Reg. No .... Name **18P104**

MSc DEGREE END SEMESTER EXAMINATION - NOVEMBER 2018

SEMESTER 1 : PHYSICS

COURSE : **16P1PHYT01 : MATHEMATICAL METHODS IN PHYSICS - I**

(For Regular - 2018 Admission & Supplementary - 2016 / 2017 Admissions)

Time : Three Hours Max. Marks: 75

Section A

Answer all questions (1 marks each)

1. A vector **r** = x*i* + y*j* + z*k*. If **F** = r^n**r**, the value of $\nabla \times \mathbf{F}$ is
   (a) 0 (b) r (c) nr^{n-1} (d) 1
2. Consider the system of equation $x - y + 3z = 4$, $x + z = 2$ and $x + y - z = 0$. This system has
   (a) a unique solution (b) finitely many solution
   (c) infinitely many solutions (d) no solution
3. The number of linearly independent eigen vectors of $\begin{bmatrix} 2 & 1 \\ 0 & 2 \end{bmatrix}$ is
   (a) 0 (b) 1 (c) 2 (d) infinite
4. $A^{ijk}_{lm} B^{l}_{m}$ is a tensor of rank
   (a) 7 (b) 3 (c) 5 (d) 6
5. The incorrect equation among the following is
   (a) $P_0(x) = 0$ (b) $P_1(x) = x$ (c) $P_n(-x) = (-1)^n P_n(x)$ (d) $P_n(-x) = (-1)^{n+1} P_n(x)$

(1 x 5 = 5)

Section B

Answer any 7 (2 marks each)

6. Give the physical explanation of divergence operation.
7. What is a linear vector space?
8. Explain Poisson's distribution with an example.
9. State the condition for diagonalizability of a matrix.
10. Show that every square matrix can be uniquely written as the sum of a hermitian and skew hermitian matrices.
11. Explain the contravariant fundamental tensor.
12. What is the inner product of a tensor?
13. Write the metric tensor in cylindrical coordinates.
14. Prove that $P_n(1) = 1$
15. Write any two transformation equations of Beta function.

(2 x 7 = 14)

Section C

Answer any 4 (5 marks each)

16. If $\mathbf{F} = xy^2\,\mathbf{i} + yz^2\,\mathbf{j} + zx^2\,\mathbf{k}$, verify Gauss theorem over the sphere $x^2 + y^2 + z^2 = 4$.

17. Find the inverse of the given matrix using Cayley-Hamilton theorem:

$$\begin{bmatrix} 3 & 1 & 1 \\ 1 & 3 & 2 \\ 2 & 2 & 3 \end{bmatrix}$$

18. Find the inverse of the given matrix by Gauss–Jordan method:

$$\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 2 \\ 1 & 1 & 3 \end{bmatrix}$$

19. What is contraction of a tensor? Show that contraction produces a tensor with a rank reduced by 2.

20. Prove that Kronecker Delta is an invariant mixed tensor of rank 2.

21. Express cos(x) in terms of $J_n(x)$.

(5 x 4 = 20)

Section D

Answer the following (12 marks each)

22.(a). Find the unit vectors in spherical polar coordinate system and prove that they are orthogonal.

OR

(b). State and prove Gauss' theorem and Stoke's theorem. Hence deduce Gauss law in electrostatics.

23.(a). Determine the Eigen values and normalized Eigen vectors.

$$\begin{bmatrix} -1 & 1 & 2 \\ 0 & -2 & 1 \\ 0 & 0 & -3 \end{bmatrix}$$

OR

(b). Find the equation of geodesic in spherical polar coordinates.

24.(a). Write the Bessel's differential equation. Obtain the series solution of Bessel's differential equation.

OR

(b). Obtain the integral representation of $J_n(x)$.

(12 x 3 = 36)