2020

PHYSICS (Honours)

Paper : PHYH - DC- 1T

[CBCS]

Full Marks : 25 Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer any *five* questions : 2×5=10

(a) Define scalar field and vector field. Give example of each.

(b) If a vector field is given by $\vec{F} = \left(x^2 + y^2 + x\right)\hat{i} - \left(2xy + y\right)\hat{j}$. Is this field irrotational ?

(c) If $\vec{r} = t\hat{i} - t^2\hat{j} + \left(t-1\right)\hat{k}$ and $\vec{S} = 2t^2\hat{i} + 6t\hat{k}$, evaluate $\int_0^2 \vec{r}\cdot\vec{S}\,dt$

(d) With the help of divergence theorem, show that $\int\left(\vec{\nabla}\phi \times \vec{\nabla}\psi\right)\cdot d\vec{s} = 0$

(e) Find the value λ, for the differential equation $\left(xy^2 + \lambda x^2 y\right)dx + \left(x+y\right)x^2 dy = 0$ is exact.

(f) Evaluate the integral $I = \int_0^\infty e^{-31}\delta\left(t-4\right)dt$

(g) Solve the following differential equation $\frac{d^5y}{dx^5} - \frac{d^3y}{dx^3} = 0$

(h) Find the unit normal to the surface $xy^3z^2 = 4$ at (–1,–1,2)

2. Answer any *three* questions : 5×3=15

(a) Use the Divergence Theorem, evaluate $\iint F.dS$ where $F = 4xi - 2y^2j + z^2k$ and S is the surface bounding the region $x^2 + y^2 = 4,\ z = 0$ and $z = 3$. 5

(b) Prove that the spherical polar coordinate system is orthogonal. 5

(c) Evaluate $\iiint (2x + y)dV$, where V is closed region bounded by the cylinder $z = 4 - x^2$ and the planes $x = 0, y = 0, y = 2$ and $z = 0$. 5

(d) Solve : $\cos^2 x \frac{dy}{dx} + y = \tan x$ 5

(e) Solve $(D^2 - 6D + 9) = 6e^{3x} + 7e^{-2x} - \log^2$ 5