No. of Printed Pages : 15

PHE-04

BACHELOR OF SCIENCE (B.Sc.)

Term-End Examination

June, 2013

01709

PHYSICS

PHE-04 : MATHEMATICAL METHODS IN PHYSICS-I

Time : 1½ hours | *Maximum Marks : 25*

B.Sc. EXAMINATION,

PHE-04 : MATHEMATICAL METHODS IN PHYSICS-I

&

PHE-05 : MATHEMATICAL METHODS IN PHYSICS-II

Instructions :

1. *Students registered for both* **PHE-04** *&* **PHE-05** *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-04** *or* **PHE-05** *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. You* ***may use*** *log tables or calculators. Symbols have their usual meanings.*

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

(a) Determine the unit vector perpendicular to the plane formed by the two vectors :

$$\vec{a} = 2\hat{i} - \hat{k}, \ \vec{b} = 3\hat{j} + 2\hat{k}$$

(b) Obtain the components of acceleration in cylindrical coordinates for a particle moving in space.

(c) Obtain the directional derivative of

$$V = \frac{k}{(x^2 + y^2 + z^2)^{1/2}}$$ at the point

(1, 2, 1) in the direction

$$\hat{n} = \left(\hat{i} + \hat{j} - 2\hat{k}\right) \Big/ \sqrt{6}.$$

(d) Determine the work done by the force $\vec{F} = y^2 \times \hat{i} + xy\,\hat{j}$ in moving a particle along the curve $y^2 = 4x$ from (0, 0) to (1, 2).

(e) Show that for a vector field $\vec{A}$,

$$\vec{\nabla} \cdot \left(\vec{\nabla} \times \vec{A}\right) = 0.$$

2. State Gauss's divergence theorem and use it to evaluate $\iint_s \vec{F} \cdot \hat{n}\, ds$ for $\vec{F} = 2xz\,\hat{i} - z^2\,\hat{j} + zx\,\hat{k}$ where s is the surface of a cube bounded by $x = 0$, $x = 1$, $y = 0$, $y = 1$, $z = 0$ and $z = 1$. **1+4**

OR

Using stoke's theorem, prove Green's theorem in a plane. 5

$$\oint_C [P\,dx + Q\,dy] = \iint_R \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y} \right) dx\,dy,$$ where

R is a region of the xy - plane bounded by a simple closed curve C.

3. Write down an expression for the binomial distribution function b(x ; n, p). Hence find mean and variance of a binomial random variable X. 4

OR

The number of bomb - hits recorded in each of the 550 small areas in a city are recorded below : 3+1

x_i	0	1	2	3	4
$f(x_i)$	224	206	88	30	2

Does it fit a poisson distribution ?

4. Determine the expectation value of x for the probability density function $f(x) = ax\,e^{-bx}$, $0<x<\infty$. 4

OR

The heat capacity of liquid sulphuric acid was measured at various temperatures yielding the following set of data : 4

X - Temp (°C) :	50	100	150	200	250
Y - Heat capacity (in cal/°C) :	0.38	0.39	0.41	0.43	0.45

Compute the correlation coefficient r_{XY}.
