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

Day : Thursday | Time : 10:00 AM-01:00 PM

Date : 8/12/2022 | **W-18347-2022** | Max. Marks : 60

N.B.
1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.

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

a) Find the directional derivative of the scalar function $f(x,y,z)=x^2+xy+z^2$ at the point $A(1,-1,-1)$ in the direction of the line AB where B has co-ordinates (3, 2, 1).

b) If $\vec{A}=2\hat{i}+3\hat{j}+5\hat{k},\ \vec{B}=\hat{i}+\hat{j}+\hat{k},\ \vec{C}=2\hat{i}+\hat{j}+3\hat{k},$
Show that : $\vec{A}\cdot(\vec{B}\times\vec{C})=\vec{B}\cdot(\vec{C}\times\vec{A})=\vec{C}\cdot(\vec{A}\times\vec{B})$.

c) If $F=f(x,y)=x^3y-e^{xy}$. Show that $F_{yx}=F_{xy}$.

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

a) Using total differentiation, find approximate value of $\sqrt{(4.99)^2+(12.02)^2}$.

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) 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).

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

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

b) If $u=x+y+z,\ v=x^2+y^2+z^2,\ w=yx+2x+xy$ prove that grad u and grad v and grad w are coplanar vector.

c) $F=a\ln(x^2+y^2)$, show that $F_{xy}=F_{yx}$ and $F_{xx}+F_{yy}=0$.

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

a) Show that given three vectors
$\vec{A}=2\hat{i}-\hat{j}-\hat{k},\ \vec{B}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{C}=3\hat{i}+2\hat{j}-5\hat{k}$, are coplanar.

b) Find the modulus of $\dfrac{i+2i}{1-3i}$.

c) Show that $z=f(x+ct)+\phi(x-ct)$ is a solution of $\dfrac{\partial^2 z}{\partial x^2}=\dfrac{1}{c^2}\dfrac{\partial^2 z}{\partial t^2}$ for all f and ϕ .

d) Show that $F=\cos y\hat{i}-x\sin y\,\hat{j}-\cos z\,\hat{k}$ is a conservative field.

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

a) Define degree, order and homogeneity of a differential equation
$\dfrac{d^2y}{dx^3}+\sqrt{\dfrac{d^2y}{dx^2}}+x=0.$

b) Evaluate $\nabla^2(\ln r)$.

c) Find the slope of the tangent to the curve
$x^3+3xy^2-y^3=0$ at $x=2$ and $y=-3$.

d) Find the angle between $\vec{A}=2\hat{i}+2\hat{j}-\hat{k},$ and $\vec{B}=6\hat{i}-23+2\hat{k}.$

e) Determine the value of 'P' so that $\vec{A}=3\hat{i}+P\hat{j}+\hat{k}$ and $\vec{B}=4\hat{i}-2\hat{j}-2\hat{k}$ are perpendicular.

f) Determine the value of x and y; if $x+iy=(1+i\sqrt{3})^4$.

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