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ALL PSUs	ENGINEERING MATHS	10:00 AM	ANANT SIR
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ALL PSUs	ENGINEERING MATHS	10:00 AM	ANANT SIR
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GATE 2024-25	STEEL STRUCTURE	6.00 PM	REHAN SIR
GATE 2024-25	ENVIRONMENT	8:00 PM	PRATIK SIR
GATE 2024-25	SOM	9:00 PM	MUKESH SIR

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ALL PSUs	ENGINEERING MATHS	10:00 AM	ANANT SIR
ALL PSUs	PRODUCTION	11:30 PM	GAURAV SIR
ALL PSUs	THERMODYNAMICS	3:00 PM	KANISTH SIR
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Q:143

Given $A=\begin{bmatrix}2 & 5\\ 0 & 3\end{bmatrix}$, the value of the determinant $\left|A^4-5A^3+6A^2+2I\right|=$ _____.

$A \rightarrow d_1, d_2 \quad d_1=2, d_2=3$

$B \rightarrow \lambda_1, \lambda_2$

4

81
56
137

method:1

$B = A^4 - 5A^3 + 6A^2 + 2I = f(A)$

$|B| = \lambda_1 \times \lambda_2$

$\lambda_1 = f(d_1) = (2)^4 - 5(2)^3 + 6(2)^2 + 2 = 2$ $\Rightarrow |B| = 4$

$\lambda_2 = f(d_2) = (3)^4 - 5(3)^3 + 6(3)^2 + 2 = 2$

$$A = \begin{bmatrix} 2 & 5 \\ 0 & 3 \end{bmatrix}$$

$$(2-\lambda)(3-\lambda) = 0$$

$$\lambda^2 - 5\lambda + 6 = 0$$

C.H.

$$A^2 - 5A + 6I = 0$$

$$A^4 - 5A^3 + 6A^2 = 0 \quad -①$$

$$|A^4 - 5A^2 + 6A^2 + 2I| = |0 + 2I| = |2I| = (2)^2 = 4$$

$kI_{2\times 2} \Rightarrow K^2$

Q:144

The determinant of the matrix M shown below is _____.

$$M=\begin{bmatrix}1 & 2 & 0 & 0\\ 3 & 4 & 0 & 0\\ 0 & 0 & 4 & 3\\ 0 & 0 & 2 & 1\end{bmatrix}$$

$R_2 \leftarrow R_2 - 2R_1$

$R_3 \leftarrow R_3 - 2R_4$

$$\begin{bmatrix}1 & 2 & 0 & 0\\ 1 & 0 & 0 & 0\\ 0 & 0 & 0 & 1\\ 0 & 0 & 2 & 1\end{bmatrix}$$

4×4

$$-1\begin{vmatrix}2 & 0 & 0\\ 0 & 0 & 1\\ 0 & 2 & 1\end{vmatrix} = 4$$

Q:145 Consider the rows vectors $v = [1, 0]$ and $w = [2, 0]$. The rank of the matrix $M = 2v^Tv + 3w^Tw$, where the superscript T denotes the transpose, is

(a) 3

(b) 2

(c) 4

(d) 1

$v^Tv = \begin{bmatrix}1\\0\end{bmatrix}\begin{bmatrix}1 & 0\end{bmatrix} = \begin{bmatrix}1 & 0\\0 & 0\end{bmatrix}$

$w^Tw = \begin{bmatrix}2\\0\end{bmatrix}\begin{bmatrix}2 & 0\end{bmatrix} = \begin{bmatrix}4 & 0\\0 & 0\end{bmatrix}$

$M = \begin{bmatrix}13 & 0\\0 & 0\end{bmatrix}$

$\rho(M) = 1$

Q:146 Consider an $n \times n$ matrix A and a non-zero $n \times 1$ vector p. Their product $Ap = \alpha^2 p$, where $\alpha \in \Re$ and $\alpha \notin \{-1, 0, 1\}$. Based on the given information, the eigen value of A^2 is:

X → eigen vector

AX = αX (α: eigen value)

(a) $\sqrt{\alpha}$

(b) α^2

(c) α

(d) α^4

Ap = α²p (α²: eigen value)

A → eigenvalue α²

A² → (α²)² = α⁴

Q:147

The eigen values of matrix, $A = \begin{bmatrix} 8 & 3 \\ 2 & 7 \end{bmatrix}$ are 5 and 10. For matrix $B = A + \alpha I$, where α is a constant and I is 2×2 identify matrix, then eigen values are

(a) 5, 10
(b) $5 + \alpha$, $10 + \alpha$
(c) $5 - \alpha$, $10 - \alpha$
(d) 5α, 10α

$B = A + \alpha I$

$B = f(A)$

$B \rightarrow \lambda_1, \lambda_2$

$\lambda_1 = f(\lambda_1) = f(5)$

$= 5 + \alpha$

$\lambda_2 = f(10) = 10 + \alpha$

Q:148

$R_3 \leftarrow R_3 + R_1$

The rank of the matrix $\begin{bmatrix} 5 & 0 & -5 & 0 \\ 0 & 2 & 0 & 1 \\ -5 & 0 & 5 & 0 \\ 0 & 1 & 0 & 2 \end{bmatrix}$ is

$\begin{bmatrix} 5 & 0 & -5 & 0 \\ 0 & 2 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 2 \end{bmatrix}_{4\times4}$

(a) 4

(b) 3

(c) 1

(d) 2

Q:149

If $P=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}$ and $Q=\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}$ then Q^TP^T is

$P^T=\begin{bmatrix}1 & 3\\ 2 & 4\end{bmatrix}$

$Q^T=\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}$

Q^TP^T

$\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}\begin{bmatrix}1 & 3\\ 2 & 4\end{bmatrix}$

$=\begin{bmatrix}2 & 4\\ 1 & 3\end{bmatrix}$

(a) $\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}$

(b) $\begin{bmatrix}1 & 3\\ 2 & 4\end{bmatrix}$

(c) $\begin{bmatrix}2 & 4\\ 1 & 3\end{bmatrix}$

(d) $\begin{bmatrix}2 & 1\\ 4 & 3\end{bmatrix}$

Q:150

$R_2 \leftarrow R_2 - 3R_1$

$R_3 \leftarrow R_3 - 5R_1$

$R_4 \leftarrow R_4 - 7R_1$

$$\begin{bmatrix} 1 & 2 & 2 & 3 \\ 0 & -2 & -4 & -4 \\ 0 & -4 & -8 & -8 \\ 0 & -6 & -12 & -12 \end{bmatrix}$$

The rank of matrix $\begin{bmatrix} 1 & 2 & 2 & 3 \\ 3 & 4 & 2 & 5 \\ 5 & 6 & 2 & 7 \\ 7 & 8 & 2 & 9 \end{bmatrix}$ is

(a) 4

(b) 2

(c) 1

(d) 3

Q:151

Consider the following matrix:

$$\begin{pmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{pmatrix}_{4\times4}$$

$|A - \lambda I| = 0$

$$\begin{vmatrix} -\lambda & 1 & 1 & 1 \\ 1 & -\lambda & 1 & 1 \\ 1 & 1 & -\lambda & 1 \\ 1 & 1 & 1 & -\lambda \end{vmatrix} = 0$$

$R_1 \leftarrow R_1 + R_2 + R_3 + R_4$

The largest eigenvalue of the above matrix is

3 .

$$\begin{vmatrix} 3-\lambda & 3-\lambda & 3-\lambda & 3-\lambda \\ 1 & -\lambda & 1 & 1 \\ 1 & 1 & -\lambda & 1 \\ 1 & 1 & 1 & -\lambda \end{vmatrix} = 0$$

$$(3-\lambda)\begin{vmatrix} 1 & 1 & 1 & 1 \\ 1 & -\lambda & 1 & 1 \\ 1 & 1 & -\lambda & 1 \\ 1 & 1 & 1 & -\lambda \end{vmatrix} = 0$$

$$\begin{vmatrix} (3-\lambda) & & & \\ & & & \\ & & & \\ & & & \end{vmatrix}\begin{vmatrix} 1 & 0 & 0 & 0 \\ 1 & -\lambda-1 & 0 & 0 \\ 1 & 0 & -\lambda-1 & 0 \\ 1 & 0 & 0 & -\lambda-1 \end{vmatrix} = 0$$

$$(3-\lambda)\,(-\lambda-1)^3 = 0$$

$\lambda = 3,$

$(-\lambda-1)^3 = 0$

$-\lambda-1=0$

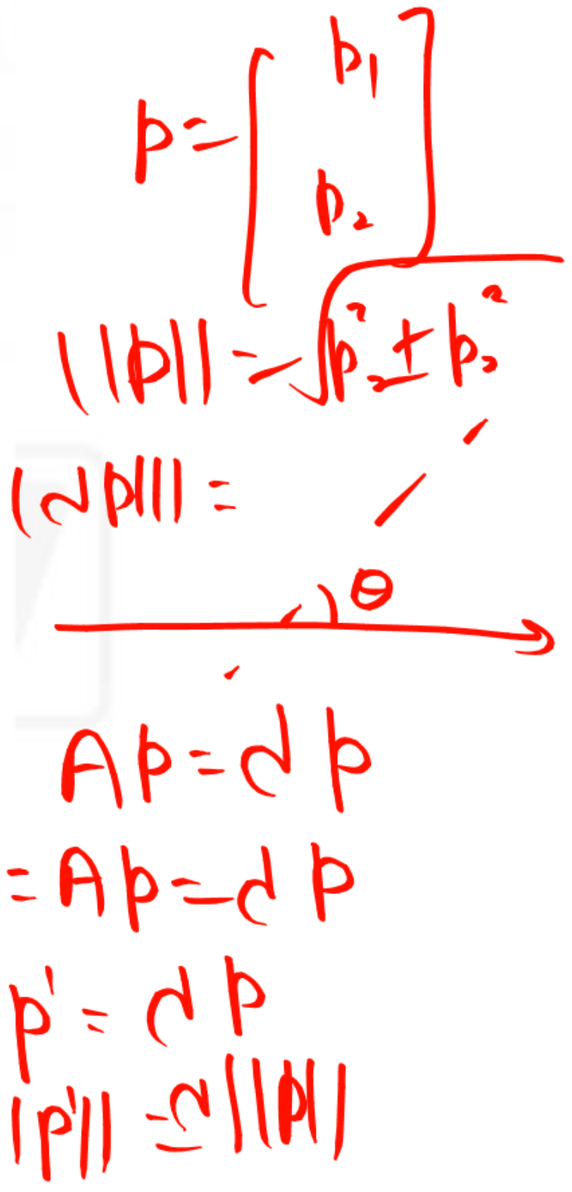
$\lambda = -1,-1,-1$

$3,-1,-1,-1$

Q:152 Consider a vector p in 2-dimensional space. Let its direction (counter-clockwise angle with the positive x-axis) be θ. Let p be an eigen vector of a 2×2 matrix A with corresponding eigen value λ, $\lambda > 0$. If we denote the magnitude of a vector v by $\|v\|$, identify the VALID statement regarding p', where $p' = Ap$.

(a) Direction of $p' = \theta, \|p'\| = \lambda \|p\|$

(b) Direction of $p' = \lambda\theta, \|p'\| = \|p\|$



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