15P107

Name: …………………………..

Reg. No………………………….

FIRST SEMESTER M.Sc. DEGREE EXTERNAL EXAMINATION FEB. 2016

(2015 Admission)

CC15P PHY1 C02 – Mathematical Physics 1
(Physics)

Time: 3 Hours **Maximum : 36 Weightage**

Section A

Answer **all** questions, each question carries 1 weightage.

1. Represent the vector $\vec{A} = 2yi - zj + 3xk$ in cylindrical coordinates (ρ, φ, z) and find A_ρ, A_φ, A_z.
2. Obtain the expressions for gradient and divergence in spherical polar coordinates.
3. Define Hermitian matrix and Unitary matrix.
4. What do you mean by symmetric tensors and anti-symmetric tensors?
5. What is meant by singular point of a differential equation? Explain the various singularities with examples
6. Define Wronskian of functions. Explain the idea of linear dependence and independence of functions in terms of Wronskian.
7. Explain Fuch's theorem.
8. What do you mean by completeness of an eigen function?
9. Show that $\Gamma(n+1) = n\,\Gamma(n)$, $n > 0$.
10. Find the Laplace Transform of t^n.
11. Define spherical Bessel function.
12. Explain the essential conditions to be satisfied for a function to be expanded in Fourier series.

(12 × 1 = 12 weightage)

Section B

Answer any **two** questions, each question carries **6** weightage.

13. (a) Express Laplacian operator in cylindrical coordinates.

    (b) Separate Helmholtz equation in spherical polar coordinates.

14. Obtain the series solution of Bessel equation. Explain the limitations of series solution.

15. (a) Represent the function f(x) = x sin(x) , $-\pi < x < \pi$ in the form of Fourier series and show that

$$\frac{\pi}{4} = \frac{1}{2} + \frac{1}{1*3} - \frac{1}{3*5} + \frac{1}{5*7} - \cdots$$

    (b) Prove that $J_0(x) = \frac{1}{\pi}\int_0^{\pi} \cos(x sin\theta)\, d\theta$

16. Obtain Rodrigue's formula for Legendre polynomial and hence find the value of $P_0(x)$, $P_1(x)$ and $P_2(x)$.

(2 × 6 = 12 weightage)

Section C

Answer any **four** questions, each question carries **3** weightage.

17. Show that sinx = $2J_1(x) - 2J_3(x) + 2J_5(x) - \ldots$.

18. Prove that $\int_{-1}^{+1} P_n(x)\, P_m(x) dx = \frac{2}{2n+1}\delta_{mn}$

19. Obtain the relation between beta and gamma functions. Hence show that $\Gamma(1/2) = \sqrt{\pi}$.

20. (a)Find the Fourier transform of $e^{-|t|}$.

    (b)Using Partial fraction expansion, find the inverse Laplace transform of $\frac{1}{(s+2)(s^2+2s+2)}$

21. Using Gram-Schmidt orthogonalisation process, form an orthonormal set from the set of functions $U_n(x) = x^n$, n = 0,1,2,… in the interval $0 \le x \le 1$ with the density functions w(x) =1.

22. Show that the similarity transformation of a matrix does not change its trace and determinant.

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