

## BACHELOR OF SCIENCE (B.Sc.)

## Term-End Examination

December, 2016

## PHYSICS

## PHE-04 : MATHEMATICAL METHODS IN

## PHYSICS-I

Time :  $1\frac{1}{2}$  hours

Maximum Marks : 25

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

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1. Attempt any *three* parts : 3×4=12

(a) Calculate the volume of a parallelepiped formed by the vectors  $\vec{A} = 2\hat{i} + \hat{j} + 4\hat{k}$ ;

$$\vec{B} = 2\hat{i} + \hat{j} \quad \text{and} \quad \vec{C} = 2\hat{j} + \hat{k}.$$

(b) Construct a unit vector normal to the surface  $x^2 + y^2 + 3xyz = 4$  at the point (1, 0, 1).

(c) Define polar and axial vectors. Give one example of each.

(d) The force  $\vec{F} = (\hat{i} + 2\hat{j} + 3\hat{k})$  N acts at a point P(3, 0, 4). Determine the torque about the origin.

(e)  $(x, y, z)$  and  $(u_1, u_2, u_3)$  are the respective cartesian and curvilinear coordinates of a point which are related by

$$x = 2u_1 - u_2 + 3u_3$$

$$y = u_1 + 2u_2 + 3u_3$$

$$z = u_1 - u_2$$

Calculate  $g_{ij}$  for all  $i$  and  $j$ . Is the system  $(u_1, u_2, u_3)$  orthogonal?

2. State Stokes' theorem. Using Stokes' theorem

evaluate the line integral  $\oint_C \vec{F} \cdot d\vec{l}$ , where C is

a circle of radius 3 which is parallel to the x-y plane at  $z = 3$  and  $\vec{F} = y\hat{i} + 9x\hat{j} - 3xy\hat{k}$ . 1+4

OR

A force  $\vec{F} = -2x\hat{i} - 3y\hat{j}$  acts on a particle.

Calculate the work done against the force in taking the particle from the origin to the point

(5, 5) along the path  $x = y$ .

3. A continuous random variable  $x$  such that  $0 \leq x \leq \pi$  has the probability distribution function :

$$P(x) = \frac{2}{\pi} \sin^2 x.$$

Calculate the mean  $\langle x \rangle$ .

3

**OR**

The probability of surviving in an accident on a highway is 0.7. Calculate the probability that 2 people out of 10 involved in accidents will survive.

3

4. The number of  $\alpha$ -particles emitted from a radioactive sample per minute is recorded to be 2016, 1953, 2130, 2511, 1890, 2220 in six samples. Calculate the best value and standard error of the mean.

5

**OR**

Resistance of a coil is measured as a function of temperature in an experiment. The following data was obtained :

Temperature ( $T^\circ$ )	40°	50°	60°	70°	80°
Resistance (R)	0.6	0.7	0.8	0.9	1.0

Obtain the least square fit

$$R = R_0 + \sigma T \text{ to the data.}$$

5

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