QC-5321

M. Sc. (Sem.-I) Examination,
December - 2023

PHYSICS

PAPER – PHY - 1001

Mathematical Methods in Physics

Time allowed : **Three Hours**

Maximum Marks : **70**
Min. Marks : **28**

*Note : This question paper contains **two** sections as under :*

Section-A ***Max. Marks-20***

This section will have 10 questions, having 02 question from each unit with no internal choice. Answer in about 20 words. All questions carry equal marks. (10×02=20)

Section-B ***Max. Marks-50***

This section contains 10 questions, having 02 questions from each unit. one question to be attempted from each unit. Words limit approximately 400-500 words. Questions may have sub divisions. All questions will have equal marks. (10×05=50)

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SECTION – A

1 (i) Define analytic function and write Cauchy-Rieman equations.

2

(ii) Calculate the residue of the following function :

$$f(z)=\frac{1}{\left(z^2-1\right)^2}.$$

2

(iii) What do you understand by Fourier integral for odd and even function. Also write the complex form on it.

2

(iv) If $g(w)$ is the Fourier transform of $f(t)$ then calculate the Fourier transform of the complex conjugate of $f(t)$.

2

(v) Calculate the Laplace transform of $f(t)=e^{at}\cos bt$ where a and b are any constant.

2

(vi) Calculate the inverse Laplace transform of $f(s)=\frac{s^2+2s-3}{s(s-3)(s+2)}$.

2

(vii) If 0.333 is the approximate value of (1/3) then calculate absolute, relative and percentage errors.

2

(viii) Solve the following differential equation :

$$\frac{d^2y}{dx^2}+y=2x;\ y(0)=-1,\ y'(0)=8.$$

2

(ix) Write a short note on Bisection method.

2

(x) What do you understand by Caley Hamilton theorem?

2

SECTION – B

UNIT - I

2 (a) State and derive Cauchy's integral theorem.

5

(b) Compute the launent series for the function $f(z)=\frac{z}{\left(z^2+1\right)}$ around $z_0=i$. Give the region where the function in valid. Also determine the principal part of the largest series.

5

OR

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3 Calculate the value of the following integrals :

(a) $\int_{o}^{2h} \frac{d\theta}{m+n\cos\theta}$ for $m > n > o$.

(b) $\int_{o}^{\infty} \frac{dx}{(x^2+1)(x^2+9)}$.

5+5

UNIT - II

4 (a) Calculate the Fourier series on the following function :

$$V(x) = \begin{cases} o & -\pi < x < o \\ V_o \sin x & o < x < \pi \end{cases}$$

5

(b) If $f(t)$ is the Fourier transform of $f(x)$ then calculate the Fourier transform of $\frac{df(x)}{dx}$.

5

OR

5 (a) Define convolution theorem in Fourier transform and discuss its physical significance.

5

(b) Calculate the Fourier transform of

$f(t) = e^{-|t|}$

5

UNIT - III

6 (a) Define Laplace transform and discuss its any three properties.

5

(b) Calculate the Laplace transform

(i) $f(t) = \frac{\sin at}{t}$

(ii) $f(t) = t^n$.

3+2

OR

7 (a) Solve the following differential equation using Laplace transform :

$\frac{d^2x}{dt^2} - 2\frac{dx}{dt} + 2x = 0$

with $x(t=0) = x'(t=0) = 1$.

5

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(b) Calculate the Laplace transform of :

$$f(t)=\begin{cases}\sin wt & 0<t<\pi/w \\ 0 & \pi/w<t<2\pi/w\end{cases}$$

5

UNIT - IV

8 (a) Calculate the value of integral $I=\int_0^1 \frac{dx}{1+x}$ using Trapezoidal and Simpson's rules.

5

(b) Write a note on the physical significance of error.

5

OR

9 (a) Calculate $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at $x = 1.1$ using

x	1.0	1.1	1.2	1.3	1.4	1.5	1.6
y	7.989	8.403	8.781	9.129	9.451	9.750	10.031

5

(b) Given $\frac{dy}{dx}=y-x$; where $y(0)=2$.

Calculate $y(0.1)$ and $y(0.2)$ using Runga - Kulta fourth other formula.

5

UNIT - V

10 (a) Apply Newton - Raphson method to solve :

$x^2+y^2=13$ and $x^2-y^2=3$.

5

(b) Write a note on the physical significance of curve fitting.

5

OR

11 (a) Solve the following system of equation :

$2x+y+z=10;\ 3x+2y+3z=18;\ x+4y+9z=16$

5

(b) Calculate the eigen values and eigen vectors of the matrix :

$$A=\begin{vmatrix}5 & 0 & 1\\ 0 & -2 & 0\\ 1 & 0 & 5\end{vmatrix}$$

5