(7 pages)

Reg. No.:.....

Code No. : 6523 **Sub. Code : ZPHM12**

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2021

First Semester

Physics — Core

MATHEMATICAL PHYSICS -I

(For those who joined in July 2021 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer

1. The value of t for which three vectors (1-t,0,0) (1,1-t,0) and (1,1,1-t) are linearly dependent is

   (a) 1 (b) 0

   (c) 2 (d) -1

2. The divergence of a vector field is always

(a) a vector

(b) a scalar

(c) sometimes a scalar and sometimes vector

(d) neither a scalar nor a vector

3. The value of $\Gamma\frac{3}{2}$ is

(a) $\sqrt{\pi}$ (b) $\frac{1}{2}\pi$

(c) $\frac{1}{2}\sqrt{\pi}$ (d) π

4. The value of $\int_0^\infty e^{-x}\left[L_n(x)\right]^2 dx$ is

(a) 0 (b) 1

(c) $n!$ (d) $\frac{1}{2^n n!}$

5. The solution of Laplace's equation in spherical polar coordinates will invole

(a) Legndre polynomial

(b) Bessel polynomial

(c) Laguerre polynomial

(d) none of the above

6. In heat flow equation $\nabla^2 u = \frac{1}{h^2} \frac{\partial u}{\partial t}$ the quantity h is called

(a) plank's constant

(b) conductivity

(c) heat flow constant

(d) diffusivity

7. A tensor of rank 2 in n- dimensional space has components

(a) n (b) $2n$

(c) n^2 (d) 2^n

8. Christoffell's 3 - index symbols are

(a) invariant (b) vectors

(c) tensors (d) not the tensors

9. The standard deviation of binomial distribution is

(a) $\frac{p+q}{2}$ (b) np

(c) npq (d) $\sqrt{npq}$

10. The probability of throwing more than 4 by one dice is

(a) 1/2 (b) 1/3

(c) 2/3 (d) 3/4

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Find the values of a, b ,c so that the function.

$$f = (x + 2y + az)\ i + (bx - 3y - z)\ j + (4x + cy + 2z)k$$

is irrotational.

Or

(b) Show that the vectors (1,2,-3) (1,3,-2) and (2,–1,5) are linearly Independent.

12. (a) Obtain the relation between Beta and Gamma functions.

Or

(b) Prove that $nP_{n(x)} = (2n-1)x\,P_{n-1} - (n-1)P_{n-1}$.

13. (a) Obtain the general solution of Laplace's equation in Cartesian Coordinates.

Or

(b) A string of length l fixed at both ends is plucked at a distanced d from one fixed point by an amount h. Find the displacement at any position at any instant of time.

14. (a) Expresses the Cartesian and the spherical polar coordinates as function of each other.

Or

(b) Distinguish between symmetric and antisymmetric tensor.

15. (a) An urn contains 10 block and 10 white balls. Find the probability of drawing two balls of the same colour.

Or

(b) The following data are the number of seeds germination out of 10 on damp filter for 80 sets of seeds. Fit a Binomial distribution of those data.

x:	0	1	2	3	4	5	6	7	8	9	10
y:	6	20	23	12	8	6	0	0	0	0	0

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)

16. (a) From the set of vectors(1,0,1) (0,0,1) and (1,1,0) construct a set of orthonormal vectors.

Or

(b) State and prove Stoke's theorem.

17. (a) Obtain the series solution of Legendre differential equation.

Or

(b) Show that $\int_0^\infty e^{-x} L_m(x) L_n(x) dx = \delta mn.$

18. (a) Determine the steady state temperature distribution in a thin plate bounded by the lines $x = 0, x = \ell,$ and $y = \infty$; assuming that heat can not escape from either surface of the plate, the edges $x = 0, x = \ell, y = \infty$ being kept at zero temperature; while the edge $y = 0$ being kept at steady temperature F(x).

Or

(b) Discuss the vibrations of circular membrane.

19. (a) Discuss the application of tensor analysis in elasticity.

Or

(b) Explain christoffel's 3 index symbols in tensor analysis.

20. (a) Find the correlation coefficient from the following data.

X	1	2	3	4	5
Y	2	5	3	8	7

Or

(b) The radius of a wire is measured in cm as 0.17,0.15,0.18,0.19,0.16, 0.17 Find the mean radius and the standard deviation.

———————