



SB-3439

M. Sc. (Part - I) Examination
March / April - 2011
Physics : Paper - III
(Mathematical Methods in Physics &
Solid State Physics)

Time : 3 Hours]

[Total Marks : 70

Instructions :

(1)

नीचे दशांशवैक निशानीवाणी विगतो उत्तरवडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="M. Sc. (Part - 1)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="Physics : Paper - 3"/>	<input type="text"/>
Subject Code No. : <input type="text" value="3"/> <input type="text" value="4"/> <input type="text" value="3"/> <input type="text" value="9"/>	<input type="text"/>
Section No. (1, 2,.....): <input type="text" value="1&2"/>	<input type="text"/>
	<input type="text" value="Student's Signature"/>

- (2) Use separate answer book for each section.
(3) Symbols used have their usual meaning.
(4) Figures to the right indicate full marks.

SECTION-I

- 1 (a) Solve the differential equation $y''+3y'+2y=x^3+x$. 4
(b) Find $P_n(x)$ for $n=0,1,2$ and 3. 4
(c) Find the residues of $\frac{z}{(z-a)(z-b)}$ at infinity. 3

- 2 (a) Derive the recurrence relation for the Legendre polynomials. 7
(b) Prove that $L[f''(x)] = s^2L[f(x)] - sf(0) - f'(0)$. 5

OR

- 2 (a) Derive the Newton's formula for forward interpolation. 7
(b) Prove that Fourier Transform of the Gaussian is another Gaussian. 5

- 3 (a) Discuss binomial, poisson and Gaussian Distributions. 7
 (b) Radium decays to radon which decays to polonium. 5
 If at $t=0$, a sample is pure radium, how much radon does it contain at time ?

OR

- 3 (a) Derive the general recursion relation and power series 7
 solution of the following Legendre's differential equation.
 $(1-x^2)y'' - 2xy' + n(n+1)y = 0$.
 (b) Define : Group and Subgroup. If $a = [4\ 6\ 1\ 3\ 5\ 2]$ 5
 and $g = [3\ 5\ 1\ 4\ 6\ 2]$, calculate $b=g^{-1}ag$.

SECTION-II

- 4 (a) Explain space groups giving suitable illustrations. 2
 (b) Draw the energy band diagrams of pure, n-type and 3
 p-type semiconductors.
 (c) Show that a superconductor is a perfect diamagnet. 3
 (d) Differentiate between ferromagnet and antiferromagnet. 3
- 5 (a) On the basis of free electron theory, derive an 5
 expression for the electrical and thermal conductivity of metal and hence establish Wiedemann Franz law.
 (b) Explain Hall effect. State its applications. 4
 (c) Show that the spacing d of plane $(h\ k\ l)$ in a simple 3

cubic lattice of side a is
$$d = \frac{a}{\sqrt{(h^2 + k^2 + l^2)}}.$$

OR

- 5 (a) Define periodic potential. Give Born-Von karman 6
 boundary condition and comment on the Bloch function.
 (b) Obtain the Bragg diffraction condition of X-ray 3
 diffraction.
 (c) Explain the meaning of : 3
 (i) Fermi surface (ii) Brillouin zone.
- 6 (a) Explain Heisenberg's exchange integration. Show 7
 how it explains ferromagnetism ? Discuss the difference in the nature of the magnetic susceptibility for a ferromagnetic and antiferromagnetic substance.

- (b) Show that Fermi energy level in intrinsic semiconductor lies at the centre of the energy band gap. **5**

OR

- 6** (a) What do you mean by superconducting energy gap ? Describe the BCS theory of superconductivity. **8**
- (b) London penetration depths for Pb at 3 K and 7.1 K are respectively, 39.6 nm and 173 nm. Calculate its transition temperature. **4**
