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

Time Duration: 3 hours

Instruction for Candidates

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

1. Solve the following first order differential equations

a. $\left(1+y^2\right)dx+\left(x-e^{-\tan^{-1}y}\right)dy=0$

b. $y\,dx+\left(x-2x^2y^3\right)dy=0$

c. $\left(y+y\cos xy\right)dx+\left(x+x\cos xy\right)dy=0$

2. Solve the following second order differential equations

a. $\frac{d^2y}{dx^2}+4y=\cos 2x$

b. $\frac{d^2y}{dx^2}-2\frac{dy}{dx}+4y=e^x\cos x$

c. $\frac{d^2y}{dx^2}+y=2\cos x$

3. Find the work done in moving an object along a straight line from $(3,2,-1)$ to $(2,-1,4)$ in a force field given by, $\vec{F}=4\hat{i}-3\hat{j}+2\hat{k}$

Show that $\vec{r}\,r^{-2}$ is irrotational.

It is given that $\phi=8x^4yz^3$. Evaluate $\vec{\nabla}\circ\vec{\nabla}\phi$

4. Suppose S is any closed surface enclosing a volume V and $\vec{A}=ax\hat{i}+by\hat{j}+cz\hat{k}$. Show that $\iint_S \vec{A}.\hat{n}\,dS=(a+b+c)V$

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

5. Show that $\vec{F}=r^2\vec{r}$ is a conservative vector field. Find a scalar function ϕ such that $\vec{F}=\vec{\nabla}\phi$.

   Verify the Stokes' theorem for $\vec{A}=(y-z+2)\hat{i}+(yz+4)\hat{j}-xz\hat{k}$ and for the surface of the cube $x=0, y=0, z=0, x=2, y=2, z=2$ above the xy-plane.

6. Obtain the expression for divergence of a vector field in orthogonal curvilinear coordinates and express it in cylindrical coordinates. Transform $\vec{A}=\frac{x}{y}\hat{i}$ to cylindrical coordinates.

   Prove that $\delta(x^2-a^2)=\frac{1}{2\vee a\vee ¿\{\delta(x-a)+\delta(x+a)\}¿}$

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