No. of Printed Pages : 15

PHE-04

01593

BACHELOR OF SCIENCE (B.Sc.)

Term-End Examination

December, 2013

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.*

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

(a) Determine the volume of the parallelepiped formed by $\vec{r}_1 = 2\hat{i} + 4\hat{j} - 5\hat{k}$, $\vec{r}_2 = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{r}_3 = \hat{i} + \hat{j}$

(b) A particular electromagnetic field in free space is given by $E_x = 0$,

$E_y = E_0 \sin(kx + \omega t), E_z = 0\ B_x = 0,\ B_y = 0,$ $B_z = -E_0 \sin(kx + \omega t)$. Obtain the relation between ω and k for which the following equation holds :

$$\vec{\nabla} \times \vec{E} = -\frac{1}{c}\frac{\partial \vec{B}}{\partial t}$$

(c) The position vector of a particle of mass m is $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$. Obtain its angular momentum $\left(\vec{r} \times m\vec{V}\right)$ in cylindrical coordinates.

(d) Show that for a scalar field $\phi(x, y, z)$,

$$\vec{\nabla} \times (\vec{\nabla}\phi) = \vec{0}$$

(e) If $\vec{F} = xy\hat{i} - z\hat{j} + x^2\hat{k}$ and C is the curve

$x = t^2$, $y = 2t$, $z = t^3$ from $t = 0$ to $t = 1$,

evaluate the integral $\int_C \vec{F} \cdot d\vec{r}$.

2. State Stoke's theorem and evaluate the integral **5**

$\int_S \vec{A} \cdot d\vec{s}$ for $\vec{A} = (2x - y)\hat{i} - yz^2\hat{j} - y^2 z\hat{k}$, where S is the upper half surface of the sphere $x^2 + y^2 + z^2 = 1$.

OR

Use Green's theorem : **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 in xy-plane bounded by a simple closed curve C, to evaluate

$$\oint_C \left[(y - \sin x)\,dx + \cos x\,dy \right],$$ where c is a

triangle OAB such that the co-ordinates of O, A and B are respectively (0, 0), $\left(\frac{\pi}{2}, 0 \right)$ and $\left(\frac{\pi}{2}, 1 \right)$.

3. In an objective type examination, 10 questions are true-false type. Caculate the probability of guessing at least 8 correct answers. 3

OR

Let y designate the number of tails which appear when 3 coins are tossed. Calculate $E(y)$. 3

4. The Maxwell-Boltzmann distribution of velocity v, of particles each of mass m, is given by 5

$$f(v) = 4\pi\left(\frac{m}{2\pi k_B T}\right)^{3/2} v^2 \exp\left(-\frac{m v^2}{2k_B T}\right) ;$$

$0 \le v \le \propto$, where T is the temperature and k_B is the Boltzmann constant. Show that the mean velocity, $\bar{v} = \sqrt{\frac{8k_B T}{m\pi}}$.

OR

The pressure of a gas corresponding to various volume V is measured, yielding the following data : 5

$V(cm^3)$	50	60	70	90	100
$p(kg\ cm^{-2})$	65	50	40	25	10

Fit the data to the equation $pV^{\gamma} = c$.
