LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – **APRIL 2016**

PH 3506 – MATHEMATICAL PHYSICS

Date: 28-04-2016 Dept. No. Max. : 100 Marks
Time: 09:00-12:00

PART – A

Answer ALL the questions: **(10 x 2 = 20 Marks)**

1. Find the square root of the number (3 + 4 i).
2. What is a multiply connected region in a complex plane?
3. Calculate the gradient of $(x^2+y^2)^{\frac{1}{2}}$
4. What is the geometrical meaning of a curl of a vector field?
5. State the function of a half-wave rectifier.
6. If $f(x)$ is odd in the interval –a to +a, then, $\int_{-a}^{+a} f(x)dx \ = ?$
7. If two rows of a square matrix are equal, what is the effect on the determinant?
8. Find the eigen values of the matrix $\begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$.
9. Define the forward difference operator.
10. State Trapezoidal rule for integration.

PART – B

Answer any FOUR questions: **(4 x 7.5 = 30 Marks)**

11. (i) Deduce the Cauchy-Riemann equations for analytic functions.

    (ii) Check whether the function $f(z) = \cos\ x - i\ \sinh y$ is analytic.

12. If $z\ =\ x+iy$, Prove i) $\cos\ z = \cos\ x \cosh y - i \sin x \sinh y$ ii) $\sin\ z = \sin\ x \cosh y + i \sinh y\ \cosh x$

13. State and prove Green's theorem in a plane.

14. Find the Fourier cosine series of f(x) = 1 for $0 \le x < T/2$ and f(x) = -1 for $-T/2 \le x < 0$.

15. Find the inverse of the matrix $\begin{bmatrix} 7 & 2 & 1 \\ 0 & 3 & -1 \\ -3 & 4 & -2 \end{bmatrix}$.

16. Fit a straight line by the least square method for the following data.

X	0	0.5	1.0	1.5	2.0	2.5
y	0	1.5	3.0	4.5	6.0	7.5

PART – C

Answer any four questions: **(4 x 12.5 = 50 Marks)**

17. (i) State and prove Cauchy's integral theorem.

(ii) (a) Find the real and imaginary part of (i) $f(z) = z^2 + 2\,i\,z^*z$ (ii) Evaluate $\oint z^2 dz$ around a unit circle in complex plane.

18. (i) Verify Gauss divergence theorem for $\iint \left(y^2 z\,\hat{i} + y^3\,\hat{j} + xz\,\hat{k} \right) . d\mathbf{A}$ over the boundary of the cube defined by $-1 \le x \le 1$, $-1 \le y \le 1$ and $0 \le z \le 2$.

(ii) Find the curl of $\dfrac{x\hat{i} + y\hat{j} + z\hat{k}}{\left(x^2+y^2+z^2\right)^{\left(\frac{1}{2}\right)}}$, where $\hat{i}, \hat{j}$ and $\hat{k}$ and ***k*** are u*n*it vectors.

19. Find the eigen values and eigen vectors for the matrix $\begin{pmatrix} 1 & -3 & 3 \\ 3 & -5 & 3 \\ 6 & -6 & 4 \end{pmatrix}$.

20. Find the Fourier series of the function with period 2π defined as $f(x) = \begin{cases} x+\pi, & 0 \le x \le \pi \\ -x-\pi, & -\pi \le x < 0. \end{cases}$

21. (i) Find the Lagrange interpolating polynomial for

x	1	2	3	5
F(x)	0	7	26	124

Hence find F(4).

(ii) Solve $\frac{\partial y}{\partial x} = y + x$ with y(0) = 1 for the step size h=0.2 to find y(0.2) and y(0.4)

22. Solve the following equations by Gauss-Siedel iteration method

$$4x + 2y + z = 14$$
$$x + 5y - z = 10$$
$$x + y + 8z = 20.$$

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