B.Sc. Semester I (Honours) Examination, 2021 (CBCS)

Subject: Physics

Paper: CC- I (Mathematical Physics - I)

Time: 2 Hours **Full Marks: 40**

The questions are of equal value. Candidates are required to give their answers in their own words as far as practicable. *You must define all the symbols you use.*

Answer any **eight** questions: 5x8=40

1. Find by double integration, the area lying inside the circle r = a$\sin\theta$ and outside the cardioid r = a(1 – $\cos\theta$)
2. A fluid motion is given by $\vec{v}$ = (y sinz – sinx)**i** + (xsinz + 2yz)**j** + (xycosz + y^2)**k.** Is the motion irrotational? If so, find the velocity potential.
3. State Green's theorem in a plane. A vector field $\vec{F}$ = (siny)**i** + x(1 + cosy)**j** . Evaluate the line integral $\int \vec{F}\,.\overrightarrow{dr}$ using Green's theorem round C where C in the curve defined by : $x^2 + y^2 = a^2$
4. Show that in spherical polar co-ordinates $(x\frac{\partial}{\partial y} - y\frac{\partial}{\partial x}) = \frac{\partial}{\partial \varphi}$
5. Determine $\vec{\nabla}.\vec{A}$ in curvilinear co-ordinate system. Hence write the expression in cylindrical co-ordinates.
6. Solve the equation: $\frac{dy}{dx} = \frac{y}{2y\,logy + y - x}$
7. A body executes forced vibration given by the equation:
   $D^2x + 2kDx + b^2x = e^{-kt}\sin \omega t$ where D = $\frac{d}{dt}$. Determine the displacement of the particle for the cases i) $\omega^2 \neq b^2 - k^2$ and ii) $\omega^2 = b^2 - k^2$.
8. What will be the shape of the curve of a given perimeter enclosing the maximum area? Given $ds = (1 + y_1^2)^{1/2}\,dx$ and $y_1 = dy/dx$
9. a) Prove that the function f(x) = $\frac{1}{\sigma\sqrt{2\pi}}$ exp $(\frac{-x^2}{2\sigma^2})$ in the limit σ tending to zero can represent a delta function (σ is positive)

   b) Prove that $\int_{-\infty}^{\infty} \delta(x - a)\delta(x - b)dx = \delta(a - b)$

10. a) An insurance company found that only 0.01% of the population faces an accident each year. If 1000 policy holders are randomly selected what will be the probability that not more than two of its clients will face the accident? $(e^{-0.1} = 0.9048)$

    b) Calculate Variance(x) considering normal/Gaussian distribution.