

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034**M.Sc. DEGREE EXAMINATION – PHYSICS****FIRST SEMESTER – NOVEMBER 2023****PPH1MC03 – MATHEMATICAL PHYSICS**

Date: 06-11-2023

Dept. No.

Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

SECTION A – K1 (CO1)**Answer ALL the questions****(5 x 1 = 5)****1 Fill in the blanks.**

- a) If a function is analytic in a domain D then it satisfies ----- equation at all points in D.
- b) A point at which $f(z)$ is not analytic is known as -----.
- c) The characteristic equation of the given matrix A is ----- .
- d) The Maclaurin series is given as ----- .
- e) $nP_n(x) =$ -----.

SECTION A – K2 (CO1)**Answer ALL the questions****(5 x 1 = 5)****2 Answer the following**

- a) Define residue at infinity.
- b) State Cauchy's Integral theorem.
- c) What is the kernel of Fourier Transform?
- d) Evaluate $\Gamma(-\frac{1}{2})$.
- e) What does the symbolic notation $P(A/B)$ says in probability?

SECTION B – K3 (CO2)**Answer any THREE of the following****(3 x 10 = 30)**

- 3 i) Use Cauchy's integral formula to evaluate $\int_C \frac{z}{(z^2-3z+2)} dz$ where C is the circle $|z-2|=1/2$ (6 Marks).
- ii) $\int_C \frac{2z+1}{(z^2+z)} dz$ Where C is a circle of $|z|=1/2$ (4 Marks).
- 4 Find the Eigen values and Eigen vectors of matrix

$$A = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}.$$
- 5 Show that $\beta(l,m) = \frac{\Gamma l \Gamma m}{\Gamma l+m}$.
- 6 Find the Fourier Transform of e^{-ax^2} where $a > 0$.
- 7 An experiment succeeds twice as often as it fails. Find the chance that in the next 6 trials there will be at least 4 successes.

SECTION C – K4 (CO3)

Answer any TWO of the following **(2 x 12.5 = 25)**

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| 8 | State and Prove Cauchy's Integral formula. |
| 9 | Using complex variable techniques evaluate the real integral $\int_0^{2\pi} \frac{\sin^2 \theta}{(5-4\sin\theta)} d\theta$. |
| 10 | Express the function $f(x) = 4x^3 + 6x^2 + 7x + 2$ in terms of Legendre polynomial. |
| 11 | Use Fourier sine transform to solve the equation $\frac{\partial u}{\partial t} = k \frac{\partial^2 u}{\partial x^2}$ under the conditions i) $u(0,t)=0$
ii) $u(x,0) = e^{-x}$ iii) $u(x,t)$ is bounded . |

SECTION D – K5 (CO4)

Answer any ONE of the following **(1 x 15 = 15)**

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|----|---|
| 12 | Find the first four terms of the Taylor's series expansion of the complex variable function $f(z) = \frac{z+1}{(z-3)(z-4)}$ about $z=2$ and Find the region of Convergence. |
| 13 | Obtain the generating function of Hermite Polynomials (Rodrigue Formula) . |

SECTION E – K6 (CO5)

Answer any ONE of the following **(1 x 20 = 20)**

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|----|---|
| 14 | Evaluate $\int_c \frac{12z-7}{(z-1)^2(2z+3)} dz$ where 'c' is the circle i) $ z =2$ and ii) $ z+i =\sqrt{3}$. |
| 15 | Find the Fourier transform for the function $f(x) = \begin{cases} 1-x^2 & \text{if } x \leq 1 \\ 0 & \text{if } x > 1 \end{cases}$. And use it to evaluate $\int_0^\infty \frac{(x \cos x - \sin x)}{(x^3)} \cos \frac{x}{2} dx$. |

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