

(i) Printed Pages : 3 Roll No.

(ii) Questions : 9 Sub. Code :

3	7	0	9
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Exam. Code :

0	4	7	3
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M.Sc. Physics 2nd Semester

(2053)

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 following with examples :
 - (i) Direct product of groups
 - (ii) Cyclic group
 - (iii) Representation group. 6
- (b) Show that character is a function of classes just as representation is a function of group elements. 6
2. (a) Define Lie group with an example, generators of lie group, rank of a lie group, casimir operator. 6
- (b) Discuss applications of group theory. 6

UNIT—II

3. (a) Find the Fourier series of the function $f(x) = |x|$, $-\pi < x < \pi$ and hence deduce that

$$\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \dots \quad 6$$

- (b) Determine complex Fourier Transform for $f(t) = e^{-|t|}$. 6

4. (a) Consider a Gaussian distribution $f(x) = Ne^{-\alpha x^2}$ where N and α are constants. Determine its Fourier constants and discuss their nature. 6

(b) Evaluate $L^{-1} \left\{ \frac{s+1}{s^2 + 6s + 25} \right\}$. 6

UNIT—III

5. (a) If a covariant tensor of rank 2 is symmetric in one coordinate system then show that it is symmetric in every coordinate system and if a mixed tensor A_i^j is symmetric in one coordinate system. Check whether it is symmetric in any other coordinate system. 6

- (b) Derive an integral equation for $y'' + w^2y = 0$ with $y(0) = 0, y'(0) = 1$. What is the type of kernel obtained? 6

6. (a) Define metric tensor g_{ij} and show that it is symmetric. Describe its significance. 6
- (b) Determine the eigen values and eigen functions of the integral equation

$$F(x) = \lambda \int_{-1}^1 (x + x') F(x') dx'. \quad 6$$

UNIT—IV

7. (a) Find $y(0.5)$ for $y' = -2x - y$ with $y(0) = -1$, with step length 0.1 using Euler method. 6
- (b) Describe the method of fitting using least squares. 6
8. (a) Discuss about utility of random numbers and Monte-Carlo technique. 6
- (b) Describe properties of Binomial and Poisson distribution. 6

UNIT—V

9. (a) What is a special Unitary group ?
- (b) Mention the conditions that a function should satisfy in order to write its Fourier series.
- (c) State and prove Existence theorem for Laplace Transforms.
- (d) What are separable Kernels ?
- (e) Write the transformation rule for a third rank pure covariant tensor from barred to unbarred coordinates.
- (f) What is a simulation ? 6×2=12