

BACHELOR OF SCIENCE (B.Sc.)

Term-End Examination

June, 2018

PHYSICS

BPHE-104/PHE-04 : MATHEMATICAL METHODS IN
PHYSICS-ITime : $1\frac{1}{2}$ hours

Maximum Marks : 25

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. Answer any *three* parts : 3×4=12

- (a) Calculate the volume of a parallelepiped having sides

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

$$\vec{b} = 2\hat{i} + 2\hat{j} - \hat{k} \text{ and}$$

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

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

$$\vec{\nabla} \times \vec{\nabla} \phi = 0.$$

(c) Define a solenoidal vector field. Determine the constant 'a' so that the vector field $\vec{A} = (2x + 3y)\hat{i} + (y - 3z)\hat{j} + (x + az)\hat{k}$ is solenoidal. Show that \vec{A} is not conservative.

(d) Express $\vec{v} = \frac{y\hat{i} - x\hat{j}}{x^2 + y^2}$ in cylindrical polar coordinates.

(e) Determine the unit tangent vector at a point on the curve C defined by

$$\vec{r} = xy\hat{i} - z\hat{j} + x^2\hat{k}, \text{ where}$$

$$x = t^2, y = 2t, \text{ and } z = t^3.$$

2. State Stokes' theorem and use it to obtain the value of curl \vec{B} , starting from Ampere's law, $\oint_l \vec{B} \cdot d\vec{l} = \mu_0 I$, where l defines the periphery of surfaces.

5

OR

Calculate the work done by the force $\vec{F} = z\hat{i} + x\hat{j} + y\hat{k}$ in moving a particle along the curve $x = \cos t$, $y = \sin t$ and $z = 3t$ for $0 \leq t < 2\pi$.

5

3. Determine the mean and variance of the normal distribution defined by $\frac{1}{\sqrt{2\pi}} \exp\left(\frac{-x^2}{2}\right)$. 5

OR

A student measures temperature (in °C) of a body and obtains five values at different times in an experiment : 25, 27, 26, 28, 24. Calculate the arithmetic mean and its standard error. 5

4. Calculate the probability of getting 3 heads in a toss of 5 ideal coins. 3

OR

The average number of phone calls received by a telephone exchange per minute between 2 a.m. and 3 a.m. is 2. Identify the probability distribution that applies in this case. Calculate the probability that during one minute, chosen at random, there will be one incoming phone call. 1+2

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