K16P 1296

Reg. No. : ....

Name : ....

First Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination, November 2016
(2014 Admission Onwards)
PHYSICS
PHY 1C01 : Mathematical Physics – 1

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** questions. (either **a** or **b**). **Each** question carries **12** marks.

1. a) Define orthogonal matrices. What do you meant by diagonalisation of matrices ? Diagonalize the matrix A given below :

$$A = \begin{bmatrix} 5 & -4 & 4 \\ 12 & -11 & 12 \\ 4 & -4 & 5 \end{bmatrix}.$$

OR

b) Obtain an expression for gradient in cylindrical and spherical coordinate system.

2. a) Define tensor in four-dimensional space. What do you meant by Rank of a tensor. Determine the metric tensor in :

i) Spherical polar co-ordinates

ii) Cylindrical co-ordinates.

OR

b) i) Derive the orthogonality condition for Legendre polynomials.

ii) Show that for integral 'n' $J_n(x) = (-1)^n \; J_{-n}(x)$. **(2×12=24)**

P.T.O.

SECTION – B

Answer **any four** (**1** mark for Part – **a)**; **3** marks for Part – **b)**; **5** marks for Part – **c)**).

3. a) What is Hermitian matrix ?

   b) Show that eigen matrices of a Hermitian matrix for distinct eigen values are orthogonal.

   c) Derive the property of a Hermitian matrix regarding its eigen values.

4. a) Define an analytic function.

   b) Show that the covariant derivative of the metric tensor is zero.

   c) Prove that an arbitrary covariant or contravariant tensor of the second rank can be written as the sum of a symmetric and a skew-symmetric tensor.

5. a) Define Wronskian function.

   b) Illustrate Frobenius method for the series solution of ordinary differential equation.

   c) Solve $y' = zxy$ by the Frobenius method.

6. a) What is Laurent series expansion ?

   b) Obtain the Laurent series expansion of $f(z) = \frac{1}{z^2 - 3z + 2}$ in the region $1 < |z| < 2$.

   c) What is residue ? Explain how it act as a powerful method of evaluating integrals around closed contours ?

7. a) What is Beta function ? Give its importance in physics.

   b) Express the integrals $I = \int_0^\infty \frac{x^3}{(1+x)^5} dx$ in terms of Beta function and then find its value.

   c) Show that $\Gamma\left(\frac{1}{4}\right)\Gamma\left(\frac{3}{4}\right) = \sqrt{2}\,\pi$.

8. a) Define spherical Bessel function.

   b) State and prove Bessel's Inequality.

   c) Explain the regular and irregular singularities of Bessel's equation. **(4×9=36)**
