B.Sc. Semester-III Examination, 2022-23

PHYSICS [Honours]

Course ID : 32411 **Course Code : SH/PHS/301/C-5**

Course Title : Mathematical Physics-II

Time : 1 Hour 15 Minutes Full Marks : 25

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

UNIT-I

1. Answer any **five** of the following questions: 1×5=5

a) What is variance?

b) Define Hermitian matrices.

c) State Cauchy's theorem.

d) What is generalized momenta?

e) Define unitary matrices.

f) Discuss the nature of singularity of the function $f(z)=\frac{1-\cosh z}{z^2}$ at z=0.

g) Define similarity transformation.

h) What do you mean by a symmetric and a skew-symmetric matrix?

UNIT-II

2. Answer any **two** of the following questions: 5×2=10

a) Is the limit $\lim_{z\to 0}\frac{\mathrm{Re}(z^2)+lm(z^2)}{z^2}$ exists? 5

b) There are on average 20 buses per hour at a point but at random times. What is the probability that there are no buses in five minutes? 5

c) i) Prove that $\frac{(1+\sqrt{3}i)^{10}}{(1-\sqrt{3}i)^{10}}=-\frac{1}{2}+\frac{\sqrt{3}}{2}i$.

ii) Find the roots of $(-1+i)^{\frac{1}{3}}$. 2+3

d) Evaluate the integral $I=\oint\frac{\sin z}{2z-\pi}dz$ over the circle |z|=2. 5

UNIT-III

3. Answer any **one** of the following question: 10×1=10

a) i) A particle of mass m moves in one dimension such that it has the Lagrangian $L=\frac{m^2\dot{x}^4}{12}+m\dot{x}^2V(x)-V^2(x)$.

ii) Find the eigen values and the corresponding eigen vectors for the matrix $A=\begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$. 4+6

b) Find the residue of $f(z)=\frac{z}{(z^2+1)^2}$ at z =i. Find $I=\int_0^{2\pi}\frac{d\theta}{5+4\cos\theta}$ using residue theorem. 3+7

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