[This question paper contains 4 printed pages.]

8104-A *Your Roll No.* .....

B.Sc. Prog./II **BS**

PH–201 – PHYSICS

(Mathematical Physics)

Time : *3 Hours* *Maximum Marks* : *75*

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt **five** *questions in all.*
Question No. 1 *is compulsory.*

1. Attempt any **five** : (3×5)

(a) What is Solenoidal vector ? Give examples.

(b) Show that vectors $5\vec{a} + 6\vec{b} - 7\vec{c}$, $7\vec{a} - 8\vec{b} + 9\vec{c}$ and $3\vec{a} - 20\vec{b} + 5\vec{c}$ are coplanar.

(c) Find the volume of the Parallelopiped whose edges are $2\hat{i} - 3\hat{j} - 4\hat{k}$, $\hat{i} - 2\hat{j} - \hat{k}$ and $3\hat{i} - \hat{j} + 2\hat{k}$.

(d) Prove $J_n(-x) = (-1)^n J_n(x)$ where $J_n(x)$ are the Bessel functions.

P.T.O.

(e) Find the Principal value of i^i.

(f) Determine region in the Z-plane represented by

$$2 < |Z - i| \leq 3$$

(g) Find the Laplace Transform of $\sinh(\alpha t)$.

2. (a) Prove $(\vec{A} \cdot \vec{B}) \cdot [(\vec{B} \times \vec{C}) \cdot (\vec{C} \times \vec{A})] = (\vec{A} \cdot \vec{B} \times \vec{C})^2$.

(b) Evaluate $\oint\oint (\vec{A} \cdot \hat{n}) \times d\vec{S}$ where

$\vec{A} = (x - y^2)\hat{i} - 2xy\hat{j} + 2yz\hat{k}$ and S is the surface of the plane $2x + y + 2z = 6$ in the first octant. (5,10)

3 (a) State Gauss' Divergence theorem and evaluate $\int_S \vec{F} \cdot \hat{n}\, dS$ using Divergence theorem where

$\vec{F} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$ and S is the surface of cube bounded by $x = 0$, $x = 1$, $y = 0$, $y = 1$, $z = 0$ and $z =$.

(b) Find the volume element in terms of cylindrical coordinates. (10,5)

4. (a) Obtain the necessary conditions for a function $f(z) = u(x, y) - iv(x, y)$ to be analytic.

(b) Evaluate $\oint_C \frac{e^z}{z^2 + 1} dz$ where $C : |z| = 2$. (10,5)

5. (a) State and prove Taylor's theorem for a complex function $f(z)$.

(b) Locate and identify the singularities of the function

$$f(z) = \frac{z}{(z^2 - 4)^3}. \qquad (10,5)$$

6. Using Contour integration, evaluate any **two** :

(i) $\int_{-\infty}^{\infty} \frac{x^2}{(x^2 - 9)(x^2 + 4)^2} dx$

(ii) $\int_0^{2\pi} \frac{d\theta}{1 + \alpha \cos\theta}, \quad 0 \leq \alpha \leq 1$

(iii) $\int_0^{\infty} \frac{\cos mx}{x^2 + 1} dx, \quad m > 0$ (7½, 7½)

7. (a) Expand in a Fourier Series

$$f(x) = \begin{cases} 0 & (-\pi \le x < 0) \\ K & (0 < x < \pi) \end{cases}$$

(b) Find the Laplace transform of $t^2 \sin \alpha t$. (10.5)