

**LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034**

**B.Sc. DEGREE EXAMINATION - PHYSICS**

THIRD SEMESTER – NOVEMBER 2015

**PH 3506 - MATHEMATICAL PHYSICS**

Date : 04/11/2015

Dept. No.

Max. : 100 Marks

Time : 09:00-12:00

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**PART – A**

Answer **ALL** the questions:

(10 x 2 = 20 Marks)

1. Write the imaginary part of  $(x + iy)^2$ .
2. Find the value of  $\cosh^2 i - \sinh^2 i$ , where  $i = \sqrt{-1}$ .
3. Given  $\vec{F} = \sin y \hat{i} + \cos x \hat{j}$  find  $\text{curl } \vec{F}$ .
4. State Stoke's theorem.
5. What do you mean by orthogonality of trigonometric system?
6. Find the fundamental period of half wave rectifier.
7. What is a triangular matrix? Give an example.
8. State the condition for a matrix to be orthogonal and unitary.
9. Express Gauss integration formula and give its importance.
10. What is interpolation?

**PART – B**

Answer any **FOUR** questions:

(4 x 7.5 = 30 Marks)

11. Derive Cauchy –Riemann equations.
12. Find the directional derivative of  $F = x^2 + y^2 + z^2$  at  $(2, -2, 1)$  in the direction of  $\hat{i} + \hat{j} + 2\hat{k}$  and also check whether  $\text{grad } f$  is an irrotational.
13. Determine the Fourier series of the function  $f(x) = x + \pi$  in the interval  $-\pi < x < \pi$  with a period of  $2\pi$ .
14. Show that the eigen vectors corresponding to distinct eigen values of a Hermitian matrix are orthogonal to each other.
15. Using Simpson's 1/3 rule, Evaluate  $\int_0^1 \sqrt{1 - x^2} dx$  with ten equal intervals.
16. Solve  $\frac{dy}{dx} = 1 - y$  with  $y = 0$  at  $x = 0$  by using improved Euler's method and tabulate the values of  $y$  at  $x = 0.1, 0.2$  and  $0.3$

**PART – C**

Answer any **FOUR** questions:

(4 x 12.5 = 50 Marks)

17. (i) Integrate  $x dz$ 
  - a. the shortest path from 0 to  $1 + i$
  - b. from 0 to 1 and vertically up to  $1 + 2i$ .(ii) Using Cauchy's integral formula, Integrate  $\frac{\sin z}{(z - \pi)^4} dz$  counterclockwise around the circle with  $|z| = 4$ .

18. (i) Find the moment of inertia of a spherical lamina about its axis S:  $x^2 + y^2 + z^2 = 9$  of constant mass density and total Mass M about the z-axis.

(ii) Obtain the heat equation using Gauss-divergence theorem.

19. Find the Fourier cosine and Fourier sine integral of  $f(x) = e^{-kx}$  where  $x > 0, k > 0$ .

20. Determine the eigen values and eigen vectors of  $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 3 & 2 \\ 0 & 0 & 2 \end{bmatrix}$ .

21. Derive Newton's forward interpolation formula and using it find the value of  $y$  at  $x=0.23$  from the following table:

$x$	0.20	0.22	0.24	0.26	0.28	0.30
$y$	1.6596	1.6698	1.6804	1.6912	1.7024	1.7139

22 (i) State and prove Green's theorem in the plane.

(ii) Show that  $A = \begin{pmatrix} 1 & -3 \\ 4 & 2 \end{pmatrix}$  satisfies Cayley-Hamilton theorem.