Reg. No .... Name **19P2004**

MSc DEGREE END SEMESTER EXAMINATION - MARCH/APRIL 2019

SEMESTER 2 : PHYSICS

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

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

Time : Three Hours Max. Marks: 75

Section A

Answer all the following (1 marks each)

1. The value of the integral $I = \frac{1}{2\pi i} \oint_c \frac{dz}{z-3}$ where c is the circle $|z| = 1$ is
   (a) 1 (b) 1/2 (c) 2 (d) 0
2. If a set of vectors are said to be linearly independent then ....
   (a) one of the vectors cannot be expressed with any of the rest
   (b) their Gram determinant is zero
   (c) both of these
   (d) no conclusion may be drawn out of the given statement.
3. The Laplace transform of Cos[at] is ....
   (a) $a/(s^2 - a^2)$ (b) $s/(s^2 - a^2)$ (c) $a/(s^2 + a^2)$ (d) $s/(s^2 + a^2)$
4. The solution of one dimensional heat equation $\frac{\partial u}{\partial t} = \alpha^2 \frac{\partial^2 u}{\partial x^2}$ exist, if
   (a) RHS is a constant (b) both LHS and RHS are constant (c) LHS is a constant (d) all of these
5. The solution of Laplace's equation in spherical polar coordinates, when it is axially symmetric about Z-axis involves
   (a) associated Legendre's function
   (b) Legendre's polynomial
   (c) Bessel's function
   (d) Helmholtz function

(1 x 5 = 5)

Section B

Answer any 7 (2 marks each)

6. Show that $f(z) = z^2$ satisfies Cauchy Reimann equations.
7. What is a Lie group?
8. Describe how Earth's nutation can be explained on the basis of transforms.
9. Find the inverse Laplace transform of $2(s^4 + 3)(s^2 + 4)$
10. What is the Laplace transform of sin(ht)?
11. Define group, subgroup and class.
12. State two properties of Green's functions.

13. Explain the different boundary conditions used to solve differential equations.

14. Find the solution of one dimensional Laplace equation in Cartesian coordinates.

15. Describe nonlinear PDE's

(2 x 7 = 14)

Section C

Answer any 4 (5 marks each)

16. Deduce Cauchy's integral formula, assuming Cauchy's integral theorem.

17. Discuss isomorphism and homomorphism of groups with examples.

18. Show that the Fourier transform of a Gaussian function is another Gaussian.

19. Obtain the Fourier transform of Dirac delta function $\delta(t - x)$

20. Show that Green's function is symmetric with respect to its two variables.

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. Derive Laurent's expansion of a function f(z) about $z = z_0$.

OR

2. Discuss Laurent's expansion and compare with Taylor's expansion.

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

OR

2. Consider the set of the following six functions: $f_1(x) = x$, $f_2(x) = 1-x$, $f_3(x) = x/(x-1)$, $f_4(x) = 1/x$, $f_5(x) = 1/(1-x)$, $f_6(x) = (x-1)/x$. Let the law of combination be defined as $f_i(x)*f_j(x)=f_i(f_j(x))$. Check if the set form a group and whether this group is isomorphic with the group of transformations of an equilateral triangle.

24.1. Find the Laplace transform of $\frac{\sin(at)}{t}$. Does the transform of $\frac{\cos(at)}{t}$ exist?

OR

2. Separate Helmholtz' equation in cylindrical coordinates.

(12 x 3 = 36)