Name of the Department	:	Physics
Name of the Course	:	B. Sc. (H) Physics – CBCS – NC - Core
Semester	:	I
Name of the Paper	:	Mathematical Physics I
Unique Paper Code	:	32221101
Question Paper Set Number	:	A
Maximum Marks	:	75

Instruction for Candidates

1. Attempt **FOUR** questions in all.
2. All questions carry equal marks.

1. Solve the following first order differential equations

   a. $(2x+3y)dx+(y-x)dy=0$
   b. $(x-2)\frac{dy}{dx}=y+2(x-2)^3$
   c. $(x^2+y^2)dy-xy\,dx=0$
   d. A machine produces 1% defective components. If the random variable X is the number of defective components in production of 50 components, then find the probabilities that X takes the value 2.

2. Solve the following second order differential equations

   a. $(D^2-5D+6)y=e^x$
   b. $(D^2-3D+2)y=\sin 2x$
   c. $(D^2+16)y=\sin x$ (Use the method of variation of parameters)

3. Find the constants a and b so that the surface $ax^2-byz=(a+2)x$ will be orthogonal to the surface $4x^2y+z^3=4$ at the point $(1,-1,2)$.
Show that $\vec{E}=\frac{\vec{r}}{r^2}$ is irrotational. Find ϕ such that $\vec{E}=-\nabla\phi$ and such that $\phi(a)=0$ where a>0.

4. Is there a differentiable vector function $\vec{V}$ such that,

$$\nabla\times\vec{V}=\vec{r}$$
$$\nabla\times\vec{V}=2\hat{\imath}+\hat{\jmath}+3\hat{k}$$

If yes, then find $\vec{V}$.
Find the value of $\nabla^2\ln r$

5. Verify Green's theorem in the plane for $\oint(y-\sin x)\,dx+\cos x\,dy$, where C is the triangle formed by points (0, 0), $(\frac{\pi}{2}, 0)$ and $(\frac{\pi}{2}, 1)$.

$$\iiint_V \frac{dV}{r^2}=\iint_S \frac{\vec{r}\circ\hat{n}}{r^2}dS$$

6. Derive an expression for $\nabla\times\vec{A}$ in orthogonal curvilinear coordinates.
Evaluate $\iint \vec{A}.\hat{n}\ dS$, where $\vec{A}=z\hat{\imath}+x\hat{\jmath}-3y^2z\hat{k}$ and S is the surface of the cylinder $x^2+y^2=16$ included in the first octant between $z=0$ to $z=5$.