

00631

BACHELOR OF SCIENCE (B.Sc.)
Term-End Examination

June, 2012

PHYSICS

PHE-4 : MATHEMATICAL METHODS IN
PHYSICS-I

Time : 1½ hours

Maximum Marks : 25

B.Sc. EXAMINATION,

PHE-4 : MATHEMATICAL METHODS
IN PHYSICS-I

&

PHE-5 : MATHEMATICAL METHODS
IN PHYSICS-II

Instructions :

1. *Students registered for both PHE-4 & PHE-5 courses should answer both the question papers in two separate answer books entering their enrolment number, course code and course title clearly on both the answer books.*
2. *Students who have registered for PHE-4 or PHE-5 should answer the relevant question paper after entering their enrolment number, course code and course title on the answer book.*

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

1. Attempt any three parts :

4x3=12

(a) Determine the angle between the vectors

$$\vec{A} = -6\hat{i} - 4\hat{j} + 2\hat{k} \text{ and } \vec{B} = \hat{i} - 2\hat{j} - \hat{k}$$

(b) Calculate the volume of the parallelepiped formed by the vectors :

$$\vec{A} = \hat{i} + 2\hat{j} - \hat{k}$$

$$\vec{B} = \hat{j} + \hat{k}$$

$$\vec{C} = \hat{i} - \hat{j}$$

(c) Determine the unit vector normal to the surface $x^2 + y^2 + z^2 = 3$ at $(1, 1, 1)$.

(d) A frictionless bead slides down a vertical helix of radius R such that its position vector at time t is given by :

$$\vec{r}(t) = a (\cos\omega t \hat{i} + \sin\omega t \hat{j}) - \frac{1}{2}gt^2 \hat{k}$$

Determine its velocity and acceleration.

(e) The cylindrical coordinates $u_1 = \rho$, $u_2 = \phi$, $u_3 = z$ are related to the Cartesian coordinates x , y and z as follows :

$$x = \rho \cos \phi$$

$$y = \rho \sin \phi$$

$$z = z$$

Show that the cylindrical coordinate system is orthogonal, i.e., $g_{ij} (i \neq j) = 0$ for all i and j .

2. A force acting on a particle is given by : 5

$$\vec{F} = -kx \hat{i} - ky \hat{j}.$$

Calculate the work done in moving the particle from (1, 1) to (4, 4) along the path $x = y$.

OR

Calculate the surface integral of a vector

$\vec{A} = x \hat{i} + 2y \hat{j} + 3z \hat{k}$ over the surface of a sphere of radius 2 by using Gauss's divergence theorem.

3. The average number of calls received in a BPO is 4 per minute. Calculate the probability that not more than one call is received during one minute 3

OR

A continuous random variable X has the probability distribution

$$P(x) = \begin{cases} \frac{1}{\pi(1+x^2)} & -1 < x < 1 \\ 0 & \text{otherwise} \end{cases}$$

Calculate its mean.

4. The extension in a material is measured as a function of load in appropriate units and is given by : 5

Load (x)	0	1	2	3	4
Extension (y)	16	13	10	6	3

Obtain the least square fit to the data

OR

Derive an expression for the mean of the normal distribution

$$n(x; \bar{x}, \sigma) = \frac{1}{\sqrt{2\pi}\sigma} \exp \left[-\frac{1}{2} \left(\frac{x-\bar{x}}{\sigma} \right)^2 \right]$$

IGNOU
ASSIGNMENT
GURU