

# 12.601

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**Question:** The matrix  $\begin{pmatrix} 1 & 1 & 2 \\ 0 & 1 & 0 \\ 1 & 2 & 1 \end{pmatrix}$ , one of the eigen values is 1. The eigen vectors corresponding to the eigen value 1 are: (CS 2016)

- a)  $\alpha \begin{pmatrix} 4 & -2 & 1 \end{pmatrix}, \alpha \neq 0, \alpha \in \mathbb{R}$
- b)  $\alpha \begin{pmatrix} -4 & 2 & 1 \end{pmatrix}, \alpha \neq 0, \alpha \in \mathbb{R}$
- c)  $\alpha \begin{pmatrix} -2 & 0 & 1 \end{pmatrix}, \alpha \neq 0, \alpha \in \mathbb{R}$
- d)  $\alpha \begin{pmatrix} 2 & 0 & 1 \end{pmatrix}, \alpha \neq 0, \alpha \in \mathbb{R}$

**Solution:**

Given:  $\lambda = 1$ , Let  $\mathbf{A} = \begin{pmatrix} 1 & 1 & 2 \\ 0 & 1 & 0 \\ 1 & 2 & 1 \end{pmatrix}$

Let  $\mathbf{v}$  be the corresponding eigenvector.

$$\Rightarrow \mathbf{A}\mathbf{v} = (1)\mathbf{v} \quad (0.1)$$

$$(\mathbf{A} - \mathbf{I})\mathbf{v} = \begin{pmatrix} 0 & 0 & 0 \end{pmatrix} \quad (0.2)$$

$$\begin{pmatrix} 0 & 1 & 2 \\ 0 & 0 & 0 \\ 1 & 2 & 0 \end{pmatrix} \mathbf{v} = \begin{pmatrix} 0 & 0 & 0 \end{pmatrix} \quad (0.3)$$

$$\therefore \mathbf{v} = \alpha \begin{pmatrix} 4 & -2 & 1 \end{pmatrix} \quad (0.4)$$

Thus, Option-A is correct.