B.Sc. 3rd Semester(Honours) Examinations, 2020-21

PHYSICS

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

Course Title: Mathematical physics - II

Time: 1hour15 minutes   **Full Marks: 25**

The figures in the margin indicate full marks

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

Section - I

1. **Answer** *any five* **of the following questions:** $(1 \times 5 = 5)$

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

b) Write down Cauchy's Integral Theorem.

c) Justify the matrix A $= \begin{bmatrix} 3 & 4-i & -2 \\ 4+i & 3 & i \\ -2 & -i & 0 \end{bmatrix}$ is Hermitian or not.

d) Prove that, $\frac{1}{\sqrt{3}}\begin{bmatrix} 1 & 1+i \\ 1-i & -1 \end{bmatrix}$ is unitary

e) What is the value of integral $\int_{-\infty}^{\infty} x\delta(x-4)dx$?

f) Write down Hamilton's canonical equations.
g) What is similarity transformation?

h) From a pack of 52 cards, one is drawn at random. Find the probability of   getting a king.

Section - II

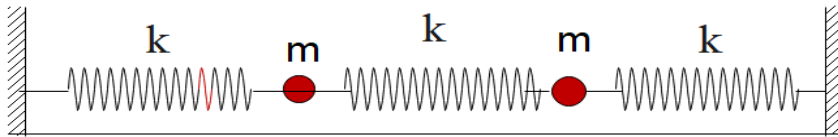**Answer *any two* of the following questions:**   **(5×2 = 10)**

2. Show that the function $u(x, y) = 4xy - 3x + 2$ is harmonic. Construct the corresponding analytic function $f(z) = u(x, y) + iv(x, y)$ (2+3=5)

3. a) If A = $\begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$, Find A^{-1}

b) Show that the matrix $\frac{1}{\sqrt{2}}\begin{bmatrix} 1 & i \\ -i & -1 \end{bmatrix}$ is unitary.   (3 +2=5)

4.

Consider the system shown in figure which two equal masses m are connected by springs having spring constant k and the masses are free to slide on a frictionless plane and the end of the spring are connected in the wall.

Find the Lagrangian of the system and hence equation of motion   (3+2=5)

5. a) Explain Binomial theorem of probability.

b) In a office of 25 people, 3 people live within 5 kms. of the office, 15 between 5-10 kms and   the rest beyond 10 kms.

i) what is the probability that a person works beyond 10 kms of the office?

ii) what is the probability that a person works within 10 kms of the office?

iii) what is the probability that a person works within 5 kms of the office?

                    (2+3=5)

Please Turn Over

Section - III

Answer *any one* of the following questions: **(10×1=10)**

6. a) Evaluate $\oint \dfrac{dz}{z-a}$ over any simple closed curve C, for z = a, inside and outside C.

b) State the residue theorem.

c) show that $\int_0^{2\pi} \dfrac{\cos 3\theta}{5-4\cos\theta}d\theta = \dfrac{5}{12}$ (3+1+6=10)

7.a) Given the Lagrangian L=$\dfrac{1}{2}m(\dot{r}^2 + r^2\dot{\theta}^2) - V(r)$. Find the Hamiltonian and hence the equation of motion ; symbols have their usual meaning.

b) Find the eigen value and eigen vector of the matrix $A = \begin{bmatrix} 2 & -2 & 0 \\ -2 & 1 & -2 \\ 0 & -2 & 0 \end{bmatrix}$

                          (2+2+6=10)

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