Reg.No.: ……..………..………………..Name : ………………………… **P104**

MSc DEGREE END SEMESTER EXAMINATION – NOVEMBER 2015

SEMESTER: 1: SUBJECT – PHYSICS

COURSE: P1PHYT01 -MATHEMATICAL METHODS IN PHYSICS – I

(Regular, Supplementary / Improvement)

Time: Three Hours Max. Marks: 75

Part A (Objective Type)

(Answer all questions. Each question carries 1 Mark)

1. The condition for a solenoidal vector field is
(a) Grad A= 0 (b) Div A= 0 (c) Curl A= 0 (d) Curl A= finite

2. The Eigen values of the matrix $\begin{bmatrix} Cos\theta & -Sin\theta \\ Sin\theta & Cos\theta \end{bmatrix}$ are
(a) $\pm e^{i\theta}$ (b) $e^{\pm i\theta}$ (c) $Cos\theta \pm Sin\theta$ (d) $\pm tan\theta$

3. If AY= PY, then Y=
(a) PYA (b) PYA^{-1} (c) A^{-1} PY (d) PYP^{-1}

4. The value of ¿ - tensor $¿_{ppq}$ is
(a) 1 (b) -1 (c) 0 (d) infinity

5. The value of $\Gamma \frac{1}{2}$ is
(a) 0 (b) π/2 (c) π (d) $\sqrt{\pi}$

(1 x 5 = 5)

Part B (Short answer)

(Answer any 5 questions. Each question carries 2 Marks)

6. Explain Gauss's divergence theorem

7. Express the position and velocity vectors of a particle in cylindrical coordinates

8. Prove that the Eigen values of a Hermitian matrix are always real

9. Evaluate a, b and c when $\begin{bmatrix} 0 & 2b & c \\ a & b & -c \\ a & -b & c \end{bmatrix}$ is orthogonal

10. Define covariant, contravariant and mixed tensors. Give examples.

11. Show that the Kronecker delta is a mixed tensor of rank 2.

12. Using the generating function for Hermites polynomials, obtain the relation
$H_n'(x) = 2nH_{n-1}$

13. Show that $\Gamma(n+1) = n\Gamma n$, where n is an integer. (2 x 5 = 10)

Part C (Problem/Short essay)

(Answer any 3 question. Each question carries 4 Marks)

14. Describe the Schimidt orthogonalization method for constructing an orthogonal set of functions from a non-orthogonal set.

15. Solve the following set of equations using Gauss elimination method

$3x+4y+5z=18$

$2x-y+8z=13$

$5x-2y+7z=20$

16. Write notes on Binomial and Poisson's distributions

17. If *n* is a positive integer and $J_{n(x)}$ is the Bessel function of n[th] order, prove that

$$J_{n(x)}=\frac{1}{\pi}\int_0^{\pi} Cos(n\theta - xSin\theta)\,d\theta$$

18. Show that $\epsilon_{ijk}\in_{pqk}=\delta_{ip}\delta_{jq}-\delta_{iq}\delta_{jp}$, where ϵ_{ijk} is the Levi-civita symbol (3 x 4 = 12)

Part D (Essay)

(Answer all question. Each question carries 12 Marks)

19. (a) State and prove Stokes theorem in vector analysis. Verify Stoke's theorem for the vector field A= (3x-2y) **i** + x^2z **j** + y^2(z+1) **k** for a plane rectangular area with vertices(0,0), (1,0), (1,2), (0,2) in the x-y plane

OR

b) Obtain the general expressions for vector operators in curvilinear coordinates and hence find the Laplacian in circular cylindrical coordinates.

20. (a)Explain matrix diagonalisation. Diagonalise the following matrix $\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

OR

(b)Find the characteristic equation of the matrices

$\begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & 1 \end{bmatrix}$ and $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and verify Cayley Hamilton equation for them.

Also find the inverse of each.

21. (a) What are Christoffel symbols? Show that they do not form the components of a tensor

Or

(b) Obtain the differential equation of a geodesic in a given space.

22. (a) Obtain the orthogonality relation for the Hermite polynomials

$$\int_{-\infty}^{+\infty} e^{-x^2} H_m(x) H_n(x)\,dx=\sqrt{\pi}\,2^n n!$$

Or

(b) Obtain the series solutions of Legendre differential equation by Frobenius method

(12 x 4 = 48)

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