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Roll No. | | | | | | | | | | | |

S. No. of Question Paper : 108 (13)

Unique Paper Code : 32221502 I

Name of the Paper : Solid State Physics

Name of the Course : B.Sc. (H) Physics

Semester : V

Duration : 3 Hours Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any *five* questions. Question No. **1** is compulsory.

All questions carry equal marks.

1. Attempt any *five* of the following : 5×3=15

(*a*) Draw P-E hysteresis loop for a ferroelectric material. Write mathematical statement of Curie-Weiss law for ferroelectric materials.

(*b*) Differentiate between acoustical and optical phonons.

(*c*) Explain the formation of cooper pair in superconductors.

(*d*) Write the primitive translational vectors of hexagonal lattice.

P.T.O.

(e) Show that every reciprocal lattice vector $\vec{G}_{hkl}$ is normal to the plane $(h\ k\ l)$.

(f) Calculate the Hall coefficient of Na based on free electron model. Na has b.c.c structure and side of the cube is 4.28 Å.

(g) Draw the variation of total polarizability with frequency of external electric field.

(h) What is the difference between Phonon and Plasmon ?

2\. (a) Derive Bragg's law in the reciprocal lattice. 8

(b) In a simple cubic crystal, show that the first order reflection from (n00) planes is equivalent (mathematically) to the *n*th order reflection from (100) plane ? 7

3\. (a) Derive an expression for the specific heat of a solid on the Debye model and show that, at low temperature, it follows T^3-law. 10

(b) Derive the dispersion relation for a linear monoatomic lattice and show that the group velocity and phase velocity of a wave are equal in the long wavelength limit. 5

4\. (a) Show that the classical paramagnetic susceptibility is given by $\chi = \frac{\mu_0 N}{3kT}\mu^2$, where symbols have their usual meanings. 10

(b) How was the classical Langevin's theory of paramagnetism modified by Weiss ? 5

5\. (a) Derive an expression for the electronic polarizability in a time varying electric field, and hence derive the Cauchy and Sellmeir relations. 12

(b) Distinguish between normal and anomalous dispersion ? 3

6\. (a) Explain the formation of allowed and forbidden energy bands for the motion of an electron in one-dimensional periodic potential in solids. 10

(b) Prove that effective mass of electron is given by $m^* = \hbar^2 / (d^2E / d^2k)$. 5

7\. (a) Explain how the *Meissner-effect* was explained by London. 6

(b) What is *Isotope effect* ? 3

(c) What do you understand by Piezoelectric effect, Pyroelectric effect & Electrostrictive effect ? 6

8\. (a) Prove that reciprocal lattice of bcc is fcc and that of fcc is bcc. 10

(b) Show that five-fold rotational symmetry does not exist ? 5

S. No. of Question paper : 1656

Unique Paper Code : 222501 (14)

2018

I

Name of the Paper : **Mathematical Physics V**

Name of the Course : **B.Sc. (Hons.) Physics**

Semester : **V**

Duration: 3 Hours

Maximum marks: 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all. Question number **1** is compulsory.

Do two questions from each section

1. Attempt any *five* of the following:

(a) Find Fourier Sine Transform of $\frac{1}{x}$.

(b) If F(s) is the Fourier transform of f(x), find the Fourier transform of $F[x^n f(x)]$

(c) If L{f(t)} is F(s) then find $L\{t^n\}$.

(d) Find L{cos(at)}.

(e) Show that $\delta(\alpha x) = \frac{\delta(x)}{|\alpha|}$, where $\alpha > 0$.

(f) Define contravariant and covariant tensors.

(g) Find Laplace transform of $t^2u(t-3)$.

3 x 5 = 15

Section – A

2. (a) Find Fourier Sine transform of $f(x) = e^{-\beta x}$ ($\beta>0$) and hence show that

$$\frac{\pi}{2} e^{-\beta x} = \int_0^\infty \frac{\lambda Sin(\lambda x)}{\beta^2+\lambda^2}$$

(b) Find Fourier Cosine transform of x^{n-1}. **10, 5**

3. (a) State the convolution theorem for Laplace transform and use it to evaluate the inverse Laplace transform of $\frac{2}{s(s^2+16)}$

(a) Solve the following differential equations using Laplace transform.

$\frac{dx}{dt} + y = 0$; $\frac{dy}{dt} - x = 0$; $x(0) = 1$; $y(0) = 1$ **8,7**

4. (a) Show that the Laplace transform of a periodic function f(t) is

$$\frac{\int_0^T f(t)e^{-st}dt}{1-e^{-sT}}\text{, where } f(t+T) = f(t),\ s > 0$$

(b) Find Laplace transform of f(t) where:

$$f(t) = \begin{cases} t & 0 < t \leq c \\ 2c - t & c < t < 2c \end{cases}$$

8, 7

Section B

5. (a) State and prove initial value theorem in Laplace transform.

(b) **Solve the following differential equation using Laplace transform**

$y'' + 2y' + 5y = e^{-x}Sin(x)$; $y(0) = 0$, $y'(0) = 1$ with y'' **and** y' **as the second and first derivative of** $y(x)$ **respectively.**

5, 10

6. (a) Prove the identity

$$\nabla.(A \times B) = B.(\nabla \times A) - A.(\nabla \times B)$$

(b) State and Prove quotient law in tensors.

(c) Show that every second order tensor can be expressed as the sum of two tensors, one of which is symmetric and other skew symmetric.

5,5,5

7. (a) Derive an expression for the moment of inertia tensor. Prove that it is a symmetric tensor and it transforms like a second order tensor.

(b) Show that:

$$\varepsilon_{iks}\,\varepsilon_{mps} = \delta_{im}\,\delta_{kp} - \delta_{ip}\,\delta_{km}$$

10, 5