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Reg. No.....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, DECEMBER 2014

(CUCSS)

Physics

PHY 1C 02—MATHEMATICAL PHYSICS – I

(2012 admission onwards)

Time : Three Hours Maximum : 36 Weightage

Section A

Answer **all** *questions.*
Each question has a weightage of 1.

1. Write down the rotation matrix for the rotation of co-ordinates through an angle θ about the z-axis.
2. Give a physical meaning for the divergence of a vector.
3. If A is an orthogonal matrix, prove that det A = ± 1.
4. Define Levi-Civita three index symbol.
5. Define a covariant tensor.
6. Explain how the roots of indicial equation provide an idea about the number of distinct solution of an ODE.
7. What are the properties of a Hermitian operator ?
8. What is meant by a singular point of a differential equation ?
9. Graphically represent $P_0(x)$, $P_1(x)$ and $P_2(x)$ in terms of x.
10. Explain Fuch's theorem.
11. Show that the term by term integration results in rapid convergence of Fourier series.
12. State the first shifting theorem of Laplace transform.

(12 × 1 = 12 weightage)

Section B

Answer any **two** *questions.*
Each question has a weightage of 6.

13. Derive the expression for curl in general curvilinear co-ordinates. Deduce the curl in spherical co-ordinates.

Turn over

14. Define orthogonal, Hermitian and unitary matrices. Diagonalise the matrix $\begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}$ by a simila transformation.

15. Establish the orthogonality of Bessel's function.

16. Explain Gram-Schmidt orthogonalisation procedure with a suitable example.

(2 × 6 = 12 weight

Section C

Answer any **four** *questions.*
Each question has a weightage of 3.

17. Transform the unit vectors i, j, k into their components in a cylindrical co-ordinate system.

18. If λ is an eigen value of a matrix A, show that λ^2 is an eigen value of A^2.

19. Show that $\sqrt{\frac{1}{2}} = \sqrt{\pi}$.

20. Show that $J_0^2(x) + 2\left[J_1^2(x) + J_2^2(x) + \ldots\right] = 1$.

21. Find the Laplace transform of the function $e^{at} \sin t$.

22. Find the Fourier series of the function :

$f(x) = x^2, -\pi \le x \le \pi$.

(4 × 3 = 12 weight