This question paper contains 3 printed pages.]

Your Roll No. ....

1397 **A**

B.Sc. (Hons.)/I

ELECTRONICS—Paper 1.6 (VI)

(Mathematical Physics—I)

Time : 3 Hours *Maximum Marks : 38*

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

Attempt ***five*** *questions in all*

Question No. **1** *is compulsory.*

Attempt at least ***one*** *question from each Section.*

1. Attempt any ***five*** of the following :

(a) Given the Eigenvalues of a matrix A, what are the values of determinant of A and trace of A. 2

(b) Show that a hermitian matrix can be expressed as a sum of hermitian matrix. 2

(c) Prove the law of sine for a triangle? 2

(d) Show $\nabla\left(|r|^{n}\right)=n|r|^{n-2}\bar{r}$ 2

(e) What are isotropic tensors? 2

(f) Prove $\delta_{ij}\in_{ijk}=0$ 2

SECTION-A

2. (a) Verify the Green's theorem for $\oint_c (xy+y^2)\,dx+x^2dy$; where '*c*' is a curve bounded by $y = x$ and $y = x^2$. 5

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(b) Find the directional derivative of $\phi = x^2 y^z + 4xz^2$ at $(1, -2, -1)$ in the direction of $2\hat{i} - \hat{j} - 2\hat{k}$. 2

3. (a) Evaluate $\int_S A.nds$, where $\bar{A} = z\hat{i} + x\hat{j} - 3y^2 z\hat{k}$ and 'S' is the surface of the cylinder $x^2 + y^2 = 16$, included in the first octant between $z = 0$ and $z = 5$. 4

(b) Prove that cylindrical co-ordinate system is orthogonal. 3

SECTION-B

4. (a) Show $\in_{rmn} \in_{rpq} = \delta_{mp}\delta_{nq} - \delta_{mq}\delta_{np}$ 3

(b) Prove the identity using tensor notation.

$$\vec{\nabla} \times (\vec{u} \times \vec{w}) = (\vec{w}.\vec{\nabla})\,\vec{u} + \vec{u}\,(\vec{\nabla}.\vec{w}) - (\vec{u}.\vec{\nabla})\,\vec{w} - \vec{w}(\vec{\nabla}.\vec{u})$$ 4

5. (a) Obtain the components of the stress tensor, the strain tensor and write the generalised form of the Hooke's Law in tensor notation. 5

(b) Show that $\in ijk \in ijk = 6$ 2

SECTION-C

6. (a) Find the diagonalizing matrix P for the given matrix A : 5

$$A = \begin{pmatrix} -2 & 0 & -1 \\ 0 & 2 & 0 \\ 3 & 0 & 2 \end{pmatrix}$$

(b) Determine whether the 4 vectors $u = (1, 2, 3)$, $v = (2, 0, -1)$, $W = (1, -1, 1)$ and $X = (2, 1, 0)$ are linearly dependent or independent. 2

7. (a) Reduce the following coupled differential equations to an eigenvalue problem and solve : 5

$$\ddot{y}_1 = -8y_1 + 2y_2 ; \dot{y}_1(0) = 6, y_1(0) = 2$$

$$\ddot{y}_2 = -3y_1 + 3y_2 ; \dot{y}_2(0) = -3, y_2(0) = -1$$

(b) Show that matrix $A = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & i \\ -i & -1 \end{pmatrix}$ is unitary. 2