M.Sc. DEGREE EXAMINATION,NOVEMBER 2019
I Year I Semester
Mathematical Physics

Time : 3 Hours **Max.marks :75**

Section A $(10 \times 2 = 20)$ Marks

Answer any **TEN** questions

1. Define orthonormal basis.
2. What are eigen values and eigen functions of a matrix?
3. State symmetry property of Green's function.
4. State any two properties of Dirac delta function.
5. Find the singularities of the function $\mathbf{f}\left(\mathbf{z}\right)=\frac{\mathbf{1}}{\mathbf{s}in\frac{\pi}{\mathbf{z}}}$.
6. Express the Taylor series expansion of a function $\mathbf{f}\left(\mathbf{z}\right)$ with centre at $\mathbf{Z}=\mathbf{Z_0}$.
7. State Cauchy's integral formula.
8. Find the Laplace transform of $\mathbf{e}^{-\mathbf{a}t}$.
9. What is a subgroup?
10. What are homomorphism and isomorphism of groups?
11. What is unitary operator?
12. Write the formula for infinite Fourier sine and cosine transforms?

Section B $(5 \times 5 = 25)$ Marks

Answer any **FIVE** questions

13. State and prove Schwartz inequality.
14. Explain one dimensional Green function.
15. Obtain the Cauchy-Riemann conditions for the function $\mathbf{f}\left(\mathbf{z}\right)=\mathbf{u}+\mathbf{i}v$ to be analytic, in a domain, *u* and *v* being functions of *x* and *y*.
16. State and prove convolution theorem for Fourier transform.
17. Construct a character table for C_{3v} point group.
18. What is Hermitian matrix? Show that the matrix $\begin{pmatrix} \mathbf{1} & \mathbf{i} & \mathbf{0} \\ -\mathbf{i} & \mathbf{0} & -\mathbf{2i} \\ \mathbf{0} & \mathbf{2i} & \mathbf{0} \end{pmatrix}$ is Hermitian matrix.
19. Expand $\mathbf{f}\left(\mathbf{z}\right)=\frac{\mathbf{1}}{(\mathbf{z}+\mathbf{1})(\mathbf{z}+\mathbf{3})}$ as a Laurent's series valid for $\mathbf{1}<\left|\mathbf{z}\right|<\mathbf{3}$.

Section C $(3 \times 10 = 30)$ Marks

Answer any **THREE** questions

20. Describe the Gram Schmidt orthogonalisation procedure of constructing an orthogonal set of vectors from a non-orthogonal set of vectors.
21. Show that $\int_{-1}^{+1} \mathbf{P_m}(\mathbf{x})\, \mathbf{P_n}(\mathbf{x})\, \mathbf{d}x = \left[\begin{array}{cc} \mathbf{0} & \mathbf{m} \neq \mathbf{n} \\ \frac{\mathbf{2}}{\mathbf{2n+1}} & \mathbf{m=n} \end{array} \right.$
22. Using Laplace transform method solve the following equation
$\frac{\mathbf{d^2x}}{\mathbf{dy^2}} - \mathbf{2}\frac{\mathbf{d}y}{\mathbf{d}x} + \mathbf{2x} = \mathbf{0};\,;\; \mathbf{x_0} = \mathbf{x_1} = \mathbf{1}$
23. i) State and prove Cauchy's Residue theorem.

    ii) Find the residue of the function $\frac{\mathbf{1}}{(\mathbf{z^2+1})^{\mathbf{2}}}$ at its poles.
24. State and prove great orthogonality theorem.

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