BACHELOR OF SCIENCE (CBCS-2018 COURSE)
S. Y. B. Sc. Sem-III :SUMMER- 2022
SUBJECT : PHYSICS : MATHEMATICAL METHODS FOR PHYSICS

Day : Tuesday
Date : 5/7/2022

S-18347-2022

Time : 03:00 PM-06:00 PM
Max. Marks : 60

N.B.

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Draw neat labeled diagrams **WHEREVER** necessary.
4) Use of **CALCULATOR** is allowed.

Q.1 Answer any **TWO** of the following: **(12)**

a) Find the directional derivative of the scalar point function $\phi = x^2y + y^2z + z^2x$ at the point (2, 2, 2) in the direction of the normal to the surface $4x^2y + 2z^2 = 2$ at the point (2, 1, 3)

b) Find the scalar and vector product of two vectors $\vec{A}$ and $\vec{B}$ where $\vec{A} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{B} = 4\hat{i} + 2\hat{j} - 3\hat{k}$ Also find the angle between $\vec{A}$ and $\vec{B}$.

c) If $y = e^{-i(\omega t - kx)}$, show that $\frac{\partial^2 y}{\partial x^2} = \frac{k^2}{\omega^2}\frac{\partial^2 y}{\partial t^2}$

Q.2 Answer any **TWO** of the following: **(12)**

a) If $z = \frac{1+\sqrt{3}i}{2}$, evaluate Z^3

b) Find the first and second partial derivatives of the function ,
$F = f(x, y) = 2x^3 y^2 + y^3$

c) Find the projection of vector $\vec{B} = \hat{i} + 5\hat{j} + 3\hat{k}$ on the vector $\vec{A} = 2\hat{i} + 3\hat{j} + 6\hat{k}$

Q.3 Answer any **TWO** of the following: **(12)**

a) If $\vec{A} = 2\hat{i} - 3\hat{j} - \hat{k}$ and $\vec{B} = \hat{i} + 4\hat{j} - 2\hat{k}$. Find
i) $\vec{A}\times\vec{B}$ ii) $\vec{B}\times\vec{A}$ iii) $(\vec{A}+\vec{B})\times(\vec{A}-\vec{B})$

b) Prove that : $\nabla^2\left(\frac{1}{r}\right) = 0$

c) Determine the directional derivative of
$\phi = 4xz - 3xy^2 + zy^2x$ at $(1, -1, 2)$ in the direction of $(\hat{i} - 2\hat{j} + \hat{k})$

P.T.O.

Q.4 Answer any **THREE** of the following: **(12)**

a) Determine unit vector normal to the surface $(x-1)^2 + y^2 + (z+2)^2 = 9$ at the point (3, 1, -4)

b) i) State the degree and order of the differential equations $\frac{d^2y}{dx^2} + \sqrt{\frac{dy}{dx}} + y = 0$

ii) Prove the relation $ln\, i = \left(\frac{\pi}{2} + 2k\pi\right)$ where k = 0, 1 etc.

c) Express the complex number πi into i) the polar form and ii) exponential form. How will you represent it on the argand diagram?

d) Show that the equation $dF = (y^2 - y + 2xy)\,dx + (x^2 - x + 2xy)\,dy$ is an exact differential. Hence determine F.

Q.5 Answer any **FOUR** of the following: **(12)**

a) Show that vector $\vec{P} = 2\hat{i} + 3\hat{j} + \hat{k}$ and $\vec{Q} = 4\hat{i} - 2\hat{j} - 2\hat{k}$ are perpendicular to each other.

b) Prove that $\vec{\nabla} \times \vec{\nabla}\phi = 0$

c) Determine the constant q such that the vector $\vec{V}(3x+y)\hat{i} + (3y-z)\hat{j} + (x+3qz)\hat{k}$ is solenoidal.

d) Find the possible error in computing the parallel resistance r of three resistances r_1, r_2 and r_3 from the formula $\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}$, if r_1, r_2 and r_3 are each in error by 1.2 %.

e) A particle moves from a point (3, -4, -2) m to a point (-2, 3, 5) m under the influence of force $\vec{F} = \left(4\hat{i} + 6\hat{j} + 4\hat{k}\right)N$. Calculate the work done by the force.

f) Using hyperbolic function show that

i) $\sinh(i\theta) = i\sin\theta$ *ii)* $\cosh(i\theta) = \cos\theta$

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