Seat Number

PHYSICS PAPER-II : PHY-122
Theoretical Physics
(112202)

P. Pages : 4

Time : Two Hours

Max. Marks : 60

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Graph or diagram should be drawn with the black ink pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory and carry equal marks.
5. Figures to the right indicating full marks.
6. Draw neat and labeled diagram wherever necessary.
7. use of log table or standard calculator (electronic) is allowed.

1. a) Attempt **any six** select correct option and rewrite the following. **6**

i) The value of $i^3 + i^4$ is

a) i b) -i
c) 1+i d) 1-i

ii) The real part of complex acceleration is given by

a) $r\omega^2$ b) $-r\omega^2$
c) $r^2\omega$ d) $-r^2\omega$

iii) $\frac{\partial^2 F}{\partial x \partial y} =$ ----------.

a) F_{xy} b) F_{xx}
c) F_{yx} d) F_{yy}

iv) The differential equation $y'' - 2xy' + \ell(\ell+1)y = 0$ is

a) Inhomogeneous b) Non linear
c) Homogeneous and linear d) Inhomogeneous

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

a) $(\vec{A} \cdot \vec{C})\vec{B} - \vec{C}(\vec{A} \cdot \vec{B})$ b) $(\vec{A} \cdot \vec{C})\vec{B} + \vec{C}(\vec{A} \cdot \vec{B})$

c) $(\vec{A} \times \vec{C})\vec{B} - \vec{C}(\vec{A} \times \vec{B})$ d) $(\vec{A} \times \vec{C})\vec{B} + \vec{C}(\vec{A} \times \vec{B})$

vi) $\hat{i} \times \hat{j} =$ ----------.

a) 0 b) 1

c) $\hat{k}$ d) $-\hat{k}$

vii) $\frac{d}{dt}(\vec{A} \times \vec{B}) =$ ----------.

a) $\vec{A}\frac{dB}{dt} + \vec{B}\frac{d\vec{A}}{dt}$ b) $\vec{A} \times \frac{d\vec{B}}{dt} + \frac{d\vec{A}}{dt} \times \vec{B}$

c) $\frac{d\vec{B}}{dt} \times \vec{A} + \frac{d\vec{A}}{dt} \times B$ d) $\vec{A} \times \frac{d\vec{B}}{dt} + \vec{B} \times \frac{d\vec{A}}{dt}$

viii) If ϕ is a scalar function, then divergence of ϕ is.

a) $\vec{\nabla} \cdot \phi$ b) $\vec{\nabla} \times \phi$

c) $\vec{\nabla}\phi$ d) Undefined

b) Attempt **any six** of the following. Answer in one sentence. **6**

i) Define equality of complex numbers.

ii) State distributive law of multiplication of complex numbers.

iii) State De-Moivre's theorem.

iv) If F (x, y, z) = 0, state first theorem related to differential equation.

v) Define degree of differential equation.

vi) State vector product of $\vec{A}$ and $\vec{B}$ in determinant form.

vii) If $\vec{A} = \hat{i} - \hat{j} + \hat{K}$, determine $|\vec{A}|$.

viii) Define curl of a vector.

ix) Define line integral of a vector.

2. Attempt **any six** of the following. **12**

i) Find addition of $z_1 = 2+3i$ and $z_2 = 2i+5$.

ii) Find argument of $z = 3+i\sqrt{3}$.

iii) If $F(x,y) = e^{\sin xy}$, find $\frac{\partial F}{\partial Y}$.

iv) Define exact differential.

v) If $F = X^2 - Y^2$ and $x = r\cos\theta;\ y = r\sin\theta$, find $(F_y)_\theta$.

vi) State any two characteristics of scalar product.

vii) If $\vec{A} = 3\hat{i} - \hat{j} + \hat{k}$, determine unit vector along $\vec{A}$.

viii) State physical significance of gradient of scalar.

ix) Divergence of vector field is a scalar. Explain in brief.

3. Attempt **any four** of the following. **12**

i) Explain addition of complex numbers using Argand diagram.

ii) Using $\cos\theta = \frac{e^{i\theta} + e^{-i\theta}}{2}$ and $\sin\theta = \frac{e^{i\theta} - e^{-i\theta}}{2i}$ show that $\sin^2\theta + \cos^2\theta = 1$.

iii) If $U = e^x \cos y$, verify that $\frac{\partial^2 U}{\partial x \partial y} = \frac{\partial^2 U}{\partial y \partial x}$.

iv) Determine volume of parallelepiped whose edges are defined by vectors $\vec{A} = \hat{i} + 2\hat{j} - 3\hat{k};\ \vec{B} = \hat{i} + \hat{k}$ and $\vec{C} = \hat{i} - 2\hat{k}$.

v) If $\vec{A} = x^2z\hat{i} + xy^2z\hat{j} - 3yz^2\hat{k}$, find curl of $\vec{A}$ at point (1, 1, 1).

vi) Determine constant 'p' so that.
$\vec{A} = (x+y)\hat{i} + (y-z)\hat{j} + (x+pz)\hat{k}$ is solenoidal.

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4. Attempt **any three** of the following.

i) Find cube root of unity.

ii) Find z^4 if $z = 1 - i$.

iii) If $x^3 + 3xy^2 - y^3 = 0$ show that $\frac{dy}{dx} = \frac{x^2+y^2}{2xy-y^2}$.

iv) State any four characteristics of scalar product of vectors.

v) Show that $\vec{\nabla}(\vec{a}\cdot\vec{r}) = \vec{a}$, where $\hat{a} = a_1i + a_2j + a_3\hat{k}$ is a constant vector and $\vec{r}$ is a position vector.

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5. Attempt **any two** of the following.

i) What is Argand diagram? Explain multiplication and division of two complex numbers using an Argand diagram.

ii) Define divergence of a vector field. Explain its physical significance.

iii) If $\vec{A} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{B} = \hat{i} + 2\hat{j} - 3\hat{k}$ & $\vec{C} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ find $\vec{A}\cdot(\vec{B}\times\vec{C})$ and $\vec{A}\times(\vec{B}\times\vec{C})$.

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