

BACHELOR OF SCIENCE (B.Sc.)

Term-End Examination

December, 2017

PHYSICS

PHE-04 : MATHEMATICAL METHODS IN
PHYSICS-ITime : $1\frac{1}{2}$ hours

Maximum Marks : 25

Note : Attempt all questions. The marks for each question are indicated against it. Symbols have their usual meanings. You may use log tables or non-programmable calculators.

1. Answer any *three* parts :

3×4=12

- (a) If $\vec{A} = 5\hat{i} + \hat{j} - 3\hat{k}$ and $\vec{B} = 2\hat{i} - 2\hat{j} - 7\hat{k}$, determine $\vec{A} + \vec{B}$. Also find a vector of magnitude six units long in the direction of \vec{A} .
- (b) Consider a force $\vec{F} = 20(6\hat{i} - \hat{j} + \hat{k})$ N acting at a point P $(-3\hat{i} + \hat{j} + 5\hat{k})$ m. What is the torque (in Nm) at point P about the origin ?

- (c) Determine the angle between the tangents to the curve $\vec{r} = t^2\hat{i} + 2t\hat{j} - t^3\hat{k}$ at the points $t = \pm 1$.
- (d) Determine the directional derivative of the scalar field $\phi(x, y, z) = xy^2 + yz^3$ at the point $(2, -1, 1)$ in the direction of the vector $\hat{i} + 2\hat{j} + 2\hat{k}$.
- (e) If $f = (x^2 + y^2 + z^2)^n$, determine n if $\vec{\nabla} \cdot (\vec{\nabla} f) = 0$.

2. A vector field is given by

$\vec{F} = (\sin y)\hat{i} + x(1 + \cos y)\hat{j}$. Evaluate the line integral over a circular path given by $x^2 + y^2 = a^2, z = 0$.

5

OR

State Gauss's divergence theorem. Using it evaluate

$$\int_S \int \vec{F} \cdot \vec{dS},$$

where $\vec{F} = x^3\hat{i} + y^3\hat{j} + z^3\hat{k}$ and S is the surface of the sphere $x^2 + y^2 + z^2 = a^2$.

5

3. The probability that a certain component survives a given shock is $3/5$. Calculate the probability that 2 of the next 4 components tested survive. 3

OR

The life of a component X has the probability density function

$$f(x) = \begin{cases} 2e^{-2x}, & \text{for } x > 0 \\ 0, & \text{for } x \leq 0 \end{cases}$$

Calculate the probabilities that it will take on a value between (i) 1 and 3, and (ii) greater than 0.5. 3

4. Obtain the regression equation which is the best fit for the following data : 5

x :	2	3	4	5	6	7
y :	3.0	5.0	5.5	6.0	8.0	9.5

OR

Obtain the mean and variance of the Poisson distribution

$$p(x; m) = \frac{e^{-m} m^x}{x!}, \quad x = 0, 1, 2, \dots \quad 5$$