LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – **NOVEMBER 2017**

PH 3506– MATHEMATICAL PHYSICS

Date: 04-11-2017 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART – A

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

1. Is $f(z) = \sin z$ an analytic function?
2. Express $f(z) = \frac{1}{3+4i}$ in the form of a+ib
3. Define symmetric and antisymmetric matrices.
4. Prove that the eigenvalues of a Hermitian matrix are real.
5. Check whether $\vec{A} = \overrightarrow{12i} + \overrightarrow{4j} - \overrightarrow{6k}$ and $\overrightarrow{B} = \overrightarrow{6i} + \overrightarrow{2j} - \overrightarrow{3k}$ are parallel or perpendicular.
6. Define a periodic function with an example.
7. Write down Simpson's one third rule.
8. Define the gradient of a scalar function.
9. Define odd and even functions and give one example each.
10. Write the algorithm of Euler's method.

PART – B

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

11. Solve the equations using matrices

4x+2y+z+3u=0; 6x+3y+4z+7u=0; 2x+y+u=0.

12. a) State and prove Cauchy's Integral Theorem. **(5)**

b) Using Cauchy's Integral Formula, evaluate $\oint_c \frac{2z^2 + z}{z-1} dz; [z] = 7.$ **(2.5)**

13. If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ Show that (i) curl $\vec{r} = 0$ (ii) curl $(\vec{r} / r^3) = 0$. **(4+3.5)**

14. Find the solution of dy/dx = x+y from x=0 to 0.2 by Euler's method.

15. Prove that div curl A = 0; curl grad φ = 0. **(4+3.5)**

16. Obtain a Fourier series for $f(x) = e^x$ $-\pi < x < \pi$.

PART – C

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

17 Find the eigenvalues and the normalized eigenvectors of A = $\begin{pmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{pmatrix}$.

18. Derive the trapezoidal rule. Use trapezoidal and simpson's one third rule to evaluate the approximate

value of $\int_0^1 dx(1+x)$ corrected to 3 decimal places taking h=0.25 **(4.5+4+4)**

19. Derive the Cauchy - Riemann equations in polar form. (6.5 + 6)

20. State and prove Gauss Divergence theorem. Using it evaluate

$\iint (x^3\, dy\, dz + y^3\, dz\, dx + z^3\, dy\, dx)$ Over the surface of the sphere S of radius. **(6.5+6)**

21. Find the Fourier series expansion of the periodic function having period 2π where

$f(x) = x^2 \quad -\pi \leq x \leq \pi$. Hence find the sum of the series $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots$

22 Verify Cayley Hamilton theorem for the matrix A = $\begin{pmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & 1 \end{pmatrix}$.

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