S.Y.B.SC. SEM – III (CBCS - 2016 COURSE) : SUMMER - 2018

SUBJECT: PHYSICS: MATHEMATICAL METHODS FOR PHYSICS

Day : **Saturday** Time: **03.00 PM TO 06.00 PM**

Date : **21/04/2018** **S-2018-0651** Max. Marks: 60

N. B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Neat diagrams must be drawn **WHEREVER** necessary.
4) Use of **logarithmic table / calculator** is allowed.
5) All the symbols have their usual meaning unless otherwise stated.

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

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

b) If $F = f(x, y) = x^3 y - e^{xy}$ show that $F_{yx} = F_{xy}$ and also find $F_{xx}, F_{yy}, F_{yxx}, F_{yyy}$

c) Using method of differential equation find the approximate value of $\sqrt{(6.01)^2 + (8.01)^2}$

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

a) If $\phi(x, y, z) = x^2 y + y^2 z + z^2 x$ determine $\vec{\nabla}\phi$ at the point (1, 3, -2).

b) Simplify $\left(\frac{1}{2} + i\frac{\sqrt{3}}{2}\right)^6 - \left(\frac{1}{2} - i\frac{\sqrt{3}}{2}\right)^6$

c) Show that the vector field represented by $\vec{F} = (z^2 + 2x + 3y)\vec{i} + (3x + 2y - z)\vec{j} + (y + 2zx)\vec{k}$ is irrotational but not solenoidal.

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

a) Simplify and show that the given number is rational number $\frac{(3+2i)}{(2-5i)} + \frac{(3-2i)}{(2+5i)}$

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

c) i) If $F = \sqrt{x^2 + y^2}$, $x = p\cos\theta$ *and* $y = q\sin\theta$ obtain the expression for $\frac{dF}{d\theta}$ by using chain rule.

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

P.T.O.

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

a) Show that the vectors $\overrightarrow{A} = 3\hat{i} - 2\hat{j} + 5\hat{k}$ *and* $\overrightarrow{C} = 2\hat{i} + \hat{j} - 4\hat{k}$ form a right angle triangle.

b) Show that $\vec{F} = \cos y\ \vec{i} - x \sin y\ \vec{j} - \cos z\ \vec{k}$ is conservative field.

c) Find the position and nature of the stationary point's for the following function $f(x) = 2x^3 - 3x^2 - 36x + 2$

d) Using $\sin\theta = \dfrac{e^{i\theta} - e^{-i\theta}}{2i}$ and $\cos\theta = \dfrac{e^{i\theta} + e^{-i\theta}}{2}$ prove that $\sin^2\theta + \cos^2\theta = 1$

Q.5 Attempt **ANY FOUR** of the following: **(12)**

a) Simplify $2(1+i)^2 - (1+i) + 1$

b) Determine the value of P so that $\vec{A} = 2\hat{i} + P\hat{j} + \hat{k}$ and $\vec{B} = 4\hat{i} - 2\hat{j} - 2\hat{k}$ are perpendicular.

c) Show that the vectors $\vec{A} = \hat{i} - 2\hat{j} + 3\hat{k}$ $\vec{B} = -2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{C} = \hat{i} - 3\hat{j} + 5\hat{k}$ are coplanar.

d) If $\phi = 2xz^4 - x^2y$ find $\nabla\phi$ at the point $(2, -2, -1)$.

e) If $F = y\cos x$. Find $\dfrac{\partial F}{\partial x}$ *and* $\dfrac{\partial^2 F}{\partial y \partial x}$

f) 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 $\vec{F} = 4\hat{i} - 3\hat{j} + 2\hat{k}$

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