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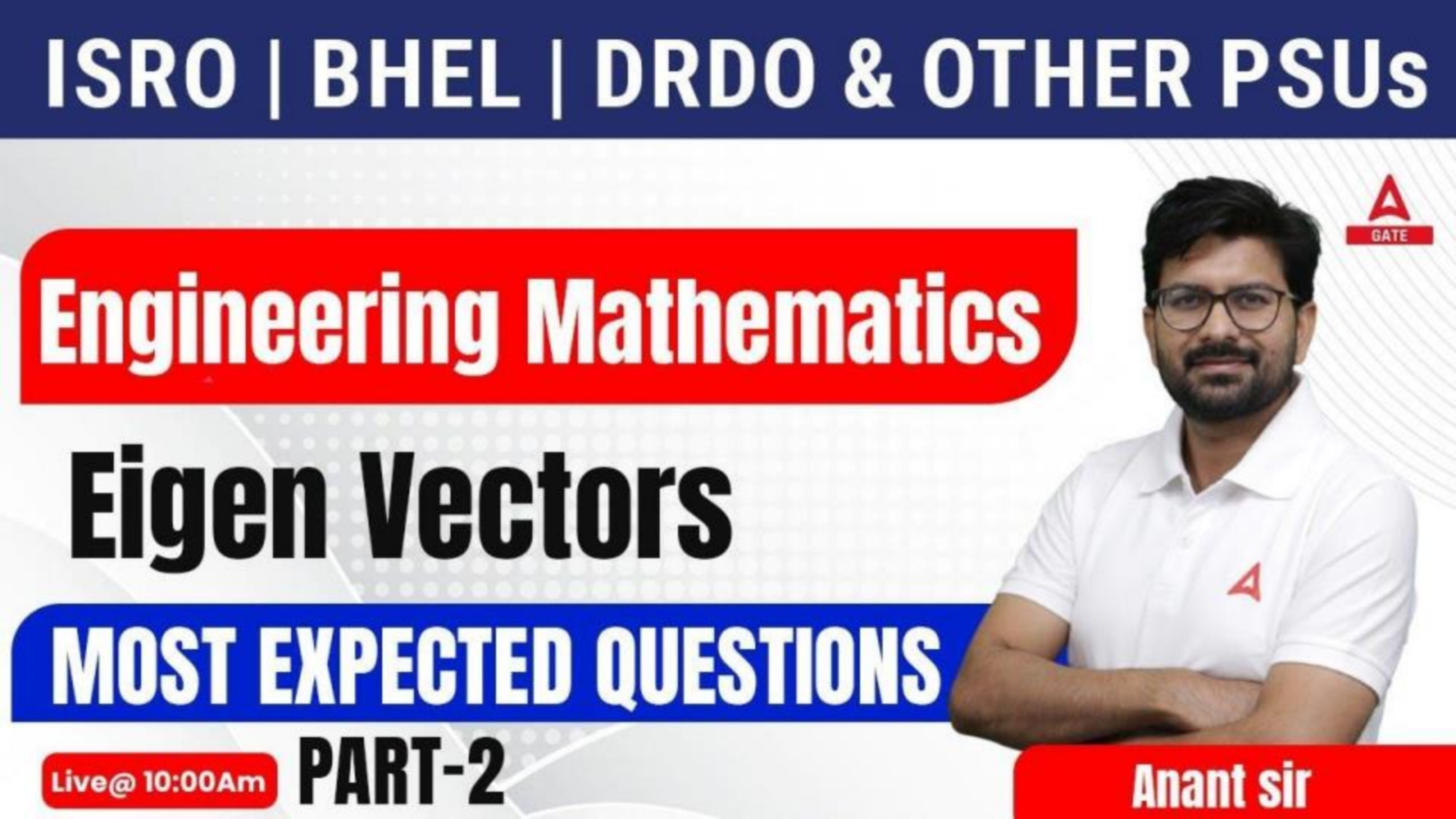
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GATE
Engineering Mathematics
Eigen Vectors
MOST EXPECTED QUESTIONS
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Q:118 For the matrix $A = \begin{bmatrix} 5 & 3 \\ 1 & 3 \end{bmatrix}$, ONE of the normalized eigen vector is given as -

(a) $\begin{pmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{pmatrix}$

(b) $\begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{-1}{\sqrt{2}} \end{pmatrix}$

(c) $\begin{pmatrix} \frac{3}{\sqrt{10}} \\ \frac{-1}{\sqrt{10}} \end{pmatrix}$

(d) $\begin{pmatrix} \frac{1}{\sqrt{5}} \\ \frac{2}{\sqrt{5}} \end{pmatrix}$

$\lambda_1 + \lambda_2 = 8$

$\lambda_1 \times \lambda_2 = 12$

$\lambda_1 = 6$

$\lambda_2 = 2$

$\vec{A} = 2\hat{i} + 3\hat{j} - \hat{k}$

$|\vec{A}| = \sqrt{(2)^2 + (3)^2 + (-1)^2}$

$A = [-3 \quad 1 \quad 4]$

$||A|| = \sqrt{(-3)^2 + (1)^2 + (4)^2}$

Normalized vector are having euclidian distance = 1

for $\lambda = 6$

$\begin{bmatrix} -1 & 3 \\ 1 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = 0$

$x_1 = 3x_2$

for $\lambda = 2$

$\begin{bmatrix} 3 & 3 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = 0$

$x_1 = -x_2$

Q:119 One of the eigenvectors of matrix $\begin{bmatrix} -5 & 2 \\ -9 & 6 \end{bmatrix}$ is -

(a) $\begin{Bmatrix} -1 \\ 1 \end{Bmatrix}$

(b) $\begin{Bmatrix} -2 \\ 9 \end{Bmatrix}$

(c) $\begin{Bmatrix} 2 \\ -1 \end{Bmatrix}$

(d) $\begin{Bmatrix} 1 \\ 1 \end{Bmatrix}$ ← X ✓

$Y \rightarrow \begin{bmatrix} 3 \\ 3 \end{bmatrix}$ $\begin{bmatrix} -2 \\ -2 \end{bmatrix}$ ← Z

$\lambda_1 + \lambda_2 = 1$

$\lambda_1 \times \lambda_2 = -12$

$\lambda_1 = 4$

$\lambda_2 = -3$

for $\lambda = 4$

$\begin{bmatrix} -9 & 2 \\ -9 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = 0$

$9x_1 = 2x_2$

for $\lambda = -3$

$\begin{bmatrix} -2 & 2 \\ -9 & 9 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = 0$

$x_1 = x_2$

$Y = 3X$

$Z = -2X$

Q:120 A matrix has eigenvalues – 1 and - 2. The corresponding eigen vectors are $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$ and $\begin{bmatrix} 1 \\ -2 \end{bmatrix}$ respectively. The matrix is -

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

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

(c) $\begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix}$

(d) $\begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$

$[A - \lambda I]X = 0$

$AX = \lambda X$

let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} 1 \\ -1 \end{bmatrix} = -1 \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

$a - b = -1$ — (1)

$c - d = 1$ — (2)

$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} 1 \\ -2 \end{bmatrix} = -2 \begin{bmatrix} 1 \\ -2 \end{bmatrix}$

$a - 2b = -2$ — (3)

$c - 2d = 4$ — (4)

$2c - 2d = 2$

$2a - 2b = -2$

$a - 2b = -2$

$a = 0 \Rightarrow b = 1$

$\Rightarrow -c = 2$

$c = -2$

Q: 121 The eigenvalues and the corresponding eigenvector of a 2 × 2 matrix are given by -

$\lambda_1 + \lambda_2 = 12$

$\lambda_1 \times \lambda_2 = 32$

Eigenvalue	Eigenvector
$\lambda_1 = 8$	$v_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$
$\lambda_2 = 4$	$v_2 = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

The matrix is -

(a) $\begin{bmatrix} 6 & 2 \\ 2 & 6 \end{bmatrix}$ (b) $\begin{bmatrix} 4 & 6 \\ 6 & 4 \end{bmatrix}$

(c) $\begin{bmatrix} 2 & 4 \\ 4 & 2 \end{bmatrix}$ (d) $\begin{bmatrix} 4 & 8 \\ 8 & 4 \end{bmatrix}$

Q:122 The number of lineary independent eigenvector of matrix $A = \begin{bmatrix} 2 & 1 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ is ___2___

$\lambda_1 = 2$

$\lambda_2 = 2$

$\lambda_3 = 3$

for $\lambda = \lambda_1 = 2$

$2x_1 = x_2$

$x_3 = -3x_2$

$X = \begin{bmatrix} 2 \\ 4 \\ -12 \end{bmatrix}$

for $\lambda = \lambda_2 = 2$

$2x_1 = x_2$

$x_3 = -3x_2$

$Y = \begin{bmatrix} 1 \\ 2 \\ -6 \end{bmatrix}$

Note:→ for a matrix with number of distinct eigen values to be 'm' number of linearly independent eigen vectors are 'm'.

Q:123 Let the eigenvalue of a 2 × 2 matrix A be 1, - 2 with eigenvector x_1 and x_2 respectively. Then the eigenvalues and eigenvectors of the matrix $A^2 - 3A + 4I$ would, respectively. be

(a) 2, 14; $x_1, \ x_2$

(b) 2, 14; $x_1 + x_2, x_1 - x_2$

(c) 2, 0; $x_1, \ x_2$

(d) 2, 0; $x_1 + x_2, \ x_1 - x_2$

$A \rightarrow \lambda_1, \lambda_2 \rightarrow X_1, X_2$

B = f(A) = polynomial of A

$B \rightarrow \mu_1, \mu_2 \rightarrow Y_1, Y_2$

$\mu_1 = f(\lambda_1)$

$\mu_2 = f(\lambda_2)$

$Y_1 = X_1$

$Y_2 = X_2$

$1 - 3 + 4 \rightarrow 2$

$4 + 6 + 4 \rightarrow 14$

let $A = \begin{bmatrix} -5 & 2 \\ -9 & 6 \end{bmatrix}$

$\lambda_1 = 4 \longrightarrow \begin{bmatrix} 2 \\ 9 \end{bmatrix}$

$\lambda_2 = -3 \longrightarrow \begin{bmatrix} 3 \\ 3 \end{bmatrix}$

$\mu_1 = 41$

$\mu_2 = 34$

$B = 3A^2 - 2A + I$

$A^2 = \begin{bmatrix} -5 & 2 \\ -9 & 6 \end{bmatrix} \begin{bmatrix} -5 & 2 \\ -9 & 6 \end{bmatrix} = \begin{bmatrix} 7 & 2 \\ -9 & 18 \end{bmatrix}$

$B = \begin{bmatrix} 21 & 6 \\ -27 & 54 \end{bmatrix} - \begin{bmatrix} -10 & +4 \\ -18 & +12 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 32 & +2 \\ -9 & 43 \end{bmatrix}$

for $\mu = \mu_1 = 41$

$\begin{bmatrix} -9 & 2 \\ -9 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = 0$

$9x_1 = 2x_2$

Q:124 In the given matrix $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix}$, one of the eigenvalues is 1. The eigenvectors corresponding to the eigenvalue 1 are -

(a) $\{\alpha\,(4, 2, 1) \mid \alpha \neq 0, \alpha \in \mathbb{R}\}$

(b) $\{\alpha\,(-4, 2, 1) \mid \alpha \neq 0, \alpha \in \mathbb{R}\}$

(c) $\{\alpha\,(\sqrt{2}, 0, 1) \mid \alpha \neq 0, \alpha \in \mathbb{R}\}$

(d) $\{\alpha\,(-\sqrt{2}, 0, 1) \mid \alpha \neq 0, \alpha \in \mathbb{R}\}$

for $\lambda = 1$

$$\begin{bmatrix} 0 & -1 & 2 \\ 0 & 0 & 0 \\ 1 & 2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = 0$$

$-x_2 + 2x_3 = 0 \Rightarrow x_2 = 2x_3$

$x_1 = -2x_2$

Q:125 The number of linearly independent eigenvectors of $\begin{bmatrix} 2 & 1 \\ 0 & 2 \end{bmatrix}$ is -

(a) 0

2, 2

(b) 1

(c) 2

(d) infinite

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GATE 2024-25	ELECTRICAL MACHINE	7:30 PM	SANTAN SIR
GATE 2024-25	COMMUNICATION	9:00 PM	RENU SIR

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ALL PSUs	GEOTECHNICAL	1:00 PM	RUDRA SIR
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	THERMODYNAMICS	3:00 PM	KANISTH SIR
GATE 2024-25	HMT	4:30 PM	YOGESH SIR
GATE 2024-25	SOM	9:00 PM	MUKESH SIR

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THERMODYNAMICS	THURSDAY Live @11AM	KANISTH SIR
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