Reg. No. : ....

Name : ....

M 24417

I Semester M.A./M.Sc./M.Com./ M.Sc. Comp. Science Degree (Reg./Sup./Imp.) Examination, November 2013

PHYSICS

PH-101 : Mathematical Physics – I

Time : 3 Hours

Max. Marks : 50

SECTION – A

Answer **any two** questions. **Each** question carries **ten** marks.

1. How are cylindrical and spherical polar co-ordinates related to the Cartesian co-ordinates ? Write down the Laplacian operator in Cartesian co-ordinate and convert the expression to the cylindrical co-ordinates.
2. Define Legendre Polynomials. State and prove orthogonal properties of Legendre's polynomials.
3. State and prove Cauchy Residue theorem.
4. What do you mean by diagonalization of matrices ? Explain the practical method of diagonalization. Diagonalize the following matrix :

$$\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

(2×10=20)

SECTION – B

Answer **any five** questions. **Each** question carries **three** marks.

5. If $u = 2x + 3$, $v = y - 4$, $w = z + 2$, show that u, v, w are orthogonal find ds^2.
6. If A and B are symmetric matrices, then show that AB is symmetric if and only if A and B commute.
7. What is a tensor ? Explain what is meant by the rank of a tensor.
8. Find the poles and residues at the poles of the function $\dfrac{z+1}{z^2-2z}$.

9. To show that $\beta(m,n) = \frac{\Gamma m \Gamma n}{\Gamma(m+n)}$.

10. Write the Hermite polynomial and determine $H_5(x)$.

11. Show that the given matrix is orthogonal $\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$.

12. Using Rodrigue's formula, prove that $\int_{-1}^{+1} P_n(x)\,dx = 0\,(n \neq 0)$. **(5x3=15)**

SECTION – C

Answer **any three** questions. **Each** question carries **five** marks.

13. Prove that $J_{\frac{-1}{2}}(x) = \sqrt{\left(\frac{2}{\pi x}\right)} \cos x$.

14. Define metric tensor and determine metric tensor in Cylindrical coordinates.

15. Find the residue of $\frac{z^4}{(z-1)^4 (z-2)(z-3)}$ at $z = 1$.

16. What are Legendre Polynomials ? Show that $P_n(-x) = (-1)^n P_n(x)$.

17. For Bessel function $J_n(x)$, prove that $J_{-n}(x) = (-1)^n J_n(x)$. **(3x5=15)**