B.Sc. 1st Semester (Honours) Examination, 2019 (CBCS)

Subject : Physics

Paper : CC-I

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

The figures in the margin indicate full marks.

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

Group – A

Answer *any five* questions. 2×5=10

1. (a) Plot the graph $y = x^2 - 4x - 5$.

(b) Find the Taylor series expansion of $\sin x$ about $\pi/2$.

(c) Find the approximate value of $\sqrt{10}$.

(d) Solve the differential equation : $\frac{dy}{dx} + y = (e)^{e^x}$.

(e) Find the angle between the two surfaces:

$x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at $(2, -1, 2)$.

(f) For a second order differential equation one of the solutions is x and Wronskian is $(x-1)e^x$. Determine the other solution.

(g) Prove that ∇^2 operator is invariant under rotation of axes.

(h) From bio-nominal distribution determine the value of $\langle x \rangle$.

Group - B

Answer *any two* questions. 5×2=10

2. (a) Determine the degree and order of the differential equation: $(e)^{\frac{dy}{dx}} = 1 + x$.

(b) Determine the differential equation whose solution is $y = ae^x + be^{3x}$. 1+4=5

3. (a) Using cylindrical co-ordinates evaluate $\iiint_V \sqrt{x^2 + y^2}\, dxdydz$ where V is the volume bounded by $z = x^2 + y^2$ and $z = 8 - (x^2 + y^2)$.

(b) The force $\vec{F} = r^2\vec{r}$ is conservative. Obtain the potential ϕ associated with this force.

2½+2½=5

460

4. (a) Express $z\hat{\underline{\imath}} - 2x\hat{\jmath} + y\hat{k}$ in cylindrical co-ordinates.

(b) If ρ, φ, z are the three cylindrical co-ordinates show that $\vec{\nabla} \log \rho$ and $\vec{\nabla} \varphi$ are solenoidal vectors. 3+2=5

5. (a) For a Dirac delta function prove that $\delta(x^2 - a^2) = \frac{1}{|2a|}[\delta(x+a) + \delta(x-a)]$.

(b) A rectangular function is defined as $y = k$ for $-a \leq x \leq a$. Under what conditions the function can be a delta function?

(c) Prove for a delta function: $\int_{-\infty}^{\infty} f(t)\delta'(t-a)\, dt = -f'(a)$. 2+2+1=5

Group - C

Answer *any two* questions. 10×2=20

6. (a) Solve the differential equation: $(D^2 + 2D + 1)y = e^{-x}(\log x)$ where $D = \frac{d}{dx}$.

(b) A land can support maximum population, L_m. The initial population was L_o. Considering the growth of population to be proportional to the population at any instant and the difference from the maximum, set up the differential equation and solve it. Also show the graphical variation of population with time. 4+5+1=10

7. (a) Find the directional derivative of $f(x) = e^x cosy$ at $(2, \pi, 0)$ along the vector $\vec{A} = 2\hat{\underline{\imath}} + 3\hat{\underline{\jmath}}$.

(b) State Green's theorem in a plane. Evaluate $\int_c \vec{F} \cdot d\vec{r}$ using Green's theorem where $\vec{F} = -y^3\hat{\underline{\imath}} + x^3\hat{\underline{\jmath}}$ and c is the circle $x^2 + y^2 = a^2$. 3+(2+5)=10

8. (a) Determine the expression of $\vec{\nabla} \cdot \vec{A}$ in curvilinear co-ordinates where $\vec{A} = \hat{e}_1 A_1 + \hat{e}_2 A_2 + \hat{e}_3 A_3$.

(b) Find the volume of the greatest rectangular parallelepiped that can be inscribed in the ellipsoid: $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$. 5+5=10

9. (a) Under what conditions Poisson distribution is applicable? Derive Poisson distribution formula from bio-nominal distribution.

(b) The probability of a bad reaction from a certain injection is 0·001. Determine the chance that out of 2000 individuals, more than two will get a bad reaction.

(c) In a bolt factory, machines M_1, M_2 and M_3 manufacture respectively 25%, 35% and 40% of total product. Of their outputs 5%, 4% and 2% are defective. One bolt is selected at random. Determine the probability that it was manufactured by machine M_3. (1+3)+3+3=10
