[This paper contains 3 printed pages]

Your Roll Number : .....

S.No. of Question Paper : 3365

a) Name of Course : B.Sc. Hons.–(Physics)_CBCS-LOCF

b) Semester : I- Semester (Repeat Paper)

c) Name of the Paper: Mathematical Physics-I

d) Unique Paper Code : 32221101

Duration: 3 Hours Maximum Marks: 75

Instructions

(a) Write your Roll No on the top immediately on receipt of this question paper.

(b) Question No. 1 is compulsory

(c) Attempt four more questions out of the rest.

(d) Non programmable scientific calculator is allowed.

Q 1 Do any five of the following: $5 \times 3 = 15$

(a) Determine the order, degree and linearity of the following differential equation

$$2x\frac{d^2y}{dx^2} + x^2\left(\frac{dy}{dx}\right) - (Sinx)y = 0$$

b) Define polar and axial vectors. Give one example of each.

c) Show that the area bounded by a simple closed curve C is given by $\frac{1}{2}\oint(xdy - ydx)$.

d) Determine the constant a so that the vector $\vec{A} = (x + 3y)\hat{i} + (y - 2z)\hat{j} + (x + az)\hat{k}$ is solenoidal.

(e) Consider the Binomial distribution B(n, p). Show that

$$\frac{P(k)}{P(k-1)} = \frac{(n-k+1)\,p}{k\,q}$$

(f) If X has a Poisson distribution such that

P (X = 1) = P (X = 2),

Find P (X = 5).

Q 2 (a) For an electric circuit with circuit constants L, R, C the charge q on the plate of the condenser is given by

$$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{C} = 0.$$

Find q at any time t. (8)

(b) Solve the following equation

$$x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + 4y = \cos\ln x + x\sin\ln x \quad (7)$$

Q 3. Solve the following differential equation

(a) $t^2\frac{d^2y}{dt^2} - 3t\frac{dy}{dt} + 5y = t\,log(t)$ (8)

(b) $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 2y = \sinh x$ (7)

Q 4. a) If $\vec{A} = (3x^2 + 6y)\hat{i} - 14\,yz\,\hat{j} + 20x\,z^2\hat{k}$, evaluate $\int_c \vec{A}.d\vec{r}$ from (0,0,0) to

(1,1,1) along the following paths c:

(i) $x = t, y = t^2, z = t^3$.

(ii) The straight line joining (0,0,0) and (1,1,1). (8)

b) Verify Green's theorem in the plane for $\oint_c (xy + y^2)\,dx + x^2\,dy$ where c is the closed curve of the region bounded by $y = x$ and $y = x^2$. (7)

Q 5. (a) Show that $\vec{F} = (2xy + z^3)\hat{i} + x^2\,\hat{j} + 3x\,z^2\hat{k}$ is a conservative force field. (b) Find the scalar potential. (7)

(b) Define the cylindrical coordinate system. Prove that this system is orthogonal. (8)

Q 6. (a) Show that in a Poisson distribution with unit mean, mean deviation about mean is (2/e) times the standard deviation . (5)

(b) Show that in a Binomial distribution B (n, p)

Mean = np and Variance = npq (6)

(a) Evaluate $\iint_S \vec{F}.n\,dS$, where $\vec{F} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$ and S is the surface of the cube bounded by x=0, x =1,y = 0, y = 1, z = 0, z =1. (4)