20P2004

Reg. No .... Name ....

M. Sc DEGREE END SEMESTER EXAMINATION - MARCH 2020

SEMESTER 2 : PHYSICS

COURSE : **16P2PHYT05 : MATHEMATICAL METHODS IN PHYSICS- II**

(For Regular - 2019 Admission & Supplementary 2018/2017/2016 Admissions)

Time : Three Hours Max. Marks: 75

Section A

Answer All the Following (1 mark each)

1. The value of the integral $I = \int_0^{2\pi} \frac{d\theta}{(5+4\cos\theta)}$ is
   (a) $8\pi/7$ (b) $10\pi/27$ (c) $8\pi/25$ (d) $10\pi/49$
2. A group may be represented by ....
   (a) unitary matrices (b) non-unitary matrices (c) both of these (d) none of these
3. The Fourier transform converts a set of time domain data vectors into a set of .... domain vectors.
   (a) space (b) amplitude (c) frequency (d) complex
4. The Fourier transform of which of the following functions does not exist?
   (a) $e^{-|x|}$ (b) xe^{-x^2} (c) e^{x^2} (d) e^{-x^2}
5. The one dimensional wave equation is
   (a) $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ (b) $\frac{\partial^2 u}{\partial t^2} = \frac{1}{c^2} \frac{\partial^2 u}{\partial x^2}$ (c) $\frac{\partial^2 u}{\partial t^2} + c^2 \frac{\partial^2 u}{\partial x^2} = 0$ (d) $\frac{\partial^2 u}{\partial t^2} + \frac{1}{c^2} \frac{\partial^2 u}{\partial x^2} = 0$

(1 x 5 = 5)

Section B

Answer any 7 (2 marks each)

6. Find the point (x, y) at which the function $f(z) = |z|^2$ is analytic.
7. Show that $f(z) = z^2$ satisfies Cauchy Reimann equations.
8. Calculate the number of classes in a discrete abelian group of order n.
9. Explain conjugate elements of groups.
10. Describe how Earth's nutation can be explained on the basis of transforms.
11. Find the inverse Laplace transform of $\frac{s+2}{s^2-4s+13}$
12. Differentiate between Fourier series and Fourier transform.
13. State two properties of one dimensional Green's function.
14. Why Green's function is said to be symmetric about its two variables x and t.
15. Explain the physical meaning of Green's function.

(2 x 7 = 14)

Section C
Answer any 4 (5 marks each)

16. Derive the conditions for a complex function to be analytic.
17. Show that SU(2) and SU(3) groups are homomorphic.
18. Show that the Fourier transform of a Gaussian function is another Gaussian.
19. Using Laplace transform discuss LCR circuit
20. Find the Green's function for the differential equation $\frac{d^2y}{dx^2} = f(x)$, subject to the boundary conditions $y(0) = 0 = y(a)$.
21. State and explain any five different types of partial differential equations that occur in Physics and the phenomena to which they are applied.

(5 x 4 = 20)

Section D
Answer any 3 (12 marks each)

22.1. Show that $\int_0^\infty \frac{dx}{(x^2+1)(x^2+9)} = \frac{\pi}{24}$.

OR

2. Derive Cauchy's integral formula.

23.1. Explain the applications of group theory in particle physics.

OR

2. Prove that any finite group of order n is isomorphic to a permutation group of 'n' symbols.

24.1. Obtain the momentum representation of hydrogen atom in the ground state.

OR

2. Find the solution of Laplace's equation in spherical polar coordinates.

(12 x 3 = 36)