth also show that $S_{-} - S_{+} = 3(N - Z)$, where N and Z are the total number of neutrons and protons present in the said nucleus respectively.

(b) If the isospin raising (τ_+) and lowering (τ_-) operators are defined as $\tau_{\pm} = \frac{1}{2}(\tau_1 \pm i\tau_2)$, then find the value of $< p|\,(\tau_+\tau_-)^q\,|p >$, where q is any nonzero positive integer. The other

Suvjit Pal

symbols carry their usual meanings. [(6+2)+2=10]

5. (a) Define the range of a charge particle in a media and then deduce a mathematical expression for it along with the discussion regarding its physical assumptions and characteristics.

(b) Let's take the effective Hamiltonian for a $n-p$ system is $\hat{H}_{eff} = \hat{H}_0 + \hat{V}_{eff}$ with the basis state ψ such that $\hat{H}_0\psi = 2\alpha\psi$. If the effective potential operator satisfies an eigenvalue equation to the same basis state ψ with eigenvalues $\pm\alpha/3$, then discuss about the effective energy spectrum of the system. Note that α is a non negative fractional real number.

[6+4=10]

6. (a) If a grad student includes spin-spin and spin-orbit interactions terms in the single particle harmonic oscillator's Hamiltonian of a nucleus then find the energy correction to the unperturbed one. Given that the interaction strengths of spin-spin and spin-orbit interactions are μ and ν respectively.

(b) Compare the energy loss of a photon for one single Compton scattering through 180 degree. [Given: $E_0/mc^2 = \alpha$, $E_0 = h\nu_0$ and $E_1 = h\nu_1$. The symbols carry their usual meaning.]

(c) Draw the physical connection between the 'Coulomb excitation' and the *Sommerfeld* number. [5+3+2=10]

Diamond Harbor Women's University
Department of Physics
M.Sc. 4th Semester Practical Examination 2021
Subject: Physics
Paper-PHY/LA/405A

FM=25 Time= 3 hrs

Experiment-25

Experiment: 25[(i) Theory & Ckt-6 (ii) Graph-12 (iii) Explanation-4 (iv) Disscusion-3]

1. In an optical transducer;

Show the change of lamp filament power and lamp filament resistance in terms of lamp filament voltage and discuss the physical characteristics with ***associated graphs***.

Lamp Voltage (V)	Lamp Power (mW)	Lamp Resistance (Ω)
0	0	0
1.0	30	27
2.0	52	42
3.0	98	63
4.0	168	69
5.0	235	77
6.0	297	86
7.0	455	91
8.0	608	94
9.0	810	99
10.0	1026	103

Sujoy Pan

2. In an optical transducer;

Show the change in open circuit voltage and short circuit current of a photovoltaic cell in terms of lamp filament voltage and discuss its characteristics with necessary graphs.

Lamp Voltage (V)	Short Circuit Current (μA)	Open Circuit Voltage (V)
0	0	0
1.0	22	0.28
2.0	56	0.52
3.0	108	1.46
4.0	202	1.73
5.0	436	2.03
6.0	860	2.12
7.0	1525	2.34
8.0	2916	2.49
9.0	6243	2.61
10.0	12350	2.74

3. Plot the output voltage of Photoconductive cell and Phototransistor w.r.t the output voltage to the filament voltage, and discuss the silent features.

Characteristics Photoconductive cell

Lamp Voltage (V)	Photoconductive cell voltage (V)	Lamp Voltage (V)	Photoconductive cell voltage (V)
0	5.12	6.0	1.60
1.0	4.91	7.0	1.09
2.0	4.60	8.0	0.81
3.0	3.42	9.0	0.68
4.0	2.87	10.0	0.57
5.0	2.29		

Characteristics of Phototransistor

Lamp Voltage (V)	Photoconductive cell voltage (V)	Lamp Voltage (V)	Photoconductive cell voltage (V)
0	4.51	6.0	1.4
1.0	4.32	7.0	0.95
2.0	4.04	8.0	0.71
3.0	3.00	9.0	0.59
4.0	2.52	10.0	0.5
5.0	2.01		

4. In an optical transducer;

Show the change in output voltage and output current of a PIN Photodiode in terms of lamp filament voltage and discuss its characteristics with necessary graphs.

Lamp Voltage (V)	PIN Photodiode output current (mA)	PIN Photodiode DC amplifier output voltage (V)
1.0 0	0	0
2.0 1	8.73	0.52
3.0 2	35.28	0.97
4.0 3	68.04	2.73
5.0 4	127.26	3.23
6.0 5	274.68	3.79
7.0 6	541.8	3.96
8.0 7	960.75	4.37
9.0 8	1837.08	4.65
10.0 9	3933.09	4.88

5. Plot the drain characteristics of a MOSFET using the data given below, and discuss its characteristics.

S.No.	V_{DS}	Drain Current I_D			
		$V_{GS} = 5V$	$V_{GS} = 6V$	$V_{GS} = 7V$	$V_{GS} = 8V$
1	0	0	0	0	0
2	2	10.1	10.1	10.2	10.2
3	4	14.9	20.4	20.4	20.5
4	6	15	25.2	31	31.9
5	8	15.1	25.2	34.9	41.8
6	10	15.1	25.2	34.9	44.7
7	12	15.2	25.3	34.9	44.8
8	14	15.3	25.3	35	44.9
9	16	15.4	25.4	35.1	45
10	18	15.5	25.5	35.2	45.1
11	20	15.6	25.6	35.4	45.3
12	22	15.7	25.7	35.5	45.4
13	24	15.8	25.8	35.6	45.6
14	26	15.9	25.9	35.8	45.7
15	28	16	26.1	36	45.9
16	30	16.1	26.3	36.1	46.1

6. Plot characteristics of SCR from the date given in the table below and discuss its features.

S. No.	Anode Voltage V_A	Anode current I_A (mA) at constant value of Gate current			
		I_G = 6.7mA	I_G = 7mA	I_G = 7.1mA	I_G = 7.3mA
1	0.5Volt	0.04	0.03		
2	0.75	0.3	0.55	0.84	1.16
3	1V	0.35	0.65	1.09	2.50
4	1.2	0.35	0.65	1.09	4.7
5	1.5	0.35	0.66	1.1	
6	2	0.36	0.66	1.1	
7	2.5	0.36	0.67	1.1	
8	3	0.36	0.67	1.1	
9	4	0.37	0.68	1.1	
10	5	0.37	0.69	1.4	
11	10	0.39	0.74	1.25	
12	15	0.41	0.79	1.45	
13	16	0.41	0.79	7.18	
14	20	0.42	0.84		
15	30	0.45	0.97		
16	33	0.46	1.13		
17	34	0.47			

7. Plot different characteristics of DIAC from the date given in the table below and discuss its features.

S. No.	Diac Voltage Va	Diac Current Ia	Diac Voltage -Va	Diac Current -Ia
1	1	0	-1	0
2	5	0	-5	0
3	10	0	-10	0
4	15	0	-15	0
5	20	0	-20	0
6	25	0	-25	0
7	30	0	-30	0
8	32	14.0		15.0
9				
10				

Suyo Pal

Diamond Harbor Women's University

Department of Physics

M.Sc. 4th Semester Practical Examination 2021

Subject: Physics

Paper-PHY/LA/405B

FM=25 Time= 3 hrs

Experiment-25

(Answer any one from the following questions.)

Experiment: 25[(i) Theory 8 (ii) Graph-10 (iii) Explanation-4 (iv) Disscusion-3]

1. In a Hall effect experiment for a given sample the data for calibration of electromagnet and data for Hall voltage at different temperatures at a magnetic field of 3.0 KGauss and probe current of 4.00 mA are given in table I and table II.

Table –I

Current (A)	Magnetic field (KG)
0.00	0.00
0.50	0.48
1.00	1.00
1.50	1.51
2.00.	2.03
2.50	2.55
3.00	3.06
3.50	3.63
4.00	3.99

Table –II

Temperature (K)	**Hall Voltage (mV)**
41.00	53.2
41.50	53.7
44.50	52.7
49.00	50.7
55.50	48.8
61.25	43.5
67.50	36.3
73.75	28.4
80.00	20.1
82.50	9.9
97.50	0.5
106.00	-2.6
111.00	-3.3

From the above data show the variation of Hall coefficient with temperature. Comment on your result.

(Given sample thickness=0.05 cm, resistivity =5 ohm-cm)

2. In a magnetoresistance experiment for a given sample data for calibration of electromagnet and data for variation resistance with magnetic fields for a probe current of 3.0 mA are given in table I and table II.

Table –I

Current (A)	Magnetic field (KG)
0.25	0.16
0.50	0.32
0.75	0.50
1.00	0.67
1.25	0.85
1.50	1.02
2.00	1.39
2.50	1.74
3.00	2.09
3.50	2.44
4.00	2.80
4.31	2.98

Table –II

Magnetic field (kG)	**Resistance (ohm)**
0.00	85.76
1.02	86.09
1.39	86.42
1.74	86.75
2.09	87.086
2.44	87.42
2.80	88.079
2.98	88.079

From the above data plot the variation of resistance ($\Delta R/R$) with the magnetic field. Comment on your result.

3. In a Quincke'smethod experiment for a given solution data for calibration of electromagnet and data for rise of solution level with increase in magnetic field are given in table I and table II.

Table –I

Curent(A)	Magnetic field (KG)
0	0.01
0.5	1.32
1.0	2.49
1.5	3.78
2.0	5.03
2.5	6.27
3.0	7.50
3.5	8.64
4.0	9.62
4.06	9.71

Table –II

Magnetic field H in KG	**Rise of solution level (h in m.m)**
0.01	0
1.32	0.15
2.49	0.38
3.78	1.23
5.03	3.58
6.27	5.65
7.50	7.61
8.64	9.30
9.62	10.38
9.71	10.47

From the above data plot the rise of solution as a function of magnetic field and hence calculate the susceptibility of the given sample.

Suj Pr

4. In a dielectric constant measurement expt. For a given sample the data for capacitance with different temperatures is given in the following table.

Temperatures (C)	Capacitance (pF)
30	695
36	715
45	720
51	721
57	723
60	725
66	734
72	745
81	769
90	798
93	812
99	844
104	880
110	933
113	966
116	1006
120	1071
122	1098
124	1147
126	1165
128	1187
130	1210
135	1208
137	1183
140	1132
142	1096
145	1050
148	1000
150	971
156	887
160	836
166	770
170	731

From the above data plot the variation of dielectric constant with temperatures and hence obtain transition temperature of the given sample.

Sujay PD