ASSIGNMENT

Paper – Mathematical Physics-II **Course- B.Sc (H) Physics**

Unit I: Orthogonal Curvilinear Coordinates and Fourier Series

1. Explain the concept of orthogonal curvilinear coordinates. Calculate the scale factors, elements of area, and volume in spherical and cylindrical coordinate systems.
2. Derive the expressions for gradient, divergence, curl, and Laplacian in spherical and cylindrical coordinate systems. Provide physical interpretations for each operation.
3. Define Fourier series and discuss its significance in representing periodic functions. Explain the convergence of Fourier series and Dirichlet conditions.
4. Show how to expand a given periodic function in a series of sine and cosine functions. Calculate Fourier coefficients for specific examples.
5. Discuss the properties of even and odd functions. Derive the Fourier cosine series and Fourier sine series for functions exhibiting these properties.
6. Explain Parseval's identity and its application in analyzing signals represented by Fourier series. Provide examples to illustrate its usage.
7. **Numerical Problem:** Given a function $f(x)$ with its Fourier series expansion $f(x) = \sum_{n=1}^{\infty} \frac{4}{(2n-1)^2} \sin((2n-1)x)$, calculate the value of $f(\pi/2)$.

Unit II: Frobenius Method and Special Integrals

8. Discuss the significance of singular points in second-order linear differential equations. Explain the Frobenius method for finding series solutions and its applications.
9. Describe Legendre differential equations and their solutions using the Frobenius method. State and prove properties of Legendre polynomials.
10. Show how to expand a function in a series of Legendre polynomials. Derive recurrence relations for Legendre polynomials.
11. Define Beta and Gamma functions and establish the relation between them. Discuss their applications in physics.
12. Express integrals in terms of Gamma and Beta functions and solve the following integral: $\int_0^1 x^2 (1-x)^3 dx$.
13. **Numerical Problem:** Solve the integral $\int_0^{\pi/2} sin^2 x\, cos^2 x\, dx$ using Beta and Gamma functions.