(i)   **Printed Pages : 4**   Roll No. ....

(ii) **Questions**   **: 9**   **Sub. Code :** | 2 | 6 | 1 | 0 | 5 |
                                 Exam. Code : | 0 | 4 | 7 | 3 |

M.Sc. Physics 2nd Semester

(2055)

MATHEMATICAL PHYSICS-II

Paper : PHY-8021

Time Allowed : Three Hours]   **[Maximum Marks : 60**

Note :— Attempt **five** questions in all, including Q.No. 9 (Unit-V) which is compulsory and selecting **one** question each from Units I-IV.

UNIT–I

1. (a) Define the terms :

    (i)   Representation of a group

    (ii) Lie group

    (iii) Structure constants of a Lie group.   6

    (b) Show that if a group H of order h is a subgroup G of order g then g is an integral multiple of h.   6

2. (a) Define multiplication table. Form a multiplication table of the group which has elements

$$I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, A = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}, B = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, C = \begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix} \quad 6$$

(b) List various applications of group theory in physics.　　6

UNIT-II

3. (a) Find Fourier series expansion for periodic function of period 2π, $f(x) = x^2$, $-\pi \le x \le \pi$. Hence find the sum of the series

$$\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} \dots \dots \qquad 6$$

(b) Show that if $\phi(p)$ is the Fourier transform of $\psi(x)$ then

$$<\hat{p}> = \int_{-\infty}^{\infty} \psi^*(x) \frac{\hbar}{i} \frac{d}{dx} \psi(x) dx. \qquad 6$$

4. (a) Show that the necessary and sufficient condition for $f(t)$ to be real is $g(-\omega) = g^*(\omega)$ where $g(\omega)$ is the Fourier transform of $f(t)$.　　6

(b) The motion of a damped 1-D oscillator is given by $\psi''(t) + 2\psi'(t) + 5\psi(t) = 0$, with $\psi(0) = 2$ and $\psi'(0) = -4$. Use Laplace transforms to show that

$$\psi(t) = \sqrt{5} e^{-t} \cos(2t + \tan^{-1}(0.5)) \qquad 6$$

UNIT-III

5. (a) What are contravariant and covariant tensors ? Explain inner and outer product of two tensors. 6

(b) Solve the equation $\phi(x) = \lambda \int_{-1}^{1} (t+x)\phi(t)dt$ for its Eigen values and Eigen functions. 6

6. (a) Show that $\dfrac{\partial A_p}{\partial x^q}$ is not a tensor even though A_p is a covariant tensor of rank 3. 6

(b) Develop an integral equation corresponding to the differential equation $y''(x) - y(x) = 0$. Given $y(1) = 1$, $y(-1) = 1$ 6

UNIT-IV

7. (a) Find the polynomial $f(x)$ by using Lagrange's formula and hence find $f(3)$ for

x	0	1	2	5
f(x)	2	3	12	147

6

(b) What are random numbers ? Explain Monte Carlo technique to generate random numbers. 6

8. (a) Explain Binomial, Poisson and Normal distributions. State central limit theorem. 6

(b) Use least square fitting method to fit a straight line to points (1, 1.7) (2,1.8) (3,2.3) (4,3.2) in XY plane. 6

UNIT-V

9. (a) What is a special Unitary group ?

(b) Find Fourier transform of $f(x) = e^{-|x|}$.

(c) What is difference between Fredholm and Volterra integral equation ?

(d) Define Greens function in one dimension.

(e) What is a metric tensor ? Is it symmetric ?

(f) Explain Euler method of solving differential equation.

$6 \times 2 = 12$