BACHELOR OF SCIENCE (B.Sc.)
Term-End Examination
December, 2012
PHYSICS
PHE-04 : 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 given against it. Symbols have their usual meanings. You **may use** log tables.*

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1. *Attempt **any three** parts :*   4x3=12

(a) Determine the vector $\vec{A}$ perpendicular to

the vectors $\vec{B} = 2\hat{i} + \hat{j} - \hat{k}$ and

$$\vec{C} = \hat{i} - \hat{j} + \hat{k}.$$

(b) Show that

$$(\vec{A} \times \vec{B}).(\vec{A} \times \vec{B}) = A^2 B^2 - (\vec{A} \cdot \vec{B})^2.$$

(c) Determine the directional derivative of the scalar field $f = x^2 + yz$ at the point (1, 2, 2) in the direction of the unit vector

$$\hat{A} = \frac{1}{\sqrt{6}} \left(2\hat{i} + \hat{j} - \hat{k} \right).$$

(d) The position vector $\vec{r}$ of a particle moving on a curve is given by

$$\vec{r} = 3t^2\hat{i} + 4t\hat{j} + 2\hat{k}.$$ Determine the angular momentum of the particle about the origin.

(e) Spherical polar coordinates $u_1 = r$, $u_2 = \theta$, $u_3 = \phi$ are related to the cartesian coordinates x, y and z as follows :

$x = r \sin\theta \cos\phi$

$y = r \sin\theta \sin\phi$

$z = r \cos\theta$.

Calculate g_{12}, g_{13} and g_{23} to show that the spherical coordinate system is orthogonal.

2. Calculate the work done in going from (1, 1) to **5** (3, 3) along the path $x = y$ by the force

$$\vec{F} = (x - y)\,\hat{i} + (x + y)\,\hat{j}.$$

OR

Using Stokes' theorem show that if the work done **5** by a force along a closed path is zero, the curl of the force field is zero.

3. The probability of surviving an attack of dengue **3** is 0.2. What is the probability that at least one person out of 10 suffering from dengue will survive ?

OR

A continuous random variable X lying between o **3** and ∞ has the probability distribution $P(x) = e^{-x}$ Obtain $<x^2>$.

4. The resistance of a coil is measured as a function **5** of temperature and is given by

T (°C) =	40	50	60	70	80
R (Ω) =	6	7	8	9	10

Obtain $R = a + b^T$ for the best fit.

OR

Derive the expression for the mean of a random **5** variable with a Poisson distribution :

$$P(x\,;\,m) = \frac{e^{-m}\,m^x}{x!}$$