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RF-3469-70

M. Sc. (Part - I) Examination

April / May - 2010

Physics : Paper - III

(Methematical Methods in Physics & Solid State Physics)

Time : Hours] [Total Marks :

RF-3469

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **M. Sc. (Part - 1)**

Name of the Subject :

☛ **Physics : Paper - 3**

☛ Subject Code No. : **3 4 6 9** ☛ Section No. (1, 2,.....) : **1**

Seat No. :

Student's Signature

(2) Answer to the **two** section must be written in **separate** answer books.

(3) Symbols used have their usual meaning.

(4) Figures to the **right** indicate full marks.

1. (a) Given a 3-dimensional function $f(r)$ how do you find its Fourier transform? (3)

(b) Explain the WKB approximation as a method to solve one dimensional differential equation. (4)

(c) What are the applications of group theory in Physics? (4)

2. (a) Deduce a recurrence relation for the Hermite polynomials $H_n(x)$. (5)

(b) Find the Laplace transform of the function **exp (bt)** in a variable t, with b as a constant. (4)

(c) What is the meaning of saying that the Legendre polynomials are orthogonal? (3)

OR

2. (a) Deduce a recurrence relation for the Legendre polynomials $P_l(x)$. (5)

(b) What are associated Legendre polynomials? What is the value of $Y_{00}(\theta,\varphi)$? (4)

(c) Define hypergeometric functions and explain the symbol ${}_2F_1$ fully. (3)

3. (a) Explain the method of separation of variables for solving the Schroedinger equation. (5)

(b) Define the Dirac delta function and explain its important properties. (4)

(c) Bring out the difference between the Bessel functions $J_n(x)$ and $j_l(r)$. (3)

OR

3. (a) Bring out the difference among the binomial, Poison and Gaussian distributions. (5)

(b) Evaluate the following definite integral by the method of residues.

$$\int_{-\infty}^{+\infty} dx/(1+x^2) \quad (4)$$

(c) Explain the numerical method for best fitting of given data to the equation $y = a \exp(bx)$. (3)

RF-3470

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Name of the Examination :

☛ **M. Sc. (Part - 1)**

Name of the Subject :

☛ **Physics : Paper - 3**

☛ Subject Code No. : **3 4 7 0** ☛ Section No. (1, 2,.....) : **2**

Seat No. :

Student's Signature

(2) Answer to the **two** section must be written in **separate** answer books.

(3) Symbols used have their usual meaning.

(4) Figures to the **right** indicate full marks.

4 (a) Give a brief summary of different bravais lattice. **3**

(b) Define periodic potential and Blochelectron. **3**

(c) Write difference between ferromagnetic and Antiferromagetic material. **2**

(d) Taking the time derivation of London equation. Show that $\frac{dj}{dt} = \left(\frac{c^2}{4\pi\lambda^2}\right).E$ Where λ = penetration depth. **3**

5 (a) Define Halleffect. State main features of A.C. electrical conductivity of metal. **4**

(b) Write basic assumption of Drud model of Metal. What is difference between Drud Model and Sommer field model of metal. **4**

(c) Compute the theoretical value of the lorenz number for alkalimetals in classical form. **4**

(where $K_B = 1.381 \times 10^{-23}\ J/K$ and $e = 1.602 \times 10^{-19}\ col.$)

OR

5 (a) Discuss the ground state properties of free electron gas. Show that the number of allowed k - values per unit volume of k - space is $\frac{V}{8\pi^3}$, V being the volume of containing N-electrons. **4**

(b) Define Brillouin zone. Write difference between direct band gap semiconductor and indirect band gap semiconductor. **4**

(c) Find the resistivity of an intrinsic Genoenium 1.5 cm long, 0.75 mm wide and 0.75 mm thick and at T = 300 °k. **4**

For Ge ni = $20.5 \times 10^{19}\ m^3$, mobility $\mu_e = 0.39\ m^2/V.S.$

and $\mu_h = 0.19\ m^2/VS$ at 300 °k.

6 (a) How do you classify the solids on the base of magnetic properties ? Explain Quantum theory of pauli paramagnetism. **5**

(b) Discuss on X-ray powder method. **3**

(c) Show that the reciprocal lattice primitive vectors satisfy the relation

$$b_1 \cdot (b_2 \times b_3) = \frac{8\pi^3}{a_1 \cdot (a_2 \times a_3)}.$$

OR

6 (a) Discuss briefly different experimental rehdt of superconductivity and explain how their interpretations lead to the basic assumptions of B.C.S. theory. **5**

(b) Write magnetic properties of super conductor. **3**

(c) Calculate the critical current which can flow through a long thin super conducting wire of Aluminum of diameter 10^{-3} meter. The critical magnetic field for Aluminum is 7.9×10^3 amp/m. **4**
