Register Number:
Date:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27

M.Sc. PHYSICS - I SEMESTER

SEMESTER EXAMINATION: OCTOBER 2019

PH 7218 – MATHEMATICAL PHYSICS

Time- $2\frac{1}{2}$hrs **Max Marks-70**

This paper contains TWO printed pages and TWO parts

PART – A

Answer any FIVE. Each question carries 10 marks.

[5 x 10 = 50]

1. Let $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ Find matrix P such that $P^{-1}AP$ is a diagonal matrix.

2. If $u - v = (x - y)(x^2 + 4xy + y^2)$ and $f(z) = u + iv$ is an analytic function of $z = x + iy$, find f(z) in terms of z by Milne Thomson method.

3. Use Cauchy's integral formula to evaluate $\oint_c \frac{z^2+1}{z^2-1} dz$, where C is Contour,

   $(a)\ |z| = \frac{3}{2},\ \ (b)\ |z-1| = 1, (c)\ |z| = \frac{1}{2}$. [4+3+3]

4. Find the Fourier series expansion for $f(x) = x + \frac{x^2}{4}, -\pi \le x \le \pi$.

5. (a) Find the Laplace transform of the function $f(t) = \left(\frac{2t}{3}\right), 0 \le t \le 3$.

   (b) Find the Fourier transform of $A = xe^{-ax^2}, a > 0$. [5+5]

6. Expand the function $f(x) = \begin{cases} 0, & -1 < x < 0 \\ 1, & 0 < x < 0 \end{cases}$ in terms of Legendre polynomials.

7. Prove the following recurrence relations using Hermite polynomial equation

   $(a)\ 2nH_{n-1}(x) = H'_n(x)$

   $(b)\ 2xH_n(x) = 2nH_{n-1}(x) + H_{n+1}(x)$.

   [6+4]

PART – B

Answer any FOUR. Each question carries 5 marks.

[4 x 5 = 20]

8. Show that $\begin{bmatrix} cos\emptyset & 0 & sin\emptyset \\ sin\theta sin\emptyset & cos\theta & -sin\theta cos\emptyset \\ -cos\theta sin\emptyset & sin\theta & cos\theta cos\emptyset \end{bmatrix}$ is an orthogonal matrix through all three conditions.

9. (a). Examine the continuity of the following

$$f(z) = \begin{cases} \frac{z^3 - iz^2 + z - i}{z - i}, & z \neq i \\ 0, & z = i \end{cases} \quad at\ z = i.$$

(b). Show that the function f(z) defined by $f(z) = \begin{cases} \frac{Re(z)}{z}, z \neq 0 \\ 0, \quad z = 0 \end{cases}$ is not continuous at $z = 0$. [3+2]

10. Prove Parseval's identity.

11. Define C_4 group with example. Explain the term Isomorphism and Homomorphism through C_4 group elements. [2+3]

12. Prove the identities $(i) e^{-1} = e,\ (ii)\ a^{-1}a = e\ and\ (iii)\ ea = a$ for all $a \in G$ follow from basic axiom. [2+2+1]

13. For the following concurrent force system, find the resultant in magnitude and direction.