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1 SEM TDC PHYH (CBCS) C 1

2023

(November)

PHYSICS

(Core)

Paper : C–1

(Mathematical Physics—I)

Full Marks : 53
Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer : 1×5=5

(a) The volume of parallelopiped formed by $\vec{A}$, $\vec{B}$ and $\vec{C}$ is

(i) $\vec{A} \times (\vec{B} \cdot \vec{C})$

(ii) $\vec{A} \cdot (\vec{B} \times \vec{C})$

(iii) $\vec{A} \cdot (\vec{B} \cdot \vec{C})$

(iv) $\vec{A} \times (\vec{B} \times \vec{C})$

(b) For a conservative laminar field

(i) $\oint \vec{E} \cdot \overrightarrow{dl} = El$

(ii) $\oint \vec{E} \cdot \overrightarrow{dl} = l$

(iii) $\oint \vec{E} \cdot \overrightarrow{dl} = 0$

(iv) $\oint \vec{E} \cdot \overrightarrow{dl} = Edl\cos\theta$

(c) The order and degree of the differential equation

$$\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 + 3y = 0$$

is

(i) order 2, degree 2

(ii) order 2, degree 1

(iii) order 1, degree 2

(iv) order 3, degree 2

(d) The curvilinear coordinates are denoted by

(i) (x, y, z) (ii) (a, b, c)

(iii) (u, v, w) (iv) (p, q, r)

(e) The maximum probability for occurrence of an event is

(i) 0

(ii) 1

(iii) ∞

(iv) None of the above

(Continued)

2. Solve the following differential equation : 5

$$\frac{dy}{dx} = \frac{6x+2y-7}{3x+y-6}$$

3. Solve the following linear differential equation : 5

$$\frac{dy}{dx} + \frac{y}{x} = 10x$$

4. Find the partial differentiation $\frac{\partial^2 f}{\partial x^2}$ and $\frac{\partial^2 f}{\partial y^2}$ for the following function : 2½+2½=5

$$f(x, y) = 2x^3 - x^2y^6$$

5. (a) What are linear and nonlinear ordinary differential equations? Give examples.

(b) Solve :

$$\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{\sqrt{1-x^2}}$$ 3+3=6

6. (a) If $\phi = 3x^2y - y^3z^2$, then find grad ϕ at the point $(1, -2, -1)$.

(b) Define solenoidal and irrotational vectors. 4+2=6

(Turn Over)

7. Prove that

$$(\vec{A}\times\vec{B})\times\vec{C}=\vec{A}\times(\vec{B}\times\vec{C})$$

if $(\vec{C}\times\vec{A})\times\vec{B}=0$. 4

8. *(a)* Find $\vec{\nabla}\phi$ at the point $(-1, -2, 1)$, where $\phi = x^2y + xz$.

(b) Show that $\vec{\nabla}\cdot\log\vec{r}=\frac{\vec{r}}{r^2}$, where $\vec{r}=\hat{i}x+\hat{j}y+\hat{k}z$. 2+2=4

9. State and prove Stokes' theorem. 5

Or

State and prove Gauss' divergence theorem.

10. What are curvilinear coordinates? Write down the expression for Laplacian in spherical and cylindrical coordinates. 2+2=4

11. Under what conditions can Poisson's probability distributions be used? Write down the probability distribution function for Poisson's distribution. 1+1=2

12. Discuss Dirac delta function with its definition and properties. 2

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