Problems on Matrix Diagonalization

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November 21, 2011

Abstract

This document contains 150 different sets of matrices. Each set has five 3×3 matrices, with one matrix each of the following type:

1. All three eigenvalues are different;
2. Two eigenvalues are same and there are two linearly independent eigenvectors for this eigenvalue;
3. Two eigenvalues are equal and there is only one linearly independent eigenvector for this eigenvalue;
4. All the three eigenvalues are equal, and the matrix has in all two linearly independent eigenvectors;
5. All the three eigenvalues are equal, but the matrix has only one linearly independent eigenvector;

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - I**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a) \begin{pmatrix} -7 & -7 & 1 \\ 5 & 5 & -1 \\ -3 & -3 & 1 \end{pmatrix}$ $(b) \begin{pmatrix} -3 & 4 & 4 \\ 0 & -3 & 0 \\ 0 & 2 & -1 \end{pmatrix}$ $(c) \begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$

$(d) \begin{pmatrix} -1 & 2 & 2 \\ -1 & -4 & -1 \\ -1 & -1 & -4 \end{pmatrix}$ $(e) \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - II**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} -7 & -7 & 6 \\ 8 & 8 & -6 \\ -5 & -5 & 6 \end{pmatrix}$ $(b)\ \begin{pmatrix} 0 & 0 & 3 \\ -2 & -2 & -3 \\ -2 & 0 & -5 \end{pmatrix}$ $(c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$

$(d)\ \begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix}$ $(e)\ \begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - III**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -7 & -6 & -9 \\ 4 & 5 & 4 \\ 6 & 4 & 8 \end{pmatrix} \qquad (b)\begin{pmatrix} -7 & 5 & -5 \\ -5 & 3 & -5 \\ 5 & -5 & 3 \end{pmatrix} \qquad (c)\begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\begin{pmatrix} -4 & 2 & -2 \\ 0 & -2 & 0 \\ 2 & -2 & 0 \end{pmatrix} \qquad (e)\begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - IV**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -7 & -6 & -7 \\ -6 & -3 & -6 \\ 2 & 6 & 2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & 0 & -4 \\ 2 & -3 & -2 \\ 2 & 0 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 1 & 0 \\ -1 & -3 & 0 \\ 1 & 1 & -2 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - V**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -7 & -6 & 5 \\ 7 & 6 & -5 \\ -4 & -4 & 4 \end{pmatrix} \qquad (b)\begin{pmatrix} -5 & 0 & 4 \\ -2 & -1 & 2 \\ -2 & 0 & 1 \end{pmatrix} \qquad (c)\begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\begin{pmatrix} -1 & 2 & -2 \\ 0 & -2 & 1 \\ 0 & -1 & 0 \end{pmatrix} \qquad (e)\begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - VI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} -7 & -3 & -5 \\ 7 & 3 & 5 \\ -1 & -1 & 1 \end{pmatrix}$ $(b)\ \begin{pmatrix} -6 & -2 & 4 \\ 6 & 1 & -6 \\ -2 & -1 & 0 \end{pmatrix}$ $(c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$

$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -2 & 4 & -1 \end{pmatrix}$ $(e)\ \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - VII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -6 & -8 & 5 \\ 7 & 9 & -5 \\ -6 & -6 & 7 \end{pmatrix} \qquad (b)\begin{pmatrix} -4 & 6 & 0 \\ -1 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix} \qquad (c)\begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -3 & 6 & -1 \end{pmatrix} \qquad (e)\begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - VIII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-6 & -6 & 3\\ 5 & 5 & -3\\ -4 & -4 & 3\end{pmatrix} \qquad (b)\begin{pmatrix}7 & -8 & -4\\ 0 & -1 & 0\\ 8 & -8 & -5\end{pmatrix} \qquad (c)\begin{pmatrix}2 & 0 & 3\\ 3 & -1 & 3\\ 6 & -6 & 2\end{pmatrix}$$

$$(d)\begin{pmatrix}-1 & -8 & 4\\ 0 & -5 & 2\\ 0 & -8 & 3\end{pmatrix} \qquad (e)\begin{pmatrix}2 & -1 & 0\\ -2 & 1 & -1\\ 2 & 3 & 3\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - IX**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -6 & -5 & 4 \\ 6 & 5 & -4 \\ -3 & -3 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 1 & -3 \\ 1 & -2 & 3 \\ 1 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 3 & -4 & 0 \\ 1 & -1 & 0 \\ 2 & -4 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - X**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a) \begin{pmatrix} -6 & 0 & -2 \\ -3 & 0 & -3 \\ 3 & 0 & -1 \end{pmatrix} \qquad (b) \begin{pmatrix} -1 & -2 & 6 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix} \qquad (c) \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d) \begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & -6 \\ 0 & 0 & 1 \end{pmatrix} \qquad (e) \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-6 & 5 & -6\\ -6 & 5 & -6\\ 4 & -4 & 2\end{pmatrix} \qquad (b)\begin{pmatrix}-1 & 2 & 0\\ -1 & 2 & 0\\ 0 & 0 & 1\end{pmatrix} \qquad (c)\begin{pmatrix}-3 & -2 & 3\\ -2 & -3 & 3\\ -4 & -8 & 7\end{pmatrix}$$

$$(d)\begin{pmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 3 & -6 & 1\end{pmatrix} \qquad (e)\begin{pmatrix}2 & 2 & 1\\ 3 & 0 & -3\\ -4 & 5 & 7\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XII**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -6 & 8 & -6 \\ -8 & 9 & -8 \\ 3 & -4 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -3 & -8 & 8 \\ 0 & 1 & -4 \\ 0 & 0 & -3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & -8 & -4 \\ 0 & -2 & -2 \\ 0 & 8 & 6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XIII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -5 & -9 & 2 \\ 2 & 6 & -2 \\ -5 & -5 & 2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -6 & -3 \\ 0 & -1 & -1 \\ 0 & 2 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & 1 & 2 \\ 1 & 2 & -2 \\ -1 & 1 & 5 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XIV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -5 & -7 & 1 \\ 5 & 7 & -1 \\ -3 & -3 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 2 & 2 & 0 \\ 0 & 1 & 0 \\ -2 & -4 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 7 & -4 & -2 \\ 4 & -1 & -2 \\ 0 & 0 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -5 & -6 & 0 \\ 4 & -3 & 4 \\ 6 & 6 & 1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 4 & 0 \\ 0 & 2 & 0 \\ -4 & 4 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & 2 \\ -1 & -4 & -1 \\ -1 & -1 & -4 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I $\boxed{\textbf{Tutorial-I}}$ **Matrix Set - XVI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -5 & -3 & 3 \\ 2 & 0 & -2 \\ -6 & -6 & 2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 2 & 0 & 0 \\ 8 & -2 & -4 \\ -4 & 2 & 4 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XVII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -5 & 0 & -2 \\ -3 & 1 & -3 \\ 3 & 0 & 0 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -1 & 0 \\ 0 & 2 & 0 \\ -1 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -4 & 2 & -2 \\ 0 & -2 & 0 \\ 2 & -2 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XVIII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a) \begin{pmatrix} -5 & 5 & 5 \\ -2 & 4 & 3 \\ -8 & 6 & 7 \end{pmatrix}$ $(b) \begin{pmatrix} 6 & -4 & 1 \\ 3 & -1 & 1 \\ 0 & 0 & 3 \end{pmatrix}$ $(c) \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$

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

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XIX**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-5 & 6 & -4\\ -6 & 6 & -6\\ 2 & -3 & 1\end{pmatrix} \qquad (b)\begin{pmatrix}3 & -2 & -2\\ 0 & 3 & 0\\ 0 & -2 & 1\end{pmatrix} \qquad (c)\begin{pmatrix}-3 & -2 & 3\\ -2 & -3 & 3\\ -4 & -8 & 7\end{pmatrix}$$

$$(d)\begin{pmatrix}-1 & 2 & -2\\ 0 & -2 & 1\\ 0 & -1 & 0\end{pmatrix} \qquad (e)\begin{pmatrix}2 & -1 & 0\\ -2 & 1 & -1\\ 2 & 3 & 3\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XX**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -4 & -6 & 3 \\ 5 & 7 & -3 \\ -4 & -4 & 5 \end{pmatrix} \qquad (b)\begin{pmatrix} 5 & 0 & 2 \\ 2 & 3 & 2 \\ -4 & 0 & -1 \end{pmatrix} \qquad (c)\begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -2 & 4 & -1 \end{pmatrix} \qquad (e)\begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXI**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} -4 & -5 & 3 \\ 7 & 8 & -3 \\ 5 & 5 & -2 \end{pmatrix}$ $(b)\ \begin{pmatrix} 1 & -1 & 0 \\ 2 & 4 & 0 \\ 4 & 2 & 3 \end{pmatrix}$ $(c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$

$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -3 & 6 & -1 \end{pmatrix}$ $(e)\ \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXII**

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-4 & -4 & -2\\ 7 & 7 & 2\\ 1 & 1 & 2\end{pmatrix}\qquad (b)\begin{pmatrix}-3 & 4 & 4\\ 0 & -3 & 0\\ 0 & 2 & -1\end{pmatrix}\qquad (c)\begin{pmatrix}3 & -1 & -1\\ 0 & 2 & -1\\ 1 & -1 & 3\end{pmatrix}$$

$$(d)\begin{pmatrix}-1 & -8 & 4\\ 0 & -5 & 2\\ 0 & -8 & 3\end{pmatrix}\qquad (e)\begin{pmatrix}2 & 2 & 1\\ 3 & 0 & -3\\ -4 & 5 & 7\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} -4 & -4 & 1 \\ -3 & -3 & 3 \\ -6 & -6 & 3 \end{pmatrix} \quad (b)\ \begin{pmatrix} 0 & 0 & 3 \\ -2 & -2 & -3 \\ -2 & 0 & -5 \end{pmatrix} \quad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$

$(d)\ \begin{pmatrix} 3 & -4 & 0 \\ 1 & -1 & 0 \\ 2 & -4 & 1 \end{pmatrix} \quad (e)\ \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXIV**

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-4 & -4 & 5\\ 3 & 3 & -5\\ 4 & 4 & -5\end{pmatrix}\qquad (b)\begin{pmatrix}-7 & 5 & -5\\ -5 & 3 & -5\\ 5 & -5 & 3\end{pmatrix}\qquad (c)\begin{pmatrix}2 & 0 & 3\\ 3 & -1 & 3\\ 6 & -6 & 2\end{pmatrix}$$

$$(d)\begin{pmatrix}1 & 0 & 0\\ 3 & 1 & -6\\ 0 & 0 & 1\end{pmatrix}\qquad (e)\begin{pmatrix}0 & 2 & 4\\ -1 & 0 & 1\\ -2 & -2 & -6\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXV**

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-4 & -3 & -1\\ -2 & 3 & -2\\ 2 & 6 & -1\end{pmatrix}\qquad (b)\begin{pmatrix}1 & 0 & -4\\ 2 & -3 & -2\\ 2 & 0 & -5\end{pmatrix}\qquad (c)\begin{pmatrix}-2 & -6 & 3\\ 4 & 0 & 5\\ 2 & 4 & -1\end{pmatrix}$$

$$(d)\begin{pmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 3 & -6 & 1\end{pmatrix}\qquad (e)\begin{pmatrix}-4 & -2 & 6\\ -4 & -6 & 6\\ -3 & -3 & 4\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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Quantum Mechanics-I $\boxed{\textbf{Tutorial-I}}$ **Matrix Set - XXVI**

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-4 & -2 & -5\\ 2 & 0 & 2\\ 2 & 2 & 3\end{pmatrix} \quad (b)\begin{pmatrix}-5 & 0 & 4\\ -2 & -1 & 2\\ -2 & 0 & 1\end{pmatrix} \quad (c)\begin{pmatrix}-4 & -8 & -7\\ 1 & -3 & 1\\ 3 & 7 & 6\end{pmatrix}$$

$$(d)\begin{pmatrix}2 & -8 & -4\\ 0 & -2 & -2\\ 0 & 8 & 6\end{pmatrix} \quad (e)\begin{pmatrix}-6 & 4 & 4\\ -2 & 0 & 2\\ -1 & 0 & 0\end{pmatrix}$$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXVII**

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -4 & -1 & -3 \\ 3 & 0 & 3 \\ -1 & -1 & 0 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -6 & -2 & 4 \\ 6 & 1 & -6 \\ -2 & -1 & 0 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & 1 & 2 \\ 1 & 2 & -2 \\ -1 & 1 & 5 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXVIII**

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-4 & -1 & 2\\ -4 & -1 & 2\\ -5 & 1 & 1\end{pmatrix} \qquad (b)\begin{pmatrix}-4 & 6 & 0\\ -1 & 1 & 0\\ 0 & 0 & -1\end{pmatrix} \qquad (c)\begin{pmatrix}-1 & 0 & 2\\ 0 & -3 & 6\\ 0 & -1 & 2\end{pmatrix}$$

$$(d)\begin{pmatrix}7 & -4 & -2\\ 4 & -1 & -2\\ 0 & 0 & 3\end{pmatrix} \qquad (e)\begin{pmatrix}2 & -1 & -3\\ -1 & 0 & 1\\ 4 & -2 & -5\end{pmatrix}$$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXIX**

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} -4 & 0 & -6 \\ 4 & 0 & 6 \\ 1 & 0 & 1 \end{pmatrix}$ $(b)\ \begin{pmatrix} 7 & -8 & -4 \\ 0 & -1 & 0 \\ 8 & -8 & -5 \end{pmatrix}$ $(c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$

$(d)\ \begin{pmatrix} -1 & 2 & 2 \\ -1 & -4 & -1 \\ -1 & -1 & -4 \end{pmatrix}$ $(e)\ \begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXX**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} -4 & 2 & 2 \\ -4 & 2 & 2 \\ 4 & -4 & -4 \end{pmatrix}$ $(b)\ \begin{pmatrix} -2 & 1 & -3 \\ 1 & -2 & 3 \\ 1 & -1 & 2 \end{pmatrix}$ $(c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$

$(d)\ \begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix}$ $(e)\ \begin{pmatrix} 2 & -1 & 0 \\ -2 & 1 & -1 \\ 2 & 3 & 3 \end{pmatrix}$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXXI**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -4 & 4 & 4 \\ -7 & 7 & 4 \\ 7 & -7 & -4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -1 & -2 & 6 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -4 & 2 & -2 \\ 0 & -2 & 0 \\ 2 & -2 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$$

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXXII**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -4 & 4 & 4 \\ -5 & 5 & 4 \\ 5 & -5 & -4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -1 & 2 & 0 \\ -1 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 1 & 0 \\ -1 & -3 & 0 \\ 1 & 1 & -2 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$$

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -4 & 6 & 6 \\ -2 & 4 & 5 \\ -2 & 2 & 1 \end{pmatrix} \qquad (b)\begin{pmatrix} -3 & -8 & 8 \\ 0 & 1 & -4 \\ 0 & 0 & -3 \end{pmatrix} \qquad (c)\begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\begin{pmatrix} -1 & 2 & -2 \\ 0 & -2 & 1 \\ 0 & -1 & 0 \end{pmatrix} \qquad (e)\begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$$

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I $\boxed{\textbf{Tutorial-I}}$ **Matrix Set - XXXIV**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} -4 & 6 & 6 \\ 2 & 0 & 3 \\ -6 & 6 & 3 \end{pmatrix}$ $(b)\ \begin{pmatrix} 1 & -6 & -3 \\ 0 & -1 & -1 \\ 0 & 2 & 2 \end{pmatrix}$ $(c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$

$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -2 & 4 & -1 \end{pmatrix}$ $(e)\ \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXXV**

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-3 & -7 & 1\\ 1 & 5 & -1\\ -5 & -5 & 3\end{pmatrix}\qquad (b)\begin{pmatrix}2 & 2 & 0\\ 0 & 1 & 0\\ -2 & -4 & 1\end{pmatrix}\qquad (c)\begin{pmatrix}-3 & -2 & 3\\ -2 & -3 & 3\\ -4 & -8 & 7\end{pmatrix}$$

$$(d)\begin{pmatrix}-3 & 4 & 0\\ -1 & 1 & 0\\ -3 & 6 & -1\end{pmatrix}\qquad (e)\begin{pmatrix}0 & 2 & 4\\ -1 & 0 & 1\\ -2 & -2 & -6\end{pmatrix}$$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXXVI**

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -3 & -6 & -4 \\ -5 & -2 & -5 \\ 6 & 6 & 7 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 4 & 0 \\ 0 & 2 & 0 \\ -4 & 4 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & -8 & 4 \\ 0 & -5 & 2 \\ 0 & -8 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXXVII**

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -3 & -4 & -6 \\ 5 & 6 & 6 \\ 5 & 5 & 7 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 2 & 0 & 0 \\ 8 & -2 & -4 \\ -4 & 2 & 4 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 3 & -4 & 0 \\ 1 & -1 & 0 \\ 2 & -4 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXXVIII**

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$$(a)\ \begin{pmatrix} -3 & -4 & -5 \\ -1 & 0 & -1 \\ 4 & 4 & 6 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -1 & 0 \\ 0 & 2 & 0 \\ -1 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & -6 \\ 0 & 0 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XXXIX**

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a) \begin{pmatrix} -3 & -3 & -5 \\ 4 & 4 & 5 \\ 4 & 4 & 5 \end{pmatrix} \qquad (b) \begin{pmatrix} 6 & -4 & 1 \\ 3 & -1 & 1 \\ 0 & 0 & 3 \end{pmatrix} \qquad (c) \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d) \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 3 & -6 & 1 \end{pmatrix} \qquad (e) \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I $\boxed{\textbf{Tutorial-I}}$ **Matrix Set - XL**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -3 & -3 & 0 \\ 4 & 2 & 2 \\ 3 & -3 & 6 \end{pmatrix} \qquad (b)\begin{pmatrix} 3 & -2 & -2 \\ 0 & 3 & 0 \\ 0 & -2 & 1 \end{pmatrix} \qquad (c)\begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\begin{pmatrix} 2 & -8 & -4 \\ 0 & -2 & -2 \\ 0 & 8 & 6 \end{pmatrix} \qquad (e)\begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XLI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -3 & 0 & -8 \\ 1 & -2 & 8 \\ 4 & 0 & 9 \end{pmatrix} \qquad (b)\begin{pmatrix} 5 & 0 & 2 \\ 2 & 3 & 2 \\ -4 & 0 & -1 \end{pmatrix} \qquad (c)\begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\begin{pmatrix} 2 & 1 & 2 \\ 1 & 2 & -2 \\ -1 & 1 & 5 \end{pmatrix} \qquad (e)\begin{pmatrix} 2 & -1 & 0 \\ -2 & 1 & -1 \\ 2 & 3 & 3 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XLII**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-3 & 1 & 1\\ 5 & -3 & -3\\ -7 & 3 & 3\end{pmatrix} \qquad (b)\begin{pmatrix}1 & -1 & 0\\ 2 & 4 & 0\\ 4 & 2 & 3\end{pmatrix} \qquad (c)\begin{pmatrix}-4 & -8 & -7\\ 1 & -3 & 1\\ 3 & 7 & 6\end{pmatrix}$$

$$(d)\begin{pmatrix}7 & -4 & -2\\ 4 & -1 & -2\\ 0 & 0 & 3\end{pmatrix} \qquad (e)\begin{pmatrix}-4 & -6 & -3\\ 8 & 8 & 4\\ 0 & 3 & 2\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XLIII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -3 & 5 & 5 \\ 6 & -4 & 1 \\ -6 & 6 & 1 \end{pmatrix} \qquad (b)\begin{pmatrix} -3 & 4 & 4 \\ 0 & -3 & 0 \\ 0 & 2 & -1 \end{pmatrix} \qquad (c)\begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\begin{pmatrix} -1 & 2 & 2 \\ -1 & -4 & -1 \\ -1 & -1 & -4 \end{pmatrix} \qquad (e)\begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XLIV**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\begin{pmatrix} -3 & 6 & -2 \\ 4 & 2 & 4 \\ 7 & -6 & 6 \end{pmatrix}$ $(b)\begin{pmatrix} 0 & 0 & 3 \\ -2 & -2 & -3 \\ -2 & 0 & -5 \end{pmatrix}$ $(c)\begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$

$(d)\begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix}$ $(e)\begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XLV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-2 & -5 & 1\\ 1 & 4 & -1\\ -3 & -3 & 2\end{pmatrix}\qquad (b)\begin{pmatrix}-7 & 5 & -5\\ -5 & 3 & -5\\ 5 & -5 & 3\end{pmatrix}\qquad (c)\begin{pmatrix}1 & -1 & 0\\ -1 & 1 & 1\\ -1 & -1 & 2\end{pmatrix}$$

$$(d)\begin{pmatrix}-4 & 2 & -2\\ 0 & -2 & 0\\ 2 & -2 & 0\end{pmatrix}\qquad (e)\begin{pmatrix}-1 & 1 & 2\\ 2 & -2 & 5\\ -2 & -1 & -6\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I $\boxed{\textbf{Tutorial-I}}$ **Matrix Set - XLVI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -2 & -3 & 1 \\ 5 & 6 & -1 \\ 3 & 3 & 0 \end{pmatrix} \qquad (b)\begin{pmatrix} 1 & 0 & -4 \\ 2 & -3 & -2 \\ 2 & 0 & -5 \end{pmatrix} \qquad (c)\begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\begin{pmatrix} -1 & 1 & 0 \\ -1 & -3 & 0 \\ 1 & 1 & -2 \end{pmatrix} \qquad (e)\begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XLVII**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -2 & -1 & -5 \\ 4 & 3 & 5 \\ -2 & -2 & 4 \end{pmatrix} \quad (b)\begin{pmatrix} -5 & 0 & 4 \\ -2 & -1 & 2 \\ -2 & 0 & 1 \end{pmatrix} \quad (c)\begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\begin{pmatrix} -1 & 2 & -2 \\ 0 & -2 & 1 \\ 0 & -1 & 0 \end{pmatrix} \quad (e)\begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XLVIII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-2 & 0 & -6\\ 0 & -2 & 6\\ 3 & 0 & 7\end{pmatrix} \qquad (b)\begin{pmatrix}-6 & -2 & 4\\ 6 & 1 & -6\\ -2 & -1 & 0\end{pmatrix} \qquad (c)\begin{pmatrix}2 & 0 & 3\\ 3 & -1 & 3\\ 6 & -6 & 2\end{pmatrix}$$

$$(d)\begin{pmatrix}-3 & 4 & 0\\ -1 & 1 & 0\\ -2 & 4 & -1\end{pmatrix} \qquad (e)\begin{pmatrix}-6 & 4 & 4\\ -2 & 0 & 2\\ -1 & 0 & 0\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XLIX**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -2 & 0 & -6 \\ 3 & 1 & 6 \\ 3 & 3 & 4 \end{pmatrix} \qquad (b)\begin{pmatrix} -4 & 6 & 0 \\ -1 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix} \qquad (c)\begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -3 & 6 & -1 \end{pmatrix} \qquad (e)\begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - L**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -2 & 0 & -4 \\ -1 & -3 & 4 \\ 2 & 0 & 4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 7 & -8 & -4 \\ 0 & -1 & 0 \\ 8 & -8 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & -8 & 4 \\ 0 & -5 & 2 \\ 0 & -8 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}-2 & 0 & 3\\ -6 & 4 & 3\\ -2 & 0 & 3\end{pmatrix} \quad (b)\begin{pmatrix}-2 & 1 & -3\\ 1 & -2 & 3\\ 1 & -1 & 2\end{pmatrix} \quad (c)\begin{pmatrix}-3 & -2 & 3\\ -2 & -3 & 3\\ -4 & -8 & 7\end{pmatrix}$$

$$(d)\begin{pmatrix}3 & -4 & 0\\ 1 & -1 & 0\\ 2 & -4 & 1\end{pmatrix} \quad (e)\begin{pmatrix}0 & 1 & 0\\ -1 & 2 & 0\\ 2 & -3 & 1\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -2 & 0 & 3 \\ 0 & -2 & 6 \\ -2 & 0 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -1 & -2 & 6 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & -6 \\ 0 & 0 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & 0 \\ -2 & 1 & -1 \\ 2 & 3 & 3 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LIII**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} -2 & 1 & 1 \\ -2 & 1 & 1 \\ 2 & -2 & -2 \end{pmatrix}$ $(b)\ \begin{pmatrix} -1 & 2 & 0 \\ -1 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ $(c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$

$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 3 & -6 & 1 \end{pmatrix}$ $(e)\ \begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LIV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -2 & 2 & -6 \\ 2 & -2 & 6 \\ 2 & 2 & 2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -3 & -8 & 8 \\ 0 & 1 & -4 \\ 0 & 0 & -3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & -8 & -4 \\ 0 & -2 & -2 \\ 0 & 8 & 6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -2 & 2 & -2 \\ -5 & 6 & -7 \\ -1 & 2 & -3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -6 & -3 \\ 0 & -1 & -1 \\ 0 & 2 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & 1 & 2 \\ 1 & 2 & -2 \\ -1 & 1 & 5 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LVI**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\begin{pmatrix} -2 & 3 & 3 \\ 2 & -1 & 1 \\ -4 & 4 & 2 \end{pmatrix}$ $(b)\begin{pmatrix} 2 & 2 & 0 \\ 0 & 1 & 0 \\ -2 & -4 & 1 \end{pmatrix}$ $(c)\begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$

$(d)\begin{pmatrix} 7 & -4 & -2 \\ 4 & -1 & -2 \\ 0 & 0 & 3 \end{pmatrix}$ $(e)\begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LVII**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -2 & 3 & 3 \\ 4 & -3 & 0 \\ -6 & 6 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 4 & 0 \\ 0 & 2 & 0 \\ -4 & 4 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & 2 \\ -1 & -4 & -1 \\ -1 & -1 & -4 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LVIII**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -1 & -3 & -3 \\ 1 & 3 & 3 \\ 1 & 1 & -1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 2 & 0 & 0 \\ 8 & -2 & -4 \\ -4 & 2 & 4 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LIX**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -1 & -3 & 1 \\ 1 & -1 & 1 \\ 1 & 3 & -1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -1 & 0 \\ 0 & 2 & 0 \\ -1 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -4 & 2 & -2 \\ 0 & -2 & 0 \\ 2 & -2 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LX**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a) \begin{pmatrix} -1 & -2 & -4 \\ 3 & 4 & 4 \\ 3 & 3 & 5 \end{pmatrix} \qquad (b) \begin{pmatrix} 6 & -4 & 1 \\ 3 & -1 & 1 \\ 0 & 0 & 3 \end{pmatrix} \qquad (c) \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d) \begin{pmatrix} -1 & 1 & 0 \\ -1 & -3 & 0 \\ 1 & 1 & -2 \end{pmatrix} \qquad (e) \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -1 & -2 & -2 \\ -1 & -2 & -2 \\ 1 & -1 & -1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 3 & -2 & -2 \\ 0 & 3 & 0 \\ 0 & -2 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & -2 \\ 0 & -2 & 1 \\ 0 & -1 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I $\boxed{\textbf{Tutorial-I}}$ **Matrix Set - LXII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -1 & -1 & -3 \\ -3 & -3 & 3 \\ -7 & -7 & 3 \end{pmatrix} \qquad (b)\begin{pmatrix} 5 & 0 & 2 \\ 2 & 3 & 2 \\ -4 & 0 & -1 \end{pmatrix} \qquad (c)\begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -2 & 4 & -1 \end{pmatrix} \qquad (e)\begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXIII**

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -1 & -1 & -3 \\ 2 & 2 & 3 \\ 2 & 2 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -1 & 0 \\ 2 & 4 & 0 \\ 4 & 2 & 3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -3 & 6 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & 0 \\ -2 & 1 & -1 \\ 2 & 3 & 3 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I $\boxed{\textbf{Tutorial-I}}$ **Matrix Set - LXIV**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -1 & 0 & -8 \\ 4 & 3 & 8 \\ -4 & -4 & 7 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -3 & 4 & 4 \\ 0 & -3 & 0 \\ 0 & 2 & -1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & -8 & 4 \\ 0 & -5 & 2 \\ 0 & -8 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXV**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -1 & 0 & -6 \\ 3 & 2 & 6 \\ -3 & -3 & 5 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 0 & 0 & 3 \\ -2 & -2 & -3 \\ -2 & 0 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 3 & -4 & 0 \\ 1 & -1 & 0 \\ 2 & -4 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXVI**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} -1 & 0 & -1 \\ 3 & 4 & -3 \\ 6 & 0 & 4 \end{pmatrix} \qquad (b)\begin{pmatrix} -7 & 5 & -5 \\ -5 & 3 & -5 \\ 5 & -5 & 3 \end{pmatrix} \qquad (c)\begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d)\begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & -6 \\ 0 & 0 & 1 \end{pmatrix} \qquad (e)\begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXVII**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -1 & 2 & 3 \\ 5 & 2 & 3 \\ -4 & -4 & -6 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & 0 & -4 \\ 2 & -3 & -2 \\ 2 & 0 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 3 & -6 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXVIII**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -1 & 3 & -7 \\ -1 & -5 & 7 \\ -5 & -5 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -5 & 0 & 4 \\ -2 & -1 & 2 \\ -2 & 0 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & -8 & -4 \\ 0 & -2 & -2 \\ 0 & 8 & 6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXIX**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -1 & 3 & -1 \\ 1 & -3 & 1 \\ -1 & -3 & -1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -6 & -2 & 4 \\ 6 & 1 & -6 \\ -2 & -1 & 0 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & 1 & 2 \\ 1 & 2 & -2 \\ -1 & 1 & 5 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXX**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} -1 & 6 & 1 \\ 0 & 7 & -2 \\ 0 & 6 & 0 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -4 & 6 & 0 \\ -1 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 7 & -4 & -2 \\ 4 & -1 & -2 \\ 0 & 0 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXI**

Eigenvalues and Eigenvectors

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 0 & -6 & 5 \\ -3 & -3 & 5 \\ -2 & -8 & 9 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 7 & -8 & -4 \\ 0 & -1 & 0 \\ 8 & -8 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & 2 \\ -1 & -4 & -1 \\ -1 & -1 & -4 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXII**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 0 & -3 & -3 \\ -1 & -2 & -3 \\ 1 & -1 & 0 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 1 & -3 \\ 1 & -2 & 3 \\ 1 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$$

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXIII**

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} 0 & -3 & 3 \\ -6 & 4 & -6 \\ -6 & 3 & -5 \end{pmatrix} \qquad (b)\begin{pmatrix} -1 & -2 & 6 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix} \qquad (c)\begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\begin{pmatrix} -4 & 2 & -2 \\ 0 & -2 & 0 \\ 2 & -2 & 0 \end{pmatrix} \qquad (e)\begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXIV**

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} 0 & -2 & -2 \\ -1 & -1 & -2 \\ 1 & -1 & 0 \end{pmatrix} \qquad (b)\begin{pmatrix} -1 & 2 & 0 \\ -1 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad (c)\begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d)\begin{pmatrix} -1 & 1 & 0 \\ -1 & -3 & 0 \\ 1 & 1 & -2 \end{pmatrix} \qquad (e)\begin{pmatrix} 2 & -1 & 0 \\ -2 & 1 & -1 \\ 2 & 3 & 3 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXV**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 0 & 0 & -4 \\ 2 & 0 & 6 \\ 2 & 0 & 6 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -3 & -8 & 8 \\ 0 & 1 & -4 \\ 0 & 0 & -3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & -2 \\ 0 & -2 & 1 \\ 0 & -1 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXVI**

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\begin{pmatrix} 0 & 0 & -4 \\ 2 & 2 & 4 \\ 2 & 2 & 4 \end{pmatrix}$ $(b)\begin{pmatrix} 1 & -6 & -3 \\ 0 & -1 & -1 \\ 0 & 2 & 2 \end{pmatrix}$ $(c)\begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$

$(d)\begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -2 & 4 & -1 \end{pmatrix}$ $(e)\begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXVII**

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 0 & 1 & -4 \\ -4 & -5 & 4 \\ -7 & -7 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 2 & 2 & 0 \\ 0 & 1 & 0 \\ -2 & -4 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -3 & 6 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXVIII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 0 & 2 & 0 \\ 2 & 1 & 2 \\ 2 & -2 & 2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 4 & 0 \\ 0 & 2 & 0 \\ -4 & 4 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & -8 & 4 \\ 0 & -5 & 2 \\ 0 & -8 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXIX**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 0 & 2 & 7 \\ 0 & 1 & -4 \\ 0 & 2 & 7 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 2 & 0 & 0 \\ 8 & -2 & -4 \\ -4 & 2 & 4 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 3 & -4 & 0 \\ 1 & -1 & 0 \\ 2 & -4 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXX**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 0 & 4 & -6 \\ -3 & -7 & 6 \\ -5 & -5 & 2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -1 & 0 \\ 0 & 2 & 0 \\ -1 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & -6 \\ 0 & 0 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXXI**

Eigenvalues and Eigenvectors

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 0 & 4 & -6 \\ 1 & -3 & 6 \\ 1 & 1 & 2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 6 & -4 & 1 \\ 3 & -1 & 1 \\ 0 & 0 & 3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 3 & -6 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXXII**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 0 & 4 & -4 \\ -6 & -2 & 0 \\ 0 & -8 & 8 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 3 & -2 & -2 \\ 0 & 3 & 0 \\ 0 & -2 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & -8 & -4 \\ 0 & -2 & -2 \\ 0 & 8 & 6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXXIII**

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}1 & -2 & 0\\ -3 & 0 & -3\\ 2 & 2 & 3\end{pmatrix}\qquad (b)\begin{pmatrix}5 & 0 & 2\\ 2 & 3 & 2\\ -4 & 0 & -1\end{pmatrix}\qquad (c)\begin{pmatrix}-3 & -2 & 3\\ -2 & -3 & 3\\ -4 & -8 & 7\end{pmatrix}$$

$$(d)\begin{pmatrix}2 & 1 & 2\\ 1 & 2 & -2\\ -1 & 1 & 5\end{pmatrix}\qquad (e)\begin{pmatrix}2 & -1 & -3\\ -1 & 0 & 1\\ 4 & -2 & -5\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXXIV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix}1 & -1 & 1\\ 5 & -3 & 1\\ 3 & -1 & -1\end{pmatrix} \qquad (b)\ \begin{pmatrix}1 & -1 & 0\\ 2 & 4 & 0\\ 4 & 2 & 3\end{pmatrix} \qquad (c)\ \begin{pmatrix}-1 & 0 & 2\\ 0 & -3 & 6\\ 0 & -1 & 2\end{pmatrix}$$

$$(d)\ \begin{pmatrix}7 & -4 & -2\\ 4 & -1 & -2\\ 0 & 0 & 3\end{pmatrix} \qquad (e)\ \begin{pmatrix}0 & 1 & 0\\ -1 & 2 & 0\\ 2 & -3 & 1\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXXV**

Eigenvalues and Eigenvectors

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- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}1 & -1 & 2\\ 0 & 2 & -2\\ 1 & 1 & 0\end{pmatrix} \qquad (b)\begin{pmatrix}-3 & 4 & 4\\ 0 & -3 & 0\\ 0 & 2 & -1\end{pmatrix} \qquad (c)\begin{pmatrix}1 & -1 & 0\\ -1 & 1 & 1\\ -1 & -1 & 2\end{pmatrix}$$

$$(d)\begin{pmatrix}-1 & 2 & 2\\ -1 & -4 & -1\\ -1 & -1 & -4\end{pmatrix} \qquad (e)\begin{pmatrix}2 & -1 & 0\\ -2 & 1 & -1\\ 2 & 3 & 3\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXXVI**

Eigenvalues and Eigenvectors

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 1 & 0 & -4 \\ 2 & 3 & 4 \\ 2 & 2 & 5 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 0 & 0 & 3 \\ -2 & -2 & -3 \\ -2 & 0 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXXVII**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} 1 & 0 & -2 \\ 1 & 0 & 4 \\ 1 & 0 & 4 \end{pmatrix}$ $(b)\ \begin{pmatrix} -7 & 5 & -5 \\ -5 & 3 & -5 \\ 5 & -5 & 3 \end{pmatrix}$ $(c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$

$(d)\ \begin{pmatrix} -4 & 2 & -2 \\ 0 & -2 & 0 \\ 2 & -2 & 0 \end{pmatrix}$ $(e)\ \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXXVIII**

Eigenvalues and Eigenvectors

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- The first matirix has three distinct eigenvalues.
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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} 1 & 0 & 6 \\ -6 & -5 & -6 \\ 6 & 6 & -2 \end{pmatrix}$ $(b)\ \begin{pmatrix} 1 & 0 & -4 \\ 2 & -3 & -2 \\ 2 & 0 & -5 \end{pmatrix}$ $(c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$

$(d)\ \begin{pmatrix} -1 & 1 & 0 \\ -1 & -3 & 0 \\ 1 & 1 & -2 \end{pmatrix}$ $(e)\ \begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - LXXXIX**

Eigenvalues and Eigenvectors

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- The first matirix has three distinct eigenvalues.
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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} 1 & 1 & -3 \\ 0 & 0 & 3 \\ -2 & -2 & 3 \end{pmatrix} \qquad (b)\begin{pmatrix} -5 & 0 & 4 \\ -2 & -1 & 2 \\ -2 & 0 & 1 \end{pmatrix} \qquad (c)\begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\begin{pmatrix} -1 & 2 & -2 \\ 0 & -2 & 1 \\ 0 & -1 & 0 \end{pmatrix} \qquad (e)\begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XC**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 1 & 1 & -3 \\ 1 & 1 & 3 \\ 1 & 1 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -6 & -2 & 4 \\ 6 & 1 & -6 \\ -2 & -1 & 0 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -2 & 4 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XCI**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 1 & 1 & -1 \\ -1 & -1 & 1 \\ 5 & -1 & -5 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -4 & 6 & 0 \\ -1 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -3 & 6 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XCII**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 1 & 1 & 1 \\ 0 & -3 & -6 \\ -2 & 1 & 4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 7 & -8 & -4 \\ 0 & -1 & 0 \\ 8 & -8 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & -8 & 4 \\ 0 & -5 & 2 \\ 0 & -8 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XCIII**

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 1 & 2 & -8 \\ 1 & 0 & 8 \\ -5 & -5 & 7 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 1 & -3 \\ 1 & -2 & 3 \\ 1 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 3 & -4 & 0 \\ 1 & -1 & 0 \\ 2 & -4 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XCIV**

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 1 & 2 & -2 \\ -3 & 9 & -9 \\ 1 & 2 & -2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -1 & -2 & 6 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & -6 \\ 0 & 0 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - XCV**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 1 & 2 & 3 \\ 0 & -6 & -6 \\ 0 & 4 & 4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -1 & 2 & 0 \\ -1 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 3 & -6 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XCVI**

Eigenvalues and Eigenvectors

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 1 & 3 & 3 \\ -9 & 1 & -3 \\ 9 & -3 & 1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -3 & -8 & 8 \\ 0 & 1 & -4 \\ 0 & 0 & -3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & -8 & -4 \\ 0 & -2 & -2 \\ 0 & 8 & 6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & 0 \\ -2 & 1 & -1 \\ 2 & 3 & 3 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XCVII**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix}1 & 4 & 2\\ -4 & 6 & -4\\ -1 & -2 & -2\end{pmatrix} \qquad (b)\begin{pmatrix}1 & -6 & -3\\ 0 & -1 & -1\\ 0 & 2 & 2\end{pmatrix} \qquad (c)\begin{pmatrix}-2 & -6 & 3\\ 4 & 0 & 5\\ 2 & 4 & -1\end{pmatrix}$$

$$(d)\begin{pmatrix}2 & 1 & 2\\ 1 & 2 & -2\\ -1 & 1 & 5\end{pmatrix} \qquad (e)\begin{pmatrix}-4 & -6 & -3\\ 8 & 8 & 4\\ 0 & 3 & 2\end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XCVIII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} 2 & -5 & 3 \\ 1 & -4 & 3 \\ 3 & -9 & 6 \end{pmatrix}$ $(b)\ \begin{pmatrix} 2 & 2 & 0 \\ 0 & 1 & 0 \\ -2 & -4 & 1 \end{pmatrix}$ $(c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$

$(d)\ \begin{pmatrix} 7 & -4 & -2 \\ 4 & -1 & -2 \\ 0 & 0 & 3 \end{pmatrix}$ $(e)\ \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - XCIX**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & -4 & -3 \\ -4 & 8 & 6 \\ 2 & -8 & -5 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 4 & 0 \\ 0 & 2 & 0 \\ -4 & 4 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & 2 \\ -1 & -4 & -1 \\ -1 & -1 & -4 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - C**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & -4 & -2 \\ -1 & 1 & -2 \\ 0 & 2 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 2 & 0 & 0 \\ 8 & -2 & -4 \\ -4 & 2 & 4 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} 2 & -4 & -1 \\ -5 & 1 & -5 \\ 4 & 4 & 7 \end{pmatrix} \qquad (b)\begin{pmatrix} 1 & -1 & 0 \\ 0 & 2 & 0 \\ -1 & -1 & 2 \end{pmatrix} \qquad (c)\begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\begin{pmatrix} -4 & 2 & -2 \\ 0 & -2 & 0 \\ 2 & -2 & 0 \end{pmatrix} \qquad (e)\begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & -3 & 1 \\ -2 & 5 & -2 \\ -2 & 6 & -1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 6 & -4 & 1 \\ 3 & -1 & 1 \\ 0 & 0 & 3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 1 & 0 \\ -1 & -3 & 0 \\ 1 & 1 & -2 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CIII**

EIGENVALUES AND EIGENVECTORS

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} 2 & -2 & -2 \\ -3 & -3 & -6 \\ 7 & -1 & 2 \end{pmatrix} \qquad (b)\begin{pmatrix} 3 & -2 & -2 \\ 0 & 3 & 0 \\ 0 & -2 & 1 \end{pmatrix} \qquad (c)\begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\begin{pmatrix} -1 & 2 & -2 \\ 0 & -2 & 1 \\ 0 & -1 & 0 \end{pmatrix} \qquad (e)\begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CIV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & -2 & 1 \\ -4 & 0 & -4 \\ 2 & 2 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 5 & 0 & 2 \\ 2 & 3 & 2 \\ -4 & 0 & -1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -2 & 4 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & 0 & -2 \\ -4 & -2 & 2 \\ 1 & 0 & 5 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -1 & 0 \\ 2 & 4 & 0 \\ 4 & 2 & 3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -3 & 6 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I $\boxed{\textbf{Tutorial-I}}$ **Matrix Set - CVI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & 2 & 2 \\ -6 & 2 & -2 \\ 6 & -2 & 2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -3 & 4 & 4 \\ 0 & -3 & 0 \\ 0 & 2 & -1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & -8 & 4 \\ 0 & -5 & 2 \\ 0 & -8 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CVII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & 2 & 2 \\ -5 & -6 & -7 \\ 1 & 2 & 3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 0 & 0 & 3 \\ -2 & -2 & -3 \\ -2 & 0 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 3 & -4 & 0 \\ 1 & -1 & 0 \\ 2 & -4 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & 0 \\ -2 & 1 & -1 \\ 2 & 3 & 3 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CVIII**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & 2 & 2 \\ 4 & 1 & 4 \\ 1 & -2 & 1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -7 & 5 & -5 \\ -5 & 3 & -5 \\ 5 & -5 & 3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & -6 \\ 0 & 0 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CIX**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & 3 & 1 \\ -2 & -3 & -1 \\ -4 & -4 & -2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & 0 & -4 \\ 2 & -3 & -2 \\ 2 & 0 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 3 & -6 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CX**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} 2 & 3 & 1 \\ 3 & 4 & -3 \\ 7 & 9 & -4 \end{pmatrix}$ $(b)\ \begin{pmatrix} -5 & 0 & 4 \\ -2 & -1 & 2 \\ -2 & 0 & 1 \end{pmatrix}$ $(c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$

$(d)\ \begin{pmatrix} 2 & -8 & -4 \\ 0 & -2 & -2 \\ 0 & 8 & 6 \end{pmatrix}$ $(e)\ \begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & 3 & 3 \\ -3 & 4 & 1 \\ 3 & -5 & -2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -6 & -2 & 4 \\ 6 & 1 & -6 \\ -2 & -1 & 0 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & 1 & 2 \\ 1 & 2 & -2 \\ -1 & 1 & 5 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 2 & 3 & 3 \\ -2 & -3 & -2 \\ -6 & -6 & 5 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -4 & 6 & 0 \\ -1 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 7 & -4 & -2 \\ 4 & -1 & -2 \\ 0 & 0 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXIII**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 3 & -6 & 0 \\ -1 & 0 & -2 \\ -1 & 3 & 1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 7 & -8 & -4 \\ 0 & -1 & 0 \\ 8 & -8 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & 2 \\ -1 & -4 & -1 \\ -1 & -1 & -4 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXIV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} 3 & -1 & 1 \\ 5 & -1 & 1 \\ 3 & -1 & 1 \end{pmatrix}$ $(b)\ \begin{pmatrix} -2 & 1 & -3 \\ 1 & -2 & 3 \\ 1 & -1 & 2 \end{pmatrix}$ $(c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$

$(d)\ \begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix}$ $(e)\ \begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 3 & 0 & -6 \\ -1 & -1 & 1 \\ 1 & -2 & -4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -1 & -2 & 6 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -4 & 2 & -2 \\ 0 & -2 & 0 \\ 2 & -2 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXVI**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} 3 & 0 & -3 \\ -6 & 6 & -6 \\ 2 & 0 & -2 \end{pmatrix} \qquad (b)\begin{pmatrix} -1 & 2 & 0 \\ -1 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad (c)\begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\begin{pmatrix} -1 & 1 & 0 \\ -1 & -3 & 0 \\ 1 & 1 & -2 \end{pmatrix} \qquad (e)\begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXVII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 3 & 0 & 2 \\ 6 & -1 & 0 \\ -3 & 2 & 4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -3 & -8 & 8 \\ 0 & 1 & -4 \\ 0 & 0 & -3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & -2 \\ 0 & -2 & 1 \\ 0 & -1 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXVIII**

EIGENVALUES AND EIGENVECTORS

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 3 & 1 & 2 \\ -2 & 0 & -2 \\ -5 & -1 & -4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -6 & -3 \\ 0 & -1 & -1 \\ 0 & 2 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -2 & 4 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & 0 \\ -2 & 1 & -1 \\ 2 & 3 & 3 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXIX**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 3 & 2 & -2 \\ 6 & 6 & -6 \\ 6 & 4 & -4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 2 & 2 & 0 \\ 0 & 1 & 0 \\ -2 & -4 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -3 & 6 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXX**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 3 & 2 & 6 \\ -2 & 3 & -2 \\ -3 & -1 & -6 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 4 & 0 \\ 0 & 2 & 0 \\ -4 & 4 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & -8 & 4 \\ 0 & -5 & 2 \\ 0 & -8 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXI**

EIGENVALUES AND EIGENVECTORS

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} 3 & 3 & -5 \\ -2 & -2 & 5 \\ -4 & -4 & 5 \end{pmatrix} \qquad (b)\begin{pmatrix} 2 & 0 & 0 \\ 8 & -2 & -4 \\ -4 & 2 & 4 \end{pmatrix} \qquad (c)\begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\begin{pmatrix} 3 & -4 & 0 \\ 1 & -1 & 0 \\ 2 & -4 & 1 \end{pmatrix} \qquad (e)\begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXII**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 3 & 6 & 3 \\ -4 & -7 & -2 \\ -6 & -6 & 4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -1 & 0 \\ 0 & 2 & 0 \\ -1 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & -6 \\ 0 & 0 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXIII**

EIGENVALUES AND EIGENVECTORS

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 4 & -7 & -7 \\ 4 & -7 & -7 \\ -4 & 4 & 4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 6 & -4 & 1 \\ 3 & -1 & 1 \\ 0 & 0 & 3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 3 & -6 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXIV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

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- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 4 & -2 & 2 \\ -5 & 1 & -5 \\ 2 & 2 & 4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 3 & -2 & -2 \\ 0 & 3 & 0 \\ 0 & -2 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & -8 & -4 \\ 0 & -2 & -2 \\ 0 & 8 & 6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXV**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} 4 & 0 & 2 \\ -4 & 0 & -2 \\ -1 & 0 & 1 \end{pmatrix} \qquad (b)\begin{pmatrix} 5 & 0 & 2 \\ 2 & 3 & 2 \\ -4 & 0 & -1 \end{pmatrix} \qquad (c)\begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\begin{pmatrix} 2 & 1 & 2 \\ 1 & 2 & -2 \\ -1 & 1 & 5 \end{pmatrix} \qquad (e)\begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXVI**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 4 & 0 & 2 \\ -1 & -1 & 2 \\ -1 & 0 & 1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -1 & 0 \\ 2 & 4 & 0 \\ 4 & 2 & 3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 7 & -4 & -2 \\ 4 & -1 & -2 \\ 0 & 0 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXVII**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} 4 & 0 & 6 \\ -6 & -7 & 4 \\ -3 & 0 & -5 \end{pmatrix}$ $(b)\ \begin{pmatrix} -3 & 4 & 4 \\ 0 & -3 & 0 \\ 0 & 2 & -1 \end{pmatrix}$ $(c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$

$(d)\ \begin{pmatrix} -1 & 2 & 2 \\ -1 & -4 & -1 \\ -1 & -1 & -4 \end{pmatrix}$ $(e)\ \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXVIII**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 4 & 0 & 6 \\ -2 & 2 & -7 \\ -2 & 0 & -3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 0 & 0 & 3 \\ -2 & -2 & -3 \\ -2 & 0 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXIX**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 4 & 0 & 6 \\ 6 & 6 & -3 \\ -2 & 0 & -3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -7 & 5 & -5 \\ -5 & 3 & -5 \\ 5 & -5 & 3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -4 & 2 & -2 \\ 0 & -2 & 0 \\ 2 & -2 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & 0 \\ -2 & 1 & -1 \\ 2 & 3 & 3 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXX**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} 4 & 0 & 6 \\ 8 & 7 & -2 \\ -2 & 0 & -3 \end{pmatrix}$ $(b)\ \begin{pmatrix} 1 & 0 & -4 \\ 2 & -3 & -2 \\ 2 & 0 & -5 \end{pmatrix}$ $(c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$

$(d)\ \begin{pmatrix} -1 & 1 & 0 \\ -1 & -3 & 0 \\ 1 & 1 & -2 \end{pmatrix}$ $(e)\ \begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I $\boxed{\textbf{Tutorial-I}}$ **Matrix Set - CXXXI**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 4 & 4 & 1 \\ -1 & -1 & -1 \\ -6 & -4 & -3 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -5 & 0 & 4 \\ -2 & -1 & 2 \\ -2 & 0 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & -2 \\ 0 & -2 & 1 \\ 0 & -1 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXXII**

Eigenvalues and Eigenvectors

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- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 4 & 5 & -3 \\ -1 & -2 & 3 \\ -1 & -1 & 2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -6 & -2 & 4 \\ 6 & 1 & -6 \\ -2 & -1 & 0 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -2 & 4 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXXIII**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 5 & -8 & 2 \\ -1 & 0 & -2 \\ -2 & 4 & 0 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -4 & 6 & 0 \\ -1 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -3 & 6 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$$

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXXIV**

Eigenvalues and Eigenvectors

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- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 5 & -7 & -7 \\ 4 & -6 & -7 \\ -4 & 4 & 5 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 7 & -8 & -4 \\ 0 & -1 & 0 \\ 8 & -8 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & -8 & 4 \\ 0 & -5 & 2 \\ 0 & -8 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXXV**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 5 & -6 & -6 \\ 3 & -4 & -6 \\ -3 & 3 & 5 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 1 & -3 \\ 1 & -2 & 3 \\ 1 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 3 & -4 & 0 \\ 1 & -1 & 0 \\ 2 & -4 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXXVI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\begin{pmatrix} 5 & -3 & 3 \\ -1 & 3 & -3 \\ -3 & 3 & -3 \end{pmatrix}$ $(b)\begin{pmatrix} -1 & -2 & 6 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$ $(c)\begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$

$(d)\begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & -6 \\ 0 & 0 & 1 \end{pmatrix}$ $(e)\begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXXVII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\begin{pmatrix} 5 & 0 & -6 \\ -1 & 1 & 1 \\ 1 & -2 & -2 \end{pmatrix} \qquad (b)\begin{pmatrix} -1 & 2 & 0 \\ -1 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad (c)\begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 3 & -6 & 1 \end{pmatrix} \qquad (e)\begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXXVIII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 5 & 0 & 4 \\ -2 & 0 & -1 \\ -2 & 0 & -1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -3 & -8 & 8 \\ 0 & 1 & -4 \\ 0 & 0 & -3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 2 & -8 & -4 \\ 0 & -2 & -2 \\ 0 & 8 & 6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXXXIX**

EIGENVALUES AND EIGENVECTORS

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a) \begin{pmatrix} 5 & 0 & 6 \\ -6 & -7 & 6 \\ -3 & 0 & -4 \end{pmatrix} \qquad (b) \begin{pmatrix} 1 & -6 & -3 \\ 0 & -1 & -1 \\ 0 & 2 & 2 \end{pmatrix} \qquad (c) \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$$

$$(d) \begin{pmatrix} 2 & 1 & 2 \\ 1 & 2 & -2 \\ -1 & 1 & 5 \end{pmatrix} \qquad (e) \begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXL**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 5 & 0 & 6 \\ -3 & -3 & -1 \\ -3 & 0 & -4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 2 & 2 & 0 \\ 0 & 1 & 0 \\ -2 & -4 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 7 & -4 & -2 \\ 4 & -1 & -2 \\ 0 & 0 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & 0 \\ -2 & 1 & -1 \\ 2 & 3 & 3 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXLI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 5 & 1 & 2 \\ -2 & 2 & -2 \\ -5 & -1 & -2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -2 & 4 & 0 \\ 0 & 2 & 0 \\ -4 & 4 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & 2 \\ -1 & -4 & -1 \\ -1 & -1 & -4 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -6 & -3 \\ 8 & 8 & 4 \\ 0 & 3 & 2 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXLII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 5 & 2 & -6 \\ -4 & -2 & 4 \\ 2 & 2 & 0 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 2 & 0 & 0 \\ 8 & -2 & -4 \\ -4 & 2 & 4 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & -3 & 6 \\ -1 & -1 & -2 \\ -2 & 2 & -6 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & -1 & -1 \\ 2 & -1 & -2 \\ -3 & 7 & 6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXLIII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 5 & 2 & 0 \\ -7 & -1 & 3 \\ 5 & 2 & 0 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 1 & -1 & 0 \\ 0 & 2 & 0 \\ -1 & -1 & 2 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 4 & -1 & -1 \\ -1 & 4 & 1 \\ 4 & -5 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -4 & 2 & -2 \\ 0 & -2 & 0 \\ 2 & -2 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & 2 & 1 \\ 3 & 0 & -3 \\ -4 & 5 & 7 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXLIV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 5 & 2 & 2 \\ -2 & 1 & 1 \\ -2 & -2 & -2 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 6 & -4 & 1 \\ 3 & -1 & 1 \\ 0 & 0 & 3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 2 & 0 & 3 \\ 3 & -1 & 3 \\ 6 & -6 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 1 & 0 \\ -1 & -3 & 0 \\ 1 & 1 & -2 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -1 & 1 & 2 \\ 2 & -2 & 5 \\ -2 & -1 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXLV**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 6 & -7 & -1 \\ 4 & -4 & -2 \\ 2 & -3 & 1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 3 & -2 & -2 \\ 0 & 3 & 0 \\ 0 & -2 & 1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -2 & -6 & 3 \\ 4 & 0 & 5 \\ 2 & 4 & -1 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & 2 & -2 \\ 0 & -2 & 1 \\ 0 & -1 & 0 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 2 & 4 \\ -1 & 0 & 1 \\ -2 & -2 & -6 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXLVI**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 6 & 0 & -6 \\ 7 & -1 & -6 \\ 4 & 0 & -4 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 5 & 0 & 2 \\ 2 & 3 & 2 \\ -4 & 0 & -1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -4 & -8 & -7 \\ 1 & -3 & 1 \\ 3 & 7 & 6 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -2 & 4 & -1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} -4 & -2 & 6 \\ -4 & -6 & 6 \\ -3 & -3 & 4 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXLVII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$(a)\ \begin{pmatrix} 6 & 0 & 1 \\ -3 & 1 & -3 \\ -6 & 0 & 1 \end{pmatrix}$ $(b)\ \begin{pmatrix} 1 & -1 & 0 \\ 2 & 4 & 0 \\ 4 & 2 & 3 \end{pmatrix}$ $(c)\ \begin{pmatrix} -3 & -2 & 3 \\ -2 & -3 & 3 \\ -4 & -8 & 7 \end{pmatrix}$

$(d)\ \begin{pmatrix} -3 & 4 & 0 \\ -1 & 1 & 0 \\ -3 & 6 & -1 \end{pmatrix}$ $(e)\ \begin{pmatrix} -6 & 4 & 4 \\ -2 & 0 & 2 \\ -1 & 0 & 0 \end{pmatrix}$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I $\boxed{\textbf{Tutorial-I}}$ **Matrix Set - CXLVIII**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 6 & 6 & 0 \\ -2 & -2 & -2 \\ 1 & 1 & 1 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -3 & 4 & 4 \\ 0 & -3 & 0 \\ 0 & 2 & -1 \end{pmatrix} \qquad (c)\ \begin{pmatrix} -1 & 0 & 2 \\ 0 & -3 & 6 \\ 0 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} -1 & -8 & 4 \\ 0 & -5 & 2 \\ 0 & -8 & 3 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 4 & 0 & -6 \\ 3 & -2 & -3 \\ 8 & -4 & -8 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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M.Sc.Physics (2011-12) **Sem-II Jan-Apr 2012**

Quantum Mechanics-I **Tutorial-I** **Matrix Set - CXLIX**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 7 & -7 & -7 \\ 6 & -6 & -7 \\ -6 & 6 & 7 \end{pmatrix} \qquad (b)\ \begin{pmatrix} 0 & 0 & 3 \\ -2 & -2 & -3 \\ -2 & 0 & -5 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 1 \\ -1 & -1 & 2 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 3 & -4 & 0 \\ 1 & -1 & 0 \\ 2 & -4 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 2 & -1 & -3 \\ -1 & 0 & 1 \\ 4 & -2 & -5 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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Quantum Mechanics-I **Tutorial-I** **Matrix Set - CL**

Eigenvalues and Eigenvectors

[1] Find eigenvalues and normalized eigenvectors of the following matrices and verify the following statements.

- The first matirix has three distinct eigenvalues.
- The second matrix has two distinct characterstic roots and three linearly independent eigenvectors.
- the third matrix has two different eigenvalues and only two linearly independent eigenvectors.
- All the three eigenvalues of the fourth matrix are equal and it has only two linearly independent eigenvectors.
- All the three eigenvalues of the fifth matrix are equal and it has only one linearly independent eigenvector.

$$(a)\ \begin{pmatrix} 7 & -6 & 6 \\ -1 & 2 & -4 \\ -5 & 5 & -7 \end{pmatrix} \qquad (b)\ \begin{pmatrix} -7 & 5 & -5 \\ -5 & 3 & -5 \\ 5 & -5 & 3 \end{pmatrix} \qquad (c)\ \begin{pmatrix} 3 & -1 & -1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{pmatrix}$$

$$(d)\ \begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & -6 \\ 0 & 0 & 1 \end{pmatrix} \qquad (e)\ \begin{pmatrix} 0 & 1 & 0 \\ -1 & 2 & 0 \\ 2 & -3 & 1 \end{pmatrix}$$

[2] Give an example of a 3×3 matrix which has three linearly independent eigenvectors and all three eigenvectors correspond to eignevalue 1.

[3] Which of the above five matrices can be diagonlized? Give reasons to support your answer.

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[1] **Answers for Set No: I**

(a) The eigenvalues are $\{-2, 1, 0\}$ and the eigenvector(s) are

$$\{-2, \{3, -2, 1\}\} \quad \{1, \{1, -1, 1\}\} \quad \{0, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -3, -1\}$ and the eigenvector(s) are

$$\{-3, \{0, -1, 1\}\} \quad \{-3, \{1, 0, 0\}\} \quad \{-1, \{2, 0, 1\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 0, 1\}\} \quad \{-3, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 2, 0\}\}$$

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[2] **Answers for Set No: II**

(a) The eigenvalues are $\{6, 1, 0\}$ and the eigenvector(s) are

$$\{6, \{1, -1, 1\}\} \quad \{1, \{-1, 2, 1\}\} \quad \{0, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -2, -2\}$ and the eigenvector(s) are

$$\{-3, \{-1, 1, 1\}\} \quad \{-2, \{-3, 0, 2\}\} \quad \{-2, \{0, 1, 0\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-2, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[3] **Answers for Set No: III**

(a) The eigenvalues are $\{3, 2, 1\}$ and the eigenvector(s) are

$$\{3, \{-3, 2, 2\}\} \quad \{2, \{-1, 0, 1\}\} \quad \{1, \{-3, 1, 2\}\}$$

(b) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{-2, \{-1, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[4] **Answers for Set No: IV**

(a) The eigenvalues are $\{-5, -3, 0\}$ and the eigenvector(s) are

$$\{-5, \{-5, -3, 4\}\} \quad \{-3, \{-2, -1, 2\}\} \quad \{0, \{-1, 0, 1\}\}$$

(b) The eigenvalues are $\{-3, -3, -1\}$ and the eigenvector(s) are

$$\{-3, \{1, 0, 1\}\} \quad \{-3, \{0, 1, 0\}\} \quad \{-1, \{2, 1, 1\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{0, 0, 1\}\} \quad \{-2, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 1\}\}$$

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[5] **Answers for Set No: V**

(a) The eigenvalues are $\{4, -1, 0\}$ and the eigenvector(s) are

$$\{4, \{1, -1, 1\}\} \quad \{-1, \{-1, 1, 0\}\} \quad \{0, \{-1, 2, 1\}\}$$

(b) The eigenvalues are $\{-3, -1, -1\}$ and the eigenvector(s) are

$$\{-3, \{2, 1, 1\}\} \quad \{-1, \{1, 0, 1\}\} \quad \{-1, \{0, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 1\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 2\}\}$$

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[6] **Answers for Set No: VI**

(a) The eigenvalues are $\{-4, 1, 0\}$ and the eigenvector(s) are

$$\{-4, \{-1, 1, 0\}\} \quad \{1, \{-1, 1, 1\}\} \quad \{0, \{-2, 3, 1\}\}$$

(b) The eigenvalues are $\{-2, -2, -1\}$ and the eigenvector(s) are

$$\{-2, \{1, 0, 1\}\} \quad \{-2, \{-1, 2, 0\}\} \quad \{-1, \{2, -3, 1\}\}$$

(c) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 1\}\}$$

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[7] **Answers for Set No: VII**

(a) The eigenvalues are $\{7, 2, 1\}$ and the eigenvector(s) are

$$\{7, \{1, -1, 1\}\} \quad \{2, \{-1, 1, 0\}\} \quad \{1, \{3, -2, 1\}\}$$

(b) The eigenvalues are $\{-2, -1, -1\}$ and the eigenvector(s) are

$$\{-2, \{3, 1, 0\}\} \quad \{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\}$$

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[8] **Answers for Set No: VIII**

(a) The eigenvalues are $\{3, -1, 0\}$ and the eigenvector(s) are

$$\{3, \{1, -1, 1\}\} \quad \{-1, \{3, -2, 1\}\} \quad \{0, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{3, -1, -1\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{-1, \{1, 0, 2\}\} \quad \{-1, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 2\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[9] **Answers for Set No: IX**

(a) The eigenvalues are $\{3, -1, 0\}$ and the eigenvector(s) are

$$\{3, \{1, -1, 1\}\} \quad \{-1, \{-1, 1, 0\}\} \quad \{0, \{-1, 2, 1\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{-3, 0, 1\}\} \quad \{-1, \{1, 1, 0\}\} \quad \{0, \{-1, 1, 1\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[10] **Answers for Set No: X**

(a) The eigenvalues are $\{-4, -3, 0\}$ and the eigenvector(s) are

$$\{-4, \{-1, 0, 1\}\} \quad \{-3, \{-2, 1, 3\}\} \quad \{0, \{0, 1, 0\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{0, 3, 1\}\} \quad \{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{2, 0, 1\}\} \quad \{1, \{0, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[11] **Answers for Set No: XI**

(a) The eigenvalues are $\{2, -1, 0\}$ and the eigenvector(s) are

$$\{2, \{-2, -2, 1\}\} \quad \{-1, \{1, 1, 0\}\} \quad \{0, \{-7, -6, 2\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{1, 1, 0\}\} \quad \{0, \{2, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[12] **Answers for Set No: XII**

(a) The eigenvalues are $\{5, 1, 0\}$ and the eigenvector(s) are

$$\{5, \{-2, -2, 1\}\} \quad \{1, \{-2, -1, 1\}\} \quad \{0, \{-1, 0, 1\}\}$$

(b) The eigenvalues are $\{-3, -3, 1\}$ and the eigenvector(s) are

$$\{-3, \{0, 1, 1\}\} \quad \{-3, \{1, 0, 0\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{0, -1, 2\}\} \quad \{2, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 2, 0\}\}$$

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[13] **Answers for Set No: XIII**

(a) The eigenvalues are $\{4, -3, 2\}$ and the eigenvector(s) are

$$\{4, \{-1, 1, 0\}\} \quad \{-3, \{1, 0, 1\}\} \quad \{2, \{-1, 1, 1\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, -1, 2\}\} \quad \{1, \{1, 0, 0\}\} \quad \{0, \{-3, -1, 1\}\}$$

(c) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{2, 0, 1\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[14] **Answers for Set No: XIV**

(a) The eigenvalues are $\{3, 2, 0\}$ and the eigenvector(s) are

$$\{3, \{1, -1, 1\}\} \quad \{2, \{-1, 1, 0\}\} \quad \{0, \{3, -2, 1\}\}$$

(b) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\} \quad \{1, \{0, 0, 1\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 2\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[15] **Answers for Set No: XV**

(a) The eigenvalues are $\{-5,-3,1\}$ and the eigenvector(s) are

$$\{-5,\{-1,0,1\}\} \quad \{-3,\{-3,1,3\}\} \quad \{1,\{-1,1,2\}\}$$

(b) The eigenvalues are $\{-2,2,2\}$ and the eigenvector(s) are

$$\{-2,\{1,0,1\}\} \quad \{2,\{0,0,1\}\} \quad \{2,\{1,1,0\}\}$$

(c) The eigenvalues are $\{3,2,2\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{2,\{1,-1,3\}\}$$

(d) The eigenvalues are $\{-3,-3,-3\}$ and the eigenvector(s) are

$$\{-3,\{-1,0,1\}\} \quad \{-3,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,1\}\}$$

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[16] **Answers for Set No: XVI**

(a) The eigenvalues are $\{-2,-1,0\}$ and the eigenvector(s) are

$$\{-2,\{-1,1,0\}\} \quad \{-1,\{3,-2,2\}\} \quad \{0,\{3,-2,3\}\}$$

(b) The eigenvalues are $\{2,2,0\}$ and the eigenvector(s) are

$$\{2,\{1,0,2\}\} \quad \{2,\{1,2,0\}\} \quad \{0,\{0,-2,1\}\}$$

(c) The eigenvalues are $\{2,2,-1\}$ and the eigenvector(s) are

$$\{2,\{1,1,0\}\} \quad \{-1,\{-2,-1,2\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-2,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,2\}\}$$

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[17] **Answers for Set No: XVII**

(a) The eigenvalues are $\{-3, -2, 1\}$ and the eigenvector(s) are

$$\{-3, \{-1, 0, 1\}\} \quad \{-2, \{-2, 1, 3\}\} \quad \{1, \{0, 1, 0\}\}$$

(b) The eigenvalues are $\{2, 2, 1\}$ and the eigenvector(s) are

$$\{2, \{0, 0, 1\}\} \quad \{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 1\}\}$$

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[18] **Answers for Set No: XVIII**

(a) The eigenvalues are $\{5, 1, 0\}$ and the eigenvector(s) are

$$\{5, \{1, 1, 1\}\} \quad \{1, \{0, -1, 1\}\} \quad \{0, \{1, -1, 2\}\}$$

(b) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 3\}\} \quad \{3, \{4, 3, 0\}\} \quad \{2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{0, 0, 1\}\} \quad \{-2, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\}$$

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[19] **Answers for Set No: XIX**

(a) The eigenvalues are $\{3,-1,0\}$ and the eigenvector(s) are

$$\{3,\{-2,-2,1\}\} \quad \{-1,\{-1,0,1\}\} \quad \{0,\{-2,-1,1\}\}$$

(b) The eigenvalues are $\{3,3,1\}$ and the eigenvector(s) are

$$\{3,\{0,-1,1\}\} \quad \{3,\{1,0,0\}\} \quad \{1,\{1,0,1\}\}$$

(c) The eigenvalues are $\{-1,1,1\}$ and the eigenvector(s) are

$$\{-1,\{2,1,2\}\} \quad \{1,\{1,1,2\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,1,1\}\} \quad \{-1,\{1,0,0\}\}$$

(e) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{-1,0,2\}\}$$

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[20] **Answers for Set No: XX**

(a) The eigenvalues are $\{5,2,1\}$ and the eigenvector(s) are

$$\{5,\{1,-1,1\}\} \quad \{2,\{-1,1,0\}\} \quad \{1,\{3,-2,1\}\}$$

(b) The eigenvalues are $\{3,3,1\}$ and the eigenvector(s) are

$$\{3,\{-1,0,1\}\} \quad \{3,\{0,1,0\}\} \quad \{1,\{-1,-1,2\}\}$$

(c) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{1,0,0\}\} \quad \{0,\{2,2,1\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{-1,0,2\}\}$$

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[21] **Answers for Set No: XXI**

(a) The eigenvalues are $\{3,-2,1\}$ and the eigenvector(s) are

$$\{3,\{-1,2,1\}\} \quad \{-2,\{-1,1,1\}\} \quad \{1,\{-1,1,0\}\}$$

(b) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{0,0,1\}\} \quad \{3,\{-1,2,0\}\} \quad \{2,\{-1,1,2\}\}$$

(c) The eigenvalues are $\{2,1,1\}$ and the eigenvector(s) are

$$\{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[22] **Answers for Set No: XXII**

(a) The eigenvalues are $\{3,2,0\}$ and the eigenvector(s) are

$$\{3,\{-2,3,1\}\} \quad \{2,\{-1,1,1\}\} \quad \{0,\{-1,1,0\}\}$$

(b) The eigenvalues are $\{-3,-3,-1\}$ and the eigenvector(s) are

$$\{-3,\{0,-1,1\}\} \quad \{-3,\{1,0,0\}\} \quad \{-1,\{2,0,1\}\}$$

(c) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{2,\{1,1,0\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,1,2\}\} \quad \{-1,\{1,0,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[23] **Answers for Set No: XXIII**

(a) The eigenvalues are $\{-3,-1,0\}$ and the eigenvector(s) are

$$\{-3,\{1,0,1\}\} \quad \{-1,\{5,-3,3\}\} \quad \{0,\{-1,1,0\}\}$$

(b) The eigenvalues are $\{-3,-2,-2\}$ and the eigenvector(s) are

$$\{-3,\{-1,1,1\}\} \quad \{-2,\{-3,0,2\}\} \quad \{-2,\{0,1,0\}\}$$

(c) The eigenvalues are $\{3,2,2\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{2,\{1,-1,3\}\}$$

(d) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\} \quad \{1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{-3,-3,-3\}$ and the eigenvector(s) are

$$\{-3,\{-1,2,0\}\}$$

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[24] **Answers for Set No: XXIV**

(a) The eigenvalues are $\{-5,-1,0\}$ and the eigenvector(s) are

$$\{-5,\{-1,1,1\}\} \quad \{-1,\{-1,2,1\}\} \quad \{0,\{-1,1,0\}\}$$

(b) The eigenvalues are $\{3,-2,-2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{-2,\{-1,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(c) The eigenvalues are $\{2,2,-1\}$ and the eigenvector(s) are

$$\{2,\{1,1,0\}\} \quad \{-1,\{-2,-1,2\}\}$$

(d) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{2,0,1\}\} \quad \{1,\{0,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,-1,1\}\}$$

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[25] **Answers for Set No: XXV**

(a) The eigenvalues are $\{-3, 1, 0\}$ and the eigenvector(s) are

$$\{-3, \{-1, 0, 1\}\} \quad \{1, \{-1, 1, 2\}\} \quad \{0, \{-3, 2, 6\}\}$$

(b) The eigenvalues are $\{-3, -3, -1\}$ and the eigenvector(s) are

$$\{-3, \{1, 0, 1\}\} \quad \{-3, \{0, 1, 0\}\} \quad \{-1, \{2, 1, 1\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[26] **Answers for Set No: XXVI**

(a) The eigenvalues are $\{-2, 1, 0\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\} \quad \{1, \{-1, 0, 1\}\} \quad \{0, \{-2, -1, 2\}\}$$

(b) The eigenvalues are $\{-3, -1, -1\}$ and the eigenvector(s) are

$$\{-3, \{2, 1, 1\}\} \quad \{-1, \{1, 0, 1\}\} \quad \{-1, \{0, 1, 0\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{0, -1, 2\}\} \quad \{2, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 1\}\}$$

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[27] **Answers for Set No: XXVII**

(a) The eigenvalues are $\{-3,-1,0\}$ and the eigenvector(s) are

$$\{-3,\{-1,1,0\}\} \quad \{-1,\{-2,3,1\}\} \quad \{0,\{-1,1,1\}\}$$

(b) The eigenvalues are $\{-2,-2,-1\}$ and the eigenvector(s) are

$$\{-2,\{1,0,1\}\} \quad \{-2,\{-1,2,0\}\} \quad \{-1,\{2,-3,1\}\}$$

(c) The eigenvalues are $\{-1,1,1\}$ and the eigenvector(s) are

$$\{-1,\{2,1,2\}\} \quad \{1,\{1,1,2\}\}$$

(d) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{2,0,1\}\} \quad \{3,\{1,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,2\}\}$$

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[28] **Answers for Set No: XXVIII**

(a) The eigenvalues are $\{-3,-1,0\}$ and the eigenvector(s) are

$$\{-3,\{1,1,1\}\} \quad \{-1,\{1,1,2\}\} \quad \{0,\{1,2,3\}\}$$

(b) The eigenvalues are $\{-2,-1,-1\}$ and the eigenvector(s) are

$$\{-2,\{3,1,0\}\} \quad \{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(c) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{1,0,0\}\} \quad \{0,\{2,2,1\}\}$$

(d) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,2\}\} \quad \{3,\{1,1,0\}\}$$

(e) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{1,0,1\}\}$$

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[29] **Answers for Set No: XXIX**

(a) The eigenvalues are $\{-2,-1,0\}$ and the eigenvector(s) are

$$\{-2,\{-3,3,1\}\} \quad \{-1,\{-2,2,1\}\} \quad \{0,\{0,1,0\}\}$$

(b) The eigenvalues are $\{3,-1,-1\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{-1,\{1,0,2\}\} \quad \{-1,\{1,1,0\}\}$$

(c) The eigenvalues are $\{2,1,1\}$ and the eigenvector(s) are

$$\{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(d) The eigenvalues are $\{-3,-3,-3\}$ and the eigenvector(s) are

$$\{-3,\{-1,0,1\}\} \quad \{-3,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\}$$

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[30] **Answers for Set No: XXX**

(a) The eigenvalues are $\{-4,-2,0\}$ and the eigenvector(s) are

$$\{-4,\{-1,-1,1\}\} \quad \{-2,\{1,1,0\}\} \quad \{0,\{0,-1,1\}\}$$

(b) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{-3,0,1\}\} \quad \{-1,\{1,1,0\}\} \quad \{0,\{-1,1,1\}\}$$

(c) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{2,\{1,1,0\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-2,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{-1,0,2\}\}$$

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[31] **Answers for Set No: XXXI**

(a) The eigenvalues are $\{-4, 3, 0\}$ and the eigenvector(s) are

$$\{-4, \{-1, -1, 1\}\} \quad \{3, \{0, -1, 1\}\} \quad \{0, \{1, 1, 0\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{0, 3, 1\}\} \quad \{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[32] **Answers for Set No: XXXII**

(a) The eigenvalues are $\{-4, 1, 0\}$ and the eigenvector(s) are

$$\{-4, \{-1, -1, 1\}\} \quad \{1, \{0, -1, 1\}\} \quad \{0, \{1, 1, 0\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{1, 1, 0\}\} \quad \{0, \{2, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{0, 0, 1\}\} \quad \{-2, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[33] **Answers for Set No: XXXIII**

(a) The eigenvalues are $\{2, -1, 0\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{0, -1, 1\}\} \quad \{0, \{-3, -4, 2\}\}$$

(b) The eigenvalues are $\{-3, -3, 1\}$ and the eigenvector(s) are

$$\{-3, \{0, 1, 1\}\} \quad \{-3, \{1, 0, 0\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 1\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[34] **Answers for Set No: XXXIV**

(a) The eigenvalues are $\{-3, 2, 0\}$ and the eigenvector(s) are

$$\{-3, \{0, -1, 1\}\} \quad \{2, \{1, 1, 0\}\} \quad \{0, \{-3, -4, 2\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, -1, 2\}\} \quad \{1, \{1, 0, 0\}\} \quad \{0, \{-3, -1, 1\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 2, 0\}\}$$

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[35] **Answers for Set No: XXXV**

(a) The eigenvalues are $\{4, 3, -2\}$ and the eigenvector(s) are

$$\{4, \{-1, 1, 0\}\} \quad \{3, \{-1, 1, 1\}\} \quad \{-2, \{1, 0, 1\}\}$$

(b) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\} \quad \{1, \{0, 0, 1\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[36] **Answers for Set No: XXXVI**

(a) The eigenvalues are $\{3, -2, 1\}$ and the eigenvector(s) are

$$\{3, \{-1, 1, 0\}\} \quad \{-2, \{-2, -1, 2\}\} \quad \{1, \{-1, 0, 1\}\}$$

(b) The eigenvalues are $\{-2, 2, 2\}$ and the eigenvector(s) are

$$\{-2, \{1, 0, 1\}\} \quad \{2, \{0, 0, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 2\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[37] **Answers for Set No: XXXVII**

(a) The eigenvalues are $\{7,2,1\}$ and the eigenvector(s) are

$$\{7,\{-1,1,1\}\} \quad \{2,\{-2,1,1\}\} \quad \{1,\{-1,1,0\}\}$$

(b) The eigenvalues are $\{2,2,0\}$ and the eigenvector(s) are

$$\{2,\{1,0,2\}\} \quad \{2,\{1,2,0\}\} \quad \{0,\{0,-2,1\}\}$$

(c) The eigenvalues are $\{2,1,1\}$ and the eigenvector(s) are

$$\{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(d) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\} \quad \{1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,1\}\}$$

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[38] **Answers for Set No: XXXVIII**

(a) The eigenvalues are $\{2,1,0\}$ and the eigenvector(s) are

$$\{2,\{-1,0,1\}\} \quad \{1,\{-1,1,0\}\} \quad \{0,\{-2,-1,2\}\}$$

(b) The eigenvalues are $\{2,2,1\}$ and the eigenvector(s) are

$$\{2,\{0,0,1\}\} \quad \{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(c) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{2,\{1,1,0\}\}$$

(d) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{2,0,1\}\} \quad \{1,\{0,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,2\}\}$$

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[39] **Answers for Set No: XXXIX**

(a) The eigenvalues are $\{5, 1, 0\}$ and the eigenvector(s) are

$$\{5, \{-1, 1, 1\}\} \quad \{1, \{-2, 1, 1\}\} \quad \{0, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 3\}\} \quad \{3, \{4, 3, 0\}\} \quad \{2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 1\}\}$$

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[40] **Answers for Set No: XL**

(a) The eigenvalues are $\{3, 2, 0\}$ and the eigenvector(s) are

$$\{3, \{-1, 2, 3\}\} \quad \{2, \{-3, 5, 6\}\} \quad \{0, \{-1, 1, 1\}\}$$

(b) The eigenvalues are $\{3, 3, 1\}$ and the eigenvector(s) are

$$\{3, \{0, -1, 1\}\} \quad \{3, \{1, 0, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{0, -1, 2\}\} \quad \{2, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\}$$

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[41] **Answers for Set No: XLI**

(a) The eigenvalues are $\{5,-2,1\}$ and the eigenvector(s) are

$$\{5,\{-1,1,1\}\} \quad \{-2,\{0,1,0\}\} \quad \{1,\{-2,2,1\}\}$$

(b) The eigenvalues are $\{3,3,1\}$ and the eigenvector(s) are

$$\{3,\{-1,0,1\}\} \quad \{3,\{0,1,0\}\} \quad \{1,\{-1,-1,2\}\}$$

(c) The eigenvalues are $\{-2,-2,1\}$ and the eigenvector(s) are

$$\{-2,\{-3,1,2\}\} \quad \{1,\{-1,1,1\}\}$$

(d) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{2,0,1\}\} \quad \{3,\{1,1,0\}\}$$

(e) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{-1,0,2\}\}$$

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[42] **Answers for Set No: XLII**

(a) The eigenvalues are $\{-2,-1,0\}$ and the eigenvector(s) are

$$\{-2,\{1,-1,2\}\} \quad \{-1,\{1,1,1\}\} \quad \{0,\{0,-1,1\}\}$$

(b) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{0,0,1\}\} \quad \{3,\{-1,2,0\}\} \quad \{2,\{-1,1,2\}\}$$

(c) The eigenvalues are $\{3,-2,-2\}$ and the eigenvector(s) are

$$\{3,\{-1,0,1\}\} \quad \{-2,\{-3,-1,2\}\}$$

(d) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,2\}\} \quad \{3,\{1,1,0\}\}$$

(e) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{-1,0,2\}\}$$

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[43] **Answers for Set No: XLIII**

(a) The eigenvalues are $\{-5, -3, 2\}$ and the eigenvector(s) are

$$\{-5, \{0, -1, 1\}\} \quad \{-3, \{-1, -3, 3\}\} \quad \{2, \{1, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -3, -1\}$ and the eigenvector(s) are

$$\{-3, \{0, -1, 1\}\} \quad \{-3, \{1, 0, 0\}\} \quad \{-1, \{2, 0, 1\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 0, 1\}\} \quad \{-3, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[44] **Answers for Set No: XLIV**

(a) The eigenvalues are $\{4, 2, -1\}$ and the eigenvector(s) are

$$\{4, \{-2, -2, 1\}\} \quad \{2, \{-2, -1, 2\}\} \quad \{-1, \{-1, 0, 1\}\}$$

(b) The eigenvalues are $\{-3, -2, -2\}$ and the eigenvector(s) are

$$\{-3, \{-1, 1, 1\}\} \quad \{-2, \{-3, 0, 2\}\} \quad \{-2, \{0, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-2, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[45] **Answers for Set No: XLV**

(a) The eigenvalues are $\{3, 2, -1\}$ and the eigenvector(s) are

$$\{3, \{-1, 1, 0\}\} \quad \{2, \{-1, 1, 1\}\} \quad \{-1, \{1, 0, 1\}\}$$

(b) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{-2, \{-1, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 2, 0\}\}$$

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[46] **Answers for Set No: XLVI**

(a) The eigenvalues are $\{3, 1, 0\}$ and the eigenvector(s) are

$$\{3, \{-1, 2, 1\}\} \quad \{1, \{-1, 1, 0\}\} \quad \{0, \{-1, 1, 1\}\}$$

(b) The eigenvalues are $\{-3, -3, -1\}$ and the eigenvector(s) are

$$\{-3, \{1, 0, 1\}\} \quad \{-3, \{0, 1, 0\}\} \quad \{-1, \{2, 1, 1\}\}$$

(c) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{0, 0, 1\}\} \quad \{-2, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[47] **Answers for Set No: XLVII**

(a) The eigenvalues are $\{4, 2, -1\}$ and the eigenvector(s) are

$$\{4, \{-1, 1, 1\}\} \quad \{2, \{-2, 3, 1\}\} \quad \{-1, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -1, -1\}$ and the eigenvector(s) are

$$\{-3, \{2, 1, 1\}\} \quad \{-1, \{1, 0, 1\}\} \quad \{-1, \{0, 1, 0\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 1\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[48] **Answers for Set No: XLVIII**

(a) The eigenvalues are $\{4, -2, 1\}$ and the eigenvector(s) are

$$\{4, \{-1, 1, 1\}\} \quad \{-2, \{0, 1, 0\}\} \quad \{1, \{-2, 2, 1\}\}$$

(b) The eigenvalues are $\{-2, -2, -1\}$ and the eigenvector(s) are

$$\{-2, \{1, 0, 1\}\} \quad \{-2, \{-1, 2, 0\}\} \quad \{-1, \{2, -3, 1\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 1\}\}$$

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[49] **Answers for Set No: XLIX**

(a) The eigenvalues are $\{4, -2, 1\}$ and the eigenvector(s) are

$$\{4, \{-1, 1, 1\}\} \quad \{-2, \{-1, 1, 0\}\} \quad \{1, \{-2, 1, 1\}\}$$

(b) The eigenvalues are $\{-2, -1, -1\}$ and the eigenvector(s) are

$$\{-2, \{3, 1, 0\}\} \quad \{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 2\}\}$$

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[50] **Answers for Set No: L**

(a) The eigenvalues are $\{-3, 2, 0\}$ and the eigenvector(s) are

$$\{-3, \{0, 1, 0\}\} \quad \{2, \{-1, 1, 1\}\} \quad \{0, \{-2, 2, 1\}\}$$

(b) The eigenvalues are $\{3, -1, -1\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{-1, \{1, 0, 2\}\} \quad \{-1, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 2\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 1\}\}$$

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[51] **Answers for Set No: LI**

(a) The eigenvalues are $\{4, 1, 0\}$ and the eigenvector(s) are

$$\{4, \{0, 1, 0\}\} \quad \{1, \{1, 1, 1\}\} \quad \{0, \{3, 3, 2\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{-3, 0, 1\}\} \quad \{-1, \{1, 1, 0\}\} \quad \{0, \{-1, 1, 1\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\}$$

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[52] **Answers for Set No: LII**

(a) The eigenvalues are $\{-2, 1, 0\}$ and the eigenvector(s) are

$$\{-2, \{0, 1, 0\}\} \quad \{1, \{1, 2, 1\}\} \quad \{0, \{3, 6, 2\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{0, 3, 1\}\} \quad \{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{2, 0, 1\}\} \quad \{1, \{0, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[53] **Answers for Set No: LIII**

(a) The eigenvalues are $\{-2,-1,0\}$ and the eigenvector(s) are

$$\{-2,\{-1,-1,1\}\} \quad \{-1,\{1,1,0\}\} \quad \{0,\{0,-1,1\}\}$$

(b) The eigenvalues are $\{1,1,0\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\} \quad \{1,\{1,1,0\}\} \quad \{0,\{2,1,0\}\}$$

(c) The eigenvalues are $\{2,1,1\}$ and the eigenvector(s) are

$$\{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(d) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\} \quad \{1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{-1,0,2\}\}$$

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[54] **Answers for Set No: LIV**

(a) The eigenvalues are $\{-4,2,0\}$ and the eigenvector(s) are

$$\{-4,\{-1,1,0\}\} \quad \{2,\{-1,1,1\}\} \quad \{0,\{-2,1,1\}\}$$

(b) The eigenvalues are $\{-3,-3,1\}$ and the eigenvector(s) are

$$\{-3,\{0,1,1\}\} \quad \{-3,\{1,0,0\}\} \quad \{1,\{-2,1,0\}\}$$

(c) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{2,\{1,1,0\}\}$$

(d) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{0,-1,2\}\} \quad \{2,\{1,0,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[55] **Answers for Set No: LV**

(a) The eigenvalues are $\{2, -1, 0\}$ and the eigenvector(s) are

$$\{2, \{1, 3, 1\}\} \quad \{-1, \{0, 1, 1\}\} \quad \{0, \{1, 2, 1\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, -1, 2\}\} \quad \{1, \{1, 0, 0\}\} \quad \{0, \{-3, -1, 1\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{2, 0, 1\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[56] **Answers for Set No: LVI**

(a) The eigenvalues are $\{-2, 1, 0\}$ and the eigenvector(s) are

$$\{-2, \{0, -1, 1\}\} \quad \{1, \{1, 1, 0\}\} \quad \{0, \{-3, -4, 2\}\}$$

(b) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\} \quad \{1, \{0, 0, 1\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 2\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 2, 0\}\}$$

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[57] **Answers for Set No: LVII**

(a) The eigenvalues are $\{-3, 1, 0\}$ and the eigenvector(s) are

$$\{-3, \{0, -1, 1\}\} \quad \{1, \{1, 1, 0\}\} \quad \{0, \{-3, -4, 2\}\}$$

(b) The eigenvalues are $\{-2, 2, 2\}$ and the eigenvector(s) are

$$\{-2, \{1, 0, 1\}\} \quad \{2, \{0, 0, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 0, 1\}\} \quad \{-3, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[58] **Answers for Set No: LVIII**

(a) The eigenvalues are $\{2, -1, 0\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{-1, \{1, -1, 1\}\} \quad \{0, \{3, -2, 1\}\}$$

(b) The eigenvalues are $\{2, 2, 0\}$ and the eigenvector(s) are

$$\{2, \{1, 0, 2\}\} \quad \{2, \{1, 2, 0\}\} \quad \{0, \{0, -2, 1\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-2, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[59] **Answers for Set No: LIX**

(a) The eigenvalues are $\{-2,-1,0\}$ and the eigenvector(s) are

$$\{-2,\{-1,0,1\}\} \quad \{-1,\{-3,1,3\}\} \quad \{0,\{-1,1,2\}\}$$

(b) The eigenvalues are $\{2,2,1\}$ and the eigenvector(s) are

$$\{2,\{0,0,1\}\} \quad \{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(c) The eigenvalues are $\{-1,1,1\}$ and the eigenvector(s) are

$$\{-1,\{2,1,2\}\} \quad \{1,\{1,1,2\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,1\}\}$$

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[60] **Answers for Set No: LX**

(a) The eigenvalues are $\{5,2,1\}$ and the eigenvector(s) are

$$\{5,\{-1,1,1\}\} \quad \{2,\{-2,1,1\}\} \quad \{1,\{-1,1,0\}\}$$

(b) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,0,3\}\} \quad \{3,\{4,3,0\}\} \quad \{2,\{1,1,0\}\}$$

(c) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{1,0,0\}\} \quad \{0,\{2,2,1\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{0,0,1\}\} \quad \{-2,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,2\}\}$$

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[61] **Answers for Set No: LXI**

(a) The eigenvalues are $\{-3,-1,0\}$ and the eigenvector(s) are

$$\{-3,\{1,1,0\}\} \quad \{-1,\{-1,-1,1\}\} \quad \{0,\{0,-1,1\}\}$$

(b) The eigenvalues are $\{3,3,1\}$ and the eigenvector(s) are

$$\{3,\{0,-1,1\}\} \quad \{3,\{1,0,0\}\} \quad \{1,\{1,0,1\}\}$$

(c) The eigenvalues are $\{2,1,1\}$ and the eigenvector(s) are

$$\{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,1,1\}\} \quad \{-1,\{1,0,0\}\}$$

(e) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{1,0,1\}\}$$

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[62] **Answers for Set No: LXII**

(a) The eigenvalues are $\{-4,3,0\}$ and the eigenvector(s) are

$$\{-4,\{1,0,1\}\} \quad \{3,\{-1,1,1\}\} \quad \{0,\{-1,1,0\}\}$$

(b) The eigenvalues are $\{3,3,1\}$ and the eigenvector(s) are

$$\{3,\{-1,0,1\}\} \quad \{3,\{0,1,0\}\} \quad \{1,\{-1,-1,2\}\}$$

(c) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{2,\{1,1,0\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\}$$

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[63] **Answers for Set No: LXIII**

(a) The eigenvalues are $\{3, 1, 0\}$ and the eigenvector(s) are

$$\{3, \{-1, 1, 1\}\} \quad \{1, \{-2, 1, 1\}\} \quad \{0, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{0, 0, 1\}\} \quad \{3, \{-1, 2, 0\}\} \quad \{2, \{-1, 1, 2\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[64] **Answers for Set No: LXIV**

(a) The eigenvalues are $\{7, 3, -1\}$ and the eigenvector(s) are

$$\{7, \{-1, 1, 1\}\} \quad \{3, \{-2, 3, 1\}\} \quad \{-1, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -3, -1\}$ and the eigenvector(s) are

$$\{-3, \{0, -1, 1\}\} \quad \{-3, \{1, 0, 0\}\} \quad \{-1, \{2, 0, 1\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 2\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[65] **Answers for Set No: LXV**

(a) The eigenvalues are $\{5, 2, -1\}$ and the eigenvector(s) are

$$\{5, \{-1, 1, 1\}\} \quad \{2, \{-2, 3, 1\}\} \quad \{-1, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -2, -2\}$ and the eigenvector(s) are

$$\{-3, \{-1, 1, 1\}\} \quad \{-2, \{-3, 0, 2\}\} \quad \{-2, \{0, 1, 0\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[66] **Answers for Set No: LXVI**

(a) The eigenvalues are $\{4, 2, 1\}$ and the eigenvector(s) are

$$\{4, \{0, 1, 0\}\} \quad \{2, \{-1, 6, 3\}\} \quad \{1, \{-1, 3, 2\}\}$$

(b) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{-2, \{-1, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{2, 0, 1\}\} \quad \{1, \{0, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[67] **Answers for Set No: LXVII**

(a) The eigenvalues are $\{-3,-2,0\}$ and the eigenvector(s) are

$$\{-3,\{-1,1,0\}\} \quad \{-2,\{1,-2,1\}\} \quad \{0,\{0,-3,2\}\}$$

(b) The eigenvalues are $\{-3,-3,-1\}$ and the eigenvector(s) are

$$\{-3,\{1,0,1\}\} \quad \{-3,\{0,1,0\}\} \quad \{-1,\{2,1,1\}\}$$

(c) The eigenvalues are $\{-1,1,1\}$ and the eigenvector(s) are

$$\{-1,\{2,1,2\}\} \quad \{1,\{1,1,2\}\}$$

(d) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\} \quad \{1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{-3,-3,-3\}$ and the eigenvector(s) are

$$\{-3,\{-1,2,0\}\}$$

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[68] **Answers for Set No: LXVIII**

(a) The eigenvalues are $\{-4,3,-2\}$ and the eigenvector(s) are

$$\{-4,\{-1,1,0\}\} \quad \{3,\{-1,1,1\}\} \quad \{-2,\{-2,3,1\}\}$$

(b) The eigenvalues are $\{-3,-1,-1\}$ and the eigenvector(s) are

$$\{-3,\{2,1,1\}\} \quad \{-1,\{1,0,1\}\} \quad \{-1,\{0,1,0\}\}$$

(c) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{1,0,0\}\} \quad \{0,\{2,2,1\}\}$$

(d) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{0,-1,2\}\} \quad \{2,\{1,0,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,-1,1\}\}$$

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[69] **Answers for Set No: LXIX**

(a) The eigenvalues are $\{-3,-2,0\}$ and the eigenvector(s) are

$$\{-3,\{-1,1,1\}\} \quad \{-2,\{-1,1,2\}\} \quad \{0,\{-1,0,1\}\}$$

(b) The eigenvalues are $\{-2,-2,-1\}$ and the eigenvector(s) are

$$\{-2,\{1,0,1\}\} \quad \{-2,\{-1,2,0\}\} \quad \{-1,\{2,-3,1\}\}$$

(c) The eigenvalues are $\{2,1,1\}$ and the eigenvector(s) are

$$\{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(d) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{2,0,1\}\} \quad \{3,\{1,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,1,0\}\}$$

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[70] **Answers for Set No: LXX**

(a) The eigenvalues are $\{4,3,-1\}$ and the eigenvector(s) are

$$\{4,\{3,2,3\}\} \quad \{3,\{2,1,2\}\} \quad \{-1,\{1,0,0\}\}$$

(b) The eigenvalues are $\{-2,-1,-1\}$ and the eigenvector(s) are

$$\{-2,\{3,1,0\}\} \quad \{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(c) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{2,\{1,1,0\}\}$$

(d) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,2\}\} \quad \{3,\{1,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,1\}\}$$

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[71] **Answers for Set No: LXXI**

(a) The eigenvalues are $\{4,3,-1\}$ and the eigenvector(s) are

$$\{4,\{1,1,2\}\} \quad \{3,\{1,2,3\}\} \quad \{-1,\{1,1,1\}\}$$

(b) The eigenvalues are $\{3,-1,-1\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{-1,\{1,0,2\}\} \quad \{-1,\{1,1,0\}\}$$

(c) The eigenvalues are $\{3,2,2\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{2,\{1,-1,3\}\}$$

(d) The eigenvalues are $\{-3,-3,-3\}$ and the eigenvector(s) are

$$\{-3,\{-1,0,1\}\} \quad \{-3,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,2\}\}$$

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[72] **Answers for Set No: LXXII**

(a) The eigenvalues are $\{-3,1,0\}$ and the eigenvector(s) are

$$\{-3,\{1,1,0\}\} \quad \{1,\{0,-1,1\}\} \quad \{0,\{-1,-1,1\}\}$$

(b) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{-3,0,1\}\} \quad \{-1,\{1,1,0\}\} \quad \{0,\{-1,1,1\}\}$$

(c) The eigenvalues are $\{2,2,-1\}$ and the eigenvector(s) are

$$\{2,\{1,1,0\}\} \quad \{-1,\{-2,-1,2\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-2,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{1,0,1\}\}$$

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[73] **Answers for Set No: LXXIII**

(a) The eigenvalues are $\{-2,1,0\}$ and the eigenvector(s) are

$$\{-2,\{0,1,1\}\} \quad \{1,\{-3,8,7\}\} \quad \{0,\{-1,3,3\}\}$$

(b) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{0,3,1\}\} \quad \{-1,\{1,0,0\}\} \quad \{0,\{2,2,1\}\}$$

(c) The eigenvalues are $\{-2,-2,1\}$ and the eigenvector(s) are

$$\{-2,\{-3,1,2\}\} \quad \{1,\{-1,1,1\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\}$$

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[74] **Answers for Set No: LXXIV**

(a) The eigenvalues are $\{-2,1,0\}$ and the eigenvector(s) are

$$\{-2,\{1,1,0\}\} \quad \{1,\{0,-1,1\}\} \quad \{0,\{-1,-1,1\}\}$$

(b) The eigenvalues are $\{1,1,0\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\} \quad \{1,\{1,1,0\}\} \quad \{0,\{2,1,0\}\}$$

(c) The eigenvalues are $\{3,-2,-2\}$ and the eigenvector(s) are

$$\{3,\{-1,0,1\}\} \quad \{-2,\{-3,-1,2\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{0,0,1\}\} \quad \{-2,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{-1,0,2\}\}$$

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[75] **Answers for Set No: LXXV**

(a) The eigenvalues are $\{4, 2, 0\}$ and the eigenvector(s) are

$$\{4, \{-1, 1, 1\}\} \quad \{2, \{-2, 1, 1\}\} \quad \{0, \{0, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -3, 1\}$ and the eigenvector(s) are

$$\{-3, \{0, 1, 1\}\} \quad \{-3, \{1, 0, 0\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 1\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[76] **Answers for Set No: LXXVI**

(a) The eigenvalues are $\{4, 2, 0\}$ and the eigenvector(s) are

$$\{4, \{-1, 1, 1\}\} \quad \{2, \{-2, 1, 1\}\} \quad \{0, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, -1, 2\}\} \quad \{1, \{1, 0, 0\}\} \quad \{0, \{-3, -1, 1\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[77] **Answers for Set No: LXXVII**

(a) The eigenvalues are $\{-4, 3, -1\}$ and the eigenvector(s) are

$$\{-4, \{1, 0, 1\}\} \quad \{3, \{-1, 1, 1\}\} \quad \{-1, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\} \quad \{1, \{0, 0, 1\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[78] **Answers for Set No: LXXVIII**

(a) The eigenvalues are $\{2, 1, 0\}$ and the eigenvector(s) are

$$\{2, \{-2, -2, 1\}\} \quad \{1, \{-2, -1, 2\}\} \quad \{0, \{-1, 0, 1\}\}$$

(b) The eigenvalues are $\{-2, 2, 2\}$ and the eigenvector(s) are

$$\{-2, \{1, 0, 1\}\} \quad \{2, \{0, 0, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 2\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 2, 0\}\}$$

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[79] **Answers for Set No: LXXIX**

(a) The eigenvalues are $\{5, 3, 0\}$ and the eigenvector(s) are

$$\{5, \{1, -1, 1\}\} \quad \{3, \{1, -2, 1\}\} \quad \{0, \{1, 0, 0\}\}$$

(b) The eigenvalues are $\{2, 2, 0\}$ and the eigenvector(s) are

$$\{2, \{1, 0, 2\}\} \quad \{2, \{1, 2, 0\}\} \quad \{0, \{0, -2, 1\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[80] **Answers for Set No: LXXX**

(a) The eigenvalues are $\{-4, -3, 2\}$ and the eigenvector(s) are

$$\{-4, \{-1, 1, 0\}\} \quad \{-3, \{-2, 3, 1\}\} \quad \{2, \{-1, 1, 1\}\}$$

(b) The eigenvalues are $\{2, 2, 1\}$ and the eigenvector(s) are

$$\{2, \{0, 0, 1\}\} \quad \{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{2, 0, 1\}\} \quad \{1, \{0, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[81] **Answers for Set No: LXXXI**

(a) The eigenvalues are $\{-4, 2, 1\}$ and the eigenvector(s) are

$$\{-4, \{-1, 1, 0\}\} \quad \{2, \{-1, 1, 1\}\} \quad \{1, \{-2, 1, 1\}\}$$

(b) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 3\}\} \quad \{3, \{4, 3, 0\}\} \quad \{2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 1\}\}$$

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[82] **Answers for Set No: LXXXII**

(a) The eigenvalues are $\{4, 2, 0\}$ and the eigenvector(s) are

$$\{4, \{-1, 1, 2\}\} \quad \{2, \{-2, 3, 4\}\} \quad \{0, \{-1, 3, 3\}\}$$

(b) The eigenvalues are $\{3, 3, 1\}$ and the eigenvector(s) are

$$\{3, \{0, -1, 1\}\} \quad \{3, \{1, 0, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{0, -1, 2\}\} \quad \{2, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 2\}\}$$

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[83] **Answers for Set No: LXXXIII**

(a) The eigenvalues are $\{3, 1, 0\}$ and the eigenvector(s) are

$$\{3, \{-1, 1, 0\}\} \quad \{1, \{-1, 0, 1\}\} \quad \{0, \{-2, -1, 2\}\}$$

(b) The eigenvalues are $\{3, 3, 1\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{3, \{0, 1, 0\}\} \quad \{1, \{-1, -1, 2\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{2, 0, 1\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 1\}\}$$

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[84] **Answers for Set No: LXXXIV**

(a) The eigenvalues are $\{-2, -1, 0\}$ and the eigenvector(s) are

$$\{-2, \{0, 1, 1\}\} \quad \{-1, \{1, 3, 1\}\} \quad \{0, \{1, 2, 1\}\}$$

(b) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{0, 0, 1\}\} \quad \{3, \{-1, 2, 0\}\} \quad \{2, \{-1, 1, 2\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 2\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\}$$

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[85] **Answers for Set No: LXXXV**

(a) The eigenvalues are $\{2, 1, 0\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{-1, 2, 1\}\} \quad \{0, \{-1, 1, 1\}\}$$

(b) The eigenvalues are $\{-3, -3, -1\}$ and the eigenvector(s) are

$$\{-3, \{0, -1, 1\}\} \quad \{-3, \{1, 0, 0\}\} \quad \{-1, \{2, 0, 1\}\}$$

(c) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(d) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 0, 1\}\} \quad \{-3, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[86] **Answers for Set No: LXXXVI**

(a) The eigenvalues are $\{5, 3, 1\}$ and the eigenvector(s) are

$$\{5, \{-1, 1, 1\}\} \quad \{3, \{-2, 1, 1\}\} \quad \{1, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -2, -2\}$ and the eigenvector(s) are

$$\{-3, \{-1, 1, 1\}\} \quad \{-2, \{-3, 0, 2\}\} \quad \{-2, \{0, 1, 0\}\}$$

(c) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-2, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[87] **Answers for Set No: LXXXVII**

(a) The eigenvalues are $\{3,2,0\}$ and the eigenvector(s) are

$$\{3,\{-1,1,1\}\} \quad \{2,\{-2,1,1\}\} \quad \{0,\{0,1,0\}\}$$

(b) The eigenvalues are $\{3,-2,-2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{-2,\{-1,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(c) The eigenvalues are $\{3,2,2\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{2,\{1,-1,3\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[88] **Answers for Set No: LXXXVIII**

(a) The eigenvalues are $\{-5,-2,1\}$ and the eigenvector(s) are

$$\{-5,\{-2,1,2\}\} \quad \{-2,\{-2,2,1\}\} \quad \{1,\{-1,1,0\}\}$$

(b) The eigenvalues are $\{-3,-3,-1\}$ and the eigenvector(s) are

$$\{-3,\{1,0,1\}\} \quad \{-3,\{0,1,0\}\} \quad \{-1,\{2,1,1\}\}$$

(c) The eigenvalues are $\{2,2,-1\}$ and the eigenvector(s) are

$$\{2,\{1,1,0\}\} \quad \{-1,\{-2,-1,2\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{0,0,1\}\} \quad \{-2,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[89] **Answers for Set No: LXXXIX**

(a) The eigenvalues are $\{3, 1, 0\}$ and the eigenvector(s) are

$$\{3, \{-1, 1, 1\}\} \quad \{1, \{-2, 3, 1\}\} \quad \{0, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -1, -1\}$ and the eigenvector(s) are

$$\{-3, \{2, 1, 1\}\} \quad \{-1, \{1, 0, 1\}\} \quad \{-1, \{0, 1, 0\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 1\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 2, 0\}\}$$

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[90] **Answers for Set No: XC**

(a) The eigenvalues are $\{3, 2, 0\}$ and the eigenvector(s) are

$$\{3, \{-1, 1, 1\}\} \quad \{2, \{-2, 1, 1\}\} \quad \{0, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{-2, -2, -1\}$ and the eigenvector(s) are

$$\{-2, \{1, 0, 1\}\} \quad \{-2, \{-1, 2, 0\}\} \quad \{-1, \{2, -3, 1\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[91] **Answers for Set No: XCI**

(a) The eigenvalues are $\{-3,-2,0\}$ and the eigenvector(s) are

$$\{-3,\{1,-1,3\}\} \quad \{-2,\{1,-1,2\}\} \quad \{0,\{1,0,1\}\}$$

(b) The eigenvalues are $\{-2,-1,-1\}$ and the eigenvector(s) are

$$\{-2,\{3,1,0\}\} \quad \{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(c) The eigenvalues are $\{-1,1,1\}$ and the eigenvector(s) are

$$\{-1,\{2,1,2\}\} \quad \{1,\{1,1,2\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,1,0\}\}$$

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[92] **Answers for Set No: XCII**

(a) The eigenvalues are $\{3,-1,0\}$ and the eigenvector(s) are

$$\{3,\{0,-1,1\}\} \quad \{-1,\{1,-3,1\}\} \quad \{0,\{1,-2,1\}\}$$

(b) The eigenvalues are $\{3,-1,-1\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{-1,\{1,0,2\}\} \quad \{-1,\{1,1,0\}\}$$

(c) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{1,0,0\}\} \quad \{0,\{2,2,1\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,1,2\}\} \quad \{-1,\{1,0,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,1\}\}$$

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[93] **Answers for Set No: XCIII**

(a) The eigenvalues are $\{7, 2, -1\}$ and the eigenvector(s) are

$$\{7, \{-1, 1, 1\}\} \quad \{2, \{-2, 3, 1\}\} \quad \{-1, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{-3, 0, 1\}\} \quad \{-1, \{1, 1, 0\}\} \quad \{0, \{-1, 1, 1\}\}$$

(c) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 2\}\}$$

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[94] **Answers for Set No: XCIV**

(a) The eigenvalues are $\{5, 3, 0\}$ and the eigenvector(s) are

$$\{5, \{1, 3, 1\}\} \quad \{3, \{1, 2, 1\}\} \quad \{0, \{0, 1, 1\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{0, 3, 1\}\} \quad \{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(c) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{2, 0, 1\}\} \quad \{1, \{0, 1, 0\}\}$$

(e) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 1\}\}$$

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[95] **Answers for Set No: XCV**

(a) The eigenvalues are $\{-2, 1, 0\}$ and the eigenvector(s) are

$$\{-2, \{0, -3, 2\}\} \quad \{1, \{1, 0, 0\}\} \quad \{0, \{-1, -1, 1\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{1, 1, 0\}\} \quad \{0, \{2, 1, 0\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\}$$

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[96] **Answers for Set No: XCVI**

(a) The eigenvalues are $\{4, -2, 1\}$ and the eigenvector(s) are

$$\{4, \{0, -1, 1\}\} \quad \{-2, \{-1, -1, 2\}\} \quad \{1, \{-1, -3, 3\}\}$$

(b) The eigenvalues are $\{-3, -3, 1\}$ and the eigenvector(s) are

$$\{-3, \{0, 1, 1\}\} \quad \{-3, \{1, 0, 0\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{0, -1, 2\}\} \quad \{2, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[97] **Answers for Set No: XCVII**

(a) The eigenvalues are $\{4, 2, -1\}$ and the eigenvector(s) are

$$\{4, \{-2, -2, 1\}\} \quad \{2, \{-2, -1, 1\}\} \quad \{-1, \{-1, 0, 1\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, -1, 2\}\} \quad \{1, \{1, 0, 0\}\} \quad \{0, \{-3, -1, 1\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{2, 0, 1\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[98] **Answers for Set No: XCVIII**

(a) The eigenvalues are $\{3, 1, 0\}$ and the eigenvector(s) are

$$\{3, \{1, 1, 2\}\} \quad \{1, \{1, 2, 3\}\} \quad \{0, \{1, 1, 1\}\}$$

(b) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\} \quad \{1, \{0, 0, 1\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 2\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[99] **Answers for Set No: XCIX**

(a) The eigenvalues are $\{4,1,0\}$ and the eigenvector(s) are

$$\{4,\{1,-2,2\}\} \quad \{1,\{1,-2,3\}\} \quad \{0,\{1,-1,2\}\}$$

(b) The eigenvalues are $\{-2,2,2\}$ and the eigenvector(s) are

$$\{-2,\{1,0,1\}\} \quad \{2,\{0,0,1\}\} \quad \{2,\{1,1,0\}\}$$

(c) The eigenvalues are $\{-1,1,1\}$ and the eigenvector(s) are

$$\{-1,\{2,1,2\}\} \quad \{1,\{1,1,2\}\}$$

(d) The eigenvalues are $\{-3,-3,-3\}$ and the eigenvector(s) are

$$\{-3,\{-1,0,1\}\} \quad \{-3,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[100] **Answers for Set No: C**

(a) The eigenvalues are $\{3,2,1\}$ and the eigenvector(s) are

$$\{3,\{-2,0,1\}\} \quad \{2,\{-3,-1,2\}\} \quad \{1,\{-2,-1,1\}\}$$

(b) The eigenvalues are $\{2,2,0\}$ and the eigenvector(s) are

$$\{2,\{1,0,2\}\} \quad \{2,\{1,2,0\}\} \quad \{0,\{0,-2,1\}\}$$

(c) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{1,0,0\}\} \quad \{0,\{2,2,1\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-2,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{-3,-3,-3\}$ and the eigenvector(s) are

$$\{-3,\{-1,2,0\}\}$$

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[101] **Answers for Set No: CI**

(a) The eigenvalues are $\{6,3,1\}$ and the eigenvector(s) are

$$\{6,\{-1,1,0\}\} \quad \{3,\{-1,0,1\}\} \quad \{1,\{-2,-1,2\}\}$$

(b) The eigenvalues are $\{2,2,1\}$ and the eigenvector(s) are

$$\{2,\{0,0,1\}\} \quad \{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(c) The eigenvalues are $\{2,1,1\}$ and the eigenvector(s) are

$$\{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,-1,1\}\}$$

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[102] **Answers for Set No: CII**

(a) The eigenvalues are $\{3,2,1\}$ and the eigenvector(s) are

$$\{3,\{-1,1,2\}\} \quad \{2,\{-3,2,6\}\} \quad \{1,\{-1,0,1\}\}$$

(b) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,0,3\}\} \quad \{3,\{4,3,0\}\} \quad \{2,\{1,1,0\}\}$$

(c) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{2,\{1,1,0\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{0,0,1\}\} \quad \{-2,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,1,0\}\}$$

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[103] **Answers for Set No: CIII**

(a) The eigenvalues are $\{3,-2,0\}$ and the eigenvector(s) are

$$\{3,\{0,-1,1\}\} \quad \{-2,\{-1,-3,1\}\} \quad \{0,\{-1,-3,2\}\}$$

(b) The eigenvalues are $\{3,3,1\}$ and the eigenvector(s) are

$$\{3,\{0,-1,1\}\} \quad \{3,\{1,0,0\}\} \quad \{1,\{1,0,1\}\}$$

(c) The eigenvalues are $\{3,2,2\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{2,\{1,-1,3\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,1,1\}\} \quad \{-1,\{1,0,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,1\}\}$$

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[104] **Answers for Set No: CIV**

(a) The eigenvalues are $\{4,1,0\}$ and the eigenvector(s) are

$$\{4,\{-1,1,0\}\} \quad \{1,\{-1,0,1\}\} \quad \{0,\{-2,-1,2\}\}$$

(b) The eigenvalues are $\{3,3,1\}$ and the eigenvector(s) are

$$\{3,\{-1,0,1\}\} \quad \{3,\{0,1,0\}\} \quad \{1,\{-1,-1,2\}\}$$

(c) The eigenvalues are $\{2,2,-1\}$ and the eigenvector(s) are

$$\{2,\{1,1,0\}\} \quad \{-1,\{-2,-1,2\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,2\}\}$$

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[105] **Answers for Set No: CV**

(a) The eigenvalues are $\{4,3,-2\}$ and the eigenvector(s) are

$$\{4,\{-1,1,1\}\} \quad \{3,\{-2,2,1\}\} \quad \{-2,\{0,1,0\}\}$$

(b) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{0,0,1\}\} \quad \{3,\{-1,2,0\}\} \quad \{2,\{-1,1,2\}\}$$

(c) The eigenvalues are $\{-2,-2,1\}$ and the eigenvector(s) are

$$\{-2,\{-3,1,2\}\} \quad \{1,\{-1,1,1\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{1,0,1\}\}$$

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[106] **Answers for Set No: CVI**

(a) The eigenvalues are $\{4,2,0\}$ and the eigenvector(s) are

$$\{4,\{0,-1,1\}\} \quad \{2,\{-1,-3,3\}\} \quad \{0,\{-1,-1,2\}\}$$

(b) The eigenvalues are $\{-3,-3,-1\}$ and the eigenvector(s) are

$$\{-3,\{0,-1,1\}\} \quad \{-3,\{1,0,0\}\} \quad \{-1,\{2,0,1\}\}$$

(c) The eigenvalues are $\{3,-2,-2\}$ and the eigenvector(s) are

$$\{3,\{-1,0,1\}\} \quad \{-2,\{-3,-1,2\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,1,2\}\} \quad \{-1,\{1,0,0\}\}$$

(e) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\}$$

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[107] **Answers for Set No: CVII**

(a) The eigenvalues are $\{-2, 1, 0\}$ and the eigenvector(s) are

$$\{-2, \{1, -3, 1\}\} \quad \{1, \{0, -1, 1\}\} \quad \{0, \{1, -2, 1\}\}$$

(b) The eigenvalues are $\{-3, -2, -2\}$ and the eigenvector(s) are

$$\{-3, \{-1, 1, 1\}\} \quad \{-2, \{-3, 0, 2\}\} \quad \{-2, \{0, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[108] **Answers for Set No: CVIII**

(a) The eigenvalues are $\{3, 1, 0\}$ and the eigenvector(s) are

$$\{3, \{-2, -2, 1\}\} \quad \{1, \{-2, -1, 2\}\} \quad \{0, \{-1, 0, 1\}\}$$

(b) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{-2, \{-1, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{2, 0, 1\}\} \quad \{1, \{0, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[109] **Answers for Set No: CIX**

(a) The eigenvalues are $\{-2,-1,0\}$ and the eigenvector(s) are

$$\{-2,\{-1,1,1\}\} \quad \{-1,\{-1,1,0\}\} \quad \{0,\{-1,0,2\}\}$$

(b) The eigenvalues are $\{-3,-3,-1\}$ and the eigenvector(s) are

$$\{-3,\{1,0,1\}\} \quad \{-3,\{0,1,0\}\} \quad \{-1,\{2,1,1\}\}$$

(c) The eigenvalues are $\{2,1,1\}$ and the eigenvector(s) are

$$\{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(d) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\} \quad \{1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[110] **Answers for Set No: CX**

(a) The eigenvalues are $\{3,-2,1\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{-2,\{-1,1,1\}\} \quad \{1,\{2,-1,1\}\}$$

(b) The eigenvalues are $\{-3,-1,-1\}$ and the eigenvector(s) are

$$\{-3,\{2,1,1\}\} \quad \{-1,\{1,0,1\}\} \quad \{-1,\{0,1,0\}\}$$

(c) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{2,\{1,1,0\}\}$$

(d) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{0,-1,2\}\} \quad \{2,\{1,0,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[111] **Answers for Set No: CXI**

(a) The eigenvalues are $\{3, 2, -1\}$ and the eigenvector(s) are

$$\{3, \{0, -1, 1\}\} \quad \{2, \{-1, -3, 3\}\} \quad \{-1, \{-1, -1, 2\}\}$$

(b) The eigenvalues are $\{-2, -2, -1\}$ and the eigenvector(s) are

$$\{-2, \{1, 0, 1\}\} \quad \{-2, \{-1, 2, 0\}\} \quad \{-1, \{2, -3, 1\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{2, 0, 1\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 2, 0\}\}$$

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[112] **Answers for Set No: CXII**

(a) The eigenvalues are $\{3, 2, -1\}$ and the eigenvector(s) are

$$\{3, \{3, -2, 3\}\} \quad \{2, \{3, -2, 2\}\} \quad \{-1, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{-2, -1, -1\}$ and the eigenvector(s) are

$$\{-2, \{3, 1, 0\}\} \quad \{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 2\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[113] **Answers for Set No: CXIII**

(a) The eigenvalues are $\{3, 1, 0\}$ and the eigenvector(s) are

$$\{3, \{-2, 0, 1\}\} \quad \{1, \{-3, -1, 2\}\} \quad \{0, \{-2, -1, 1\}\}$$

(b) The eigenvalues are $\{3, -1, -1\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{-1, \{1, 0, 2\}\} \quad \{-1, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 0, 1\}\} \quad \{-3, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[114] **Answers for Set No: CXIV**

(a) The eigenvalues are $\{2, 1, 0\}$ and the eigenvector(s) are

$$\{2, \{1, 2, 1\}\} \quad \{1, \{1, 3, 1\}\} \quad \{0, \{0, 1, 1\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{-3, 0, 1\}\} \quad \{-1, \{1, 1, 0\}\} \quad \{0, \{-1, 1, 1\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-2, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 1\}\}$$

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[115] **Answers for Set No: CXV**

(a) The eigenvalues are $\{-3, 1, 0\}$ and the eigenvector(s) are

$$\{-3, \{1, 0, 1\}\} \quad \{1, \{3, -1, 1\}\} \quad \{0, \{2, -1, 1\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{0, 3, 1\}\} \quad \{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 2\}\}$$

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[116] **Answers for Set No: CXVI**

(a) The eigenvalues are $\{6, 1, 0\}$ and the eigenvector(s) are

$$\{6, \{0, 1, 0\}\} \quad \{1, \{3, 6, 2\}\} \quad \{0, \{1, 2, 1\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{1, 1, 0\}\} \quad \{0, \{2, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{0, 0, 1\}\} \quad \{-2, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 1\}\}$$

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[117] **Answers for Set No: CXVII**

(a) The eigenvalues are $\{3,2,1\}$ and the eigenvector(s) are

$$\{3,\{2,3,0\}\} \quad \{2,\{-2,-4,1\}\} \quad \{1,\{-1,-3,1\}\}$$

(b) The eigenvalues are $\{-3,-3,1\}$ and the eigenvector(s) are

$$\{-3,\{0,1,1\}\} \quad \{-3,\{1,0,0\}\} \quad \{1,\{-2,1,0\}\}$$

(c) The eigenvalues are $\{2,1,1\}$ and the eigenvector(s) are

$$\{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,1,1\}\} \quad \{-1,\{1,0,0\}\}$$

(e) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\}$$

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[118] **Answers for Set No: CXVIII**

(a) The eigenvalues are $\{-2,1,0\}$ and the eigenvector(s) are

$$\{-2,\{-1,1,2\}\} \quad \{1,\{-1,0,1\}\} \quad \{0,\{-1,1,1\}\}$$

(b) The eigenvalues are $\{1,1,0\}$ and the eigenvector(s) are

$$\{1,\{0,-1,2\}\} \quad \{1,\{1,0,0\}\} \quad \{0,\{-3,-1,1\}\}$$

(c) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{2,\{1,1,0\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{-1,0,2\}\}$$

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[119] **Answers for Set No: CXIX**

(a) The eigenvalues are $\{3, 2, 0\}$ and the eigenvector(s) are

$$\{3, \{1, 2, 2\}\} \quad \{2, \{2, 3, 4\}\} \quad \{0, \{0, 1, 1\}\}$$

(b) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\} \quad \{1, \{0, 0, 1\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[120] **Answers for Set No: CXX**

(a) The eigenvalues are $\{-3, 2, 1\}$ and the eigenvector(s) are

$$\{-3, \{-1, 0, 1\}\} \quad \{2, \{-2, -2, 1\}\} \quad \{1, \{-2, -1, 1\}\}$$

(b) The eigenvalues are $\{-2, 2, 2\}$ and the eigenvector(s) are

$$\{-2, \{1, 0, 1\}\} \quad \{2, \{0, 0, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 2\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[121] **Answers for Set No: CXXI**

(a) The eigenvalues are $\{5, 1, 0\}$ and the eigenvector(s) are

$$\{5, \{-1, 1, 1\}\} \quad \{1, \{-2, 3, 1\}\} \quad \{0, \{-1, 1, 0\}\}$$

(b) The eigenvalues are $\{2, 2, 0\}$ and the eigenvector(s) are

$$\{2, \{1, 0, 2\}\} \quad \{2, \{1, 2, 0\}\} \quad \{0, \{0, -2, 1\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[122] **Answers for Set No: CXXII**

(a) The eigenvalues are $\{-3, 2, 1\}$ and the eigenvector(s) are

$$\{-3, \{-1, 1, 0\}\} \quad \{2, \{3, -2, 3\}\} \quad \{1, \{3, -2, 2\}\}$$

(b) The eigenvalues are $\{2, 2, 1\}$ and the eigenvector(s) are

$$\{2, \{0, 0, 1\}\} \quad \{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{2, 0, 1\}\} \quad \{1, \{0, 1, 0\}\}$$

(e) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 2, 0\}\}$$

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[123] **Answers for Set No: CXXIII**

(a) The eigenvalues are $\{4, -3, 0\}$ and the eigenvector(s) are

$$\{4, \{-1, -1, 1\}\} \quad \{-3, \{1, 1, 0\}\} \quad \{0, \{0, -1, 1\}\}$$

(b) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 3\}\} \quad \{3, \{4, 3, 0\}\} \quad \{2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[124] **Answers for Set No: CXXIV**

(a) The eigenvalues are $\{6, 2, 1\}$ and the eigenvector(s) are

$$\{6, \{-1, 1, 0\}\} \quad \{2, \{-1, 0, 1\}\} \quad \{1, \{-2, -1, 2\}\}$$

(b) The eigenvalues are $\{3, 3, 1\}$ and the eigenvector(s) are

$$\{3, \{0, -1, 1\}\} \quad \{3, \{1, 0, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{0, -1, 2\}\} \quad \{2, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[125] **Answers for Set No: CXXV**

(a) The eigenvalues are $\{3, 2, 0\}$ and the eigenvector(s) are

$$\{3, \{-2, 2, 1\}\} \quad \{2, \{-1, 1, 1\}\} \quad \{0, \{0, 1, 0\}\}$$

(b) The eigenvalues are $\{3, 3, 1\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{3, \{0, 1, 0\}\} \quad \{1, \{-1, -1, 2\}\}$$

(c) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{2, 0, 1\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 1\}\}$$

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[126] **Answers for Set No: CXXVI**

(a) The eigenvalues are $\{3, 2, -1\}$ and the eigenvector(s) are

$$\{3, \{-2, 1, 1\}\} \quad \{2, \{-1, 1, 1\}\} \quad \{-1, \{0, 1, 0\}\}$$

(b) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{0, 0, 1\}\} \quad \{3, \{-1, 2, 0\}\} \quad \{2, \{-1, 1, 2\}\}$$

(c) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 2\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 2\}\}$$

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[127] **Answers for Set No: CXXVII**

(a) The eigenvalues are $\{-7,-2,1\}$ and the eigenvector(s) are

$$\{-7,\{0,1,0\}\} \quad \{-2,\{-1,2,1\}\} \quad \{1,\{-2,2,1\}\}$$

(b) The eigenvalues are $\{-3,-3,-1\}$ and the eigenvector(s) are

$$\{-3,\{0,-1,1\}\} \quad \{-3,\{1,0,0\}\} \quad \{-1,\{2,0,1\}\}$$

(c) The eigenvalues are $\{3,2,2\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{2,\{1,-1,3\}\}$$

(d) The eigenvalues are $\{-3,-3,-3\}$ and the eigenvector(s) are

$$\{-3,\{-1,0,1\}\} \quad \{-3,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{1,0,1\}\}$$

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[128] **Answers for Set No: CXXVIII**

(a) The eigenvalues are $\{2,1,0\}$ and the eigenvector(s) are

$$\{2,\{0,1,0\}\} \quad \{1,\{-2,3,1\}\} \quad \{0,\{-3,4,2\}\}$$

(b) The eigenvalues are $\{-3,-2,-2\}$ and the eigenvector(s) are

$$\{-3,\{-1,1,1\}\} \quad \{-2,\{-3,0,2\}\} \quad \{-2,\{0,1,0\}\}$$

(c) The eigenvalues are $\{2,2,-1\}$ and the eigenvector(s) are

$$\{2,\{1,1,0\}\} \quad \{-1,\{-2,-1,2\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-2,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{1,1,1\}$ and the eigenvector(s) are

$$\{1,\{0,0,1\}\}$$

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[129] **Answers for Set No: CXXIX**

(a) The eigenvalues are $\{6,1,0\}$ and the eigenvector(s) are

$$\{6,\{0,1,0\}\} \quad \{1,\{-2,3,1\}\} \quad \{0,\{-3,4,2\}\}$$

(b) The eigenvalues are $\{3,-2,-2\}$ and the eigenvector(s) are

$$\{3,\{-1,-1,1\}\} \quad \{-2,\{-1,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(c) The eigenvalues are $\{-2,-2,1\}$ and the eigenvector(s) are

$$\{-2,\{-3,1,2\}\} \quad \{1,\{-1,1,1\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{-1,0,2\}\}$$

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[130] **Answers for Set No: CXXX**

(a) The eigenvalues are $\{7,1,0\}$ and the eigenvector(s) are

$$\{7,\{0,1,0\}\} \quad \{1,\{-2,3,1\}\} \quad \{0,\{-3,4,2\}\}$$

(b) The eigenvalues are $\{-3,-3,-1\}$ and the eigenvector(s) are

$$\{-3,\{1,0,1\}\} \quad \{-3,\{0,1,0\}\} \quad \{-1,\{2,1,1\}\}$$

(c) The eigenvalues are $\{3,-2,-2\}$ and the eigenvector(s) are

$$\{3,\{-1,0,1\}\} \quad \{-2,\{-3,-1,2\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{0,0,1\}\} \quad \{-2,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{2,2,2\}$ and the eigenvector(s) are

$$\{2,\{-1,0,2\}\}$$

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[131] **Answers for Set No: CXXXI**

(a) The eigenvalues are $\{3,-2,-1\}$ and the eigenvector(s) are

$$\{3,\{-1,0,1\}\} \quad \{-2,\{-1,1,2\}\} \quad \{-1,\{-1,1,1\}\}$$

(b) The eigenvalues are $\{-3,-1,-1\}$ and the eigenvector(s) are

$$\{-3,\{2,1,1\}\} \quad \{-1,\{1,0,1\}\} \quad \{-1,\{0,1,0\}\}$$

(c) The eigenvalues are $\{-1,1,1\}$ and the eigenvector(s) are

$$\{-1,\{2,1,2\}\} \quad \{1,\{1,1,2\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,1,1\}\} \quad \{-1,\{1,0,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[132] **Answers for Set No: CXXXII**

(a) The eigenvalues are $\{3,2,-1\}$ and the eigenvector(s) are

$$\{3,\{-2,1,1\}\} \quad \{2,\{-1,1,1\}\} \quad \{-1,\{-1,1,0\}\}$$

(b) The eigenvalues are $\{-2,-2,-1\}$ and the eigenvector(s) are

$$\{-2,\{1,0,1\}\} \quad \{-2,\{-1,2,0\}\} \quad \{-1,\{2,-3,1\}\}$$

(c) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{1,0,0\}\} \quad \{0,\{2,2,1\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[133] **Answers for Set No: CXXXIII**

(a) The eigenvalues are $\{4, 1, 0\}$ and the eigenvector(s) are

$$\{4, \{-2, 0, 1\}\} \quad \{1, \{-3, -1, 2\}\} \quad \{0, \{-2, -1, 1\}\}$$

(b) The eigenvalues are $\{-2, -1, -1\}$ and the eigenvector(s) are

$$\{-2, \{3, 1, 0\}\} \quad \{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 2, 0\}\}$$

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[134] **Answers for Set No: CXXXIV**

(a) The eigenvalues are $\{5, -2, 1\}$ and the eigenvector(s) are

$$\{5, \{-1, -1, 1\}\} \quad \{-2, \{1, 1, 0\}\} \quad \{1, \{0, -1, 1\}\}$$

(b) The eigenvalues are $\{3, -1, -1\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{-1, \{1, 0, 2\}\} \quad \{-1, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 2\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[135] **Answers for Set No: CXXXV**

(a) The eigenvalues are $\{5, 2, -1\}$ and the eigenvector(s) are

$$\{5, \{-1, -1, 1\}\} \quad \{2, \{0, -1, 1\}\} \quad \{-1, \{1, 1, 0\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{-3, 0, 1\}\} \quad \{-1, \{1, 1, 0\}\} \quad \{0, \{-1, 1, 1\}\}$$

(c) The eigenvalues are $\{3, 2, 2\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\} \quad \{2, \{1, -1, 3\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[136] **Answers for Set No: CXXXVI**

(a) The eigenvalues are $\{3, 2, 0\}$ and the eigenvector(s) are

$$\{3, \{-3, -1, 1\}\} \quad \{2, \{1, 1, 0\}\} \quad \{0, \{0, 1, 1\}\}$$

(b) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{0, 3, 1\}\} \quad \{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(c) The eigenvalues are $\{2, 2, -1\}$ and the eigenvector(s) are

$$\{2, \{1, 1, 0\}\} \quad \{-1, \{-2, -1, 2\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{2, 0, 1\}\} \quad \{1, \{0, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 1\}\}$$

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[137] **Answers for Set No: CXXXVII**

(a) The eigenvalues are $\{3, 2, -1\}$ and the eigenvector(s) are

$$\{3, \{3, -1, 1\}\} \quad \{2, \{2, -1, 1\}\} \quad \{-1, \{1, 0, 1\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{1, 1, 0\}\} \quad \{0, \{2, 1, 0\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{2, 1, 2\}\}$$

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[138] **Answers for Set No: CXXXVIII**

(a) The eigenvalues are $\{3, 1, 0\}$ and the eigenvector(s) are

$$\{3, \{-2, 1, 1\}\} \quad \{1, \{-1, 1, 1\}\} \quad \{0, \{0, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -3, 1\}$ and the eigenvector(s) are

$$\{-3, \{0, 1, 1\}\} \quad \{-3, \{1, 0, 0\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{0, -1, 2\}\} \quad \{2, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 1\}\}$$

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[139] **Answers for Set No: CXXXIX**

(a) The eigenvalues are $\{-7, 2, -1\}$ and the eigenvector(s) are

$$\{-7, \{0, 1, 0\}\} \quad \{2, \{-2, 2, 1\}\} \quad \{-1, \{-1, 2, 1\}\}$$

(b) The eigenvalues are $\{1, 1, 0\}$ and the eigenvector(s) are

$$\{1, \{0, -1, 2\}\} \quad \{1, \{1, 0, 0\}\} \quad \{0, \{-3, -1, 1\}\}$$

(c) The eigenvalues are $\{-1, 1, 1\}$ and the eigenvector(s) are

$$\{-1, \{2, 1, 2\}\} \quad \{1, \{1, 1, 2\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{2, 0, 1\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\}$$

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[140] **Answers for Set No: CXL**

(a) The eigenvalues are $\{-3, 2, -1\}$ and the eigenvector(s) are

$$\{-3, \{0, 1, 0\}\} \quad \{2, \{-2, 1, 1\}\} \quad \{-1, \{-1, 1, 1\}\}$$

(b) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\} \quad \{1, \{0, 0, 1\}\} \quad \{1, \{-2, 1, 0\}\}$$

(c) The eigenvalues are $\{-1, -1, 0\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 0\}\} \quad \{0, \{2, 2, 1\}\}$$

(d) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 2\}\} \quad \{3, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[141] **Answers for Set No: CXLI**

(a) The eigenvalues are $\{3, 2, 0\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{2, \{-1, 1, 1\}\} \quad \{0, \{-1, 1, 2\}\}$$

(b) The eigenvalues are $\{-2, 2, 2\}$ and the eigenvector(s) are

$$\{-2, \{1, 0, 1\}\} \quad \{2, \{0, 0, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(d) The eigenvalues are $\{-3, -3, -3\}$ and the eigenvector(s) are

$$\{-3, \{-1, 0, 1\}\} \quad \{-3, \{-1, 1, 0\}\}$$

(e) The eigenvalues are $\{2, 2, 2\}$ and the eigenvector(s) are

$$\{2, \{-1, 0, 2\}\}$$

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[142] **Answers for Set No: CXLII**

(a) The eigenvalues are $\{2, 1, 0\}$ and the eigenvector(s) are

$$\{2, \{4, -3, 1\}\} \quad \{1, \{5, -4, 2\}\} \quad \{0, \{2, -2, 1\}\}$$

(b) The eigenvalues are $\{2, 2, 0\}$ and the eigenvector(s) are

$$\{2, \{1, 0, 2\}\} \quad \{2, \{1, 2, 0\}\} \quad \{0, \{0, -2, 1\}\}$$

(c) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(d) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-2, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(e) The eigenvalues are $\{3, 3, 3\}$ and the eigenvector(s) are

$$\{3, \{1, 0, 1\}\}$$

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[143] **Answers for Set No: CXLIII**

(a) The eigenvalues are $\{3,1,0\}$ and the eigenvector(s) are

$$\{3,\{1,-1,1\}\} \quad \{1,\{1,-2,1\}\} \quad \{0,\{2,-5,3\}\}$$

(b) The eigenvalues are $\{2,2,1\}$ and the eigenvector(s) are

$$\{2,\{0,0,1\}\} \quad \{2,\{-1,1,0\}\} \quad \{1,\{1,0,1\}\}$$

(c) The eigenvalues are $\{3,2,2\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\} \quad \{2,\{1,-1,3\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{-1,0,1\}\} \quad \{-2,\{1,1,0\}\}$$

(e) The eigenvalues are $\{3,3,3\}$ and the eigenvector(s) are

$$\{3,\{1,0,1\}\}$$

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[144] **Answers for Set No: CXLIV**

(a) The eigenvalues are $\{3,1,0\}$ and the eigenvector(s) are

$$\{3,\{-1,1,0\}\} \quad \{1,\{1,-4,2\}\} \quad \{0,\{0,-1,1\}\}$$

(b) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{-1,0,3\}\} \quad \{3,\{4,3,0\}\} \quad \{2,\{1,1,0\}\}$$

(c) The eigenvalues are $\{2,2,-1\}$ and the eigenvector(s) are

$$\{2,\{1,1,0\}\} \quad \{-1,\{-2,-1,2\}\}$$

(d) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{0,0,1\}\} \quad \{-2,\{-1,1,0\}\}$$

(e) The eigenvalues are $\{-3,-3,-3\}$ and the eigenvector(s) are

$$\{-3,\{-1,2,0\}\}$$

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[145] **Answers for Set No: CXLV**

(a) The eigenvalues are $\{2, 1, 0\}$ and the eigenvector(s) are

$$\{2, \{2, 1, 1\}\} \quad \{1, \{3, 2, 1\}\} \quad \{0, \{5, 4, 2\}\}$$

(b) The eigenvalues are $\{3, 3, 1\}$ and the eigenvector(s) are

$$\{3, \{0, -1, 1\}\} \quad \{3, \{1, 0, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(c) The eigenvalues are $\{-2, -2, 1\}$ and the eigenvector(s) are

$$\{-2, \{-3, 1, 2\}\} \quad \{1, \{-1, 1, 1\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 1, 1\}\} \quad \{-1, \{1, 0, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, -1, 1\}\}$$

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[146] **Answers for Set No: CXLVI**

(a) The eigenvalues are $\{2, -1, 0\}$ and the eigenvector(s) are

$$\{2, \{3, 3, 2\}\} \quad \{-1, \{0, 1, 0\}\} \quad \{0, \{1, 1, 1\}\}$$

(b) The eigenvalues are $\{3, 3, 1\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{3, \{0, 1, 0\}\} \quad \{1, \{-1, -1, 2\}\}$$

(c) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, 0, 1\}\} \quad \{-2, \{-3, -1, 2\}\}$$

(d) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{0, 0, 1\}\} \quad \{-1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-2, -2, -2\}$ and the eigenvector(s) are

$$\{-2, \{-1, 1, 0\}\}$$

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[147] **Answers for Set No: CXLVII**

(a) The eigenvalues are $\{4,3,1\}$ and the eigenvector(s) are

$$\{4,\{-1,-1,2\}\} \quad \{3,\{-1,-3,3\}\} \quad \{1,\{0,1,0\}\}$$

(b) The eigenvalues are $\{3,3,2\}$ and the eigenvector(s) are

$$\{3,\{0,0,1\}\} \quad \{3,\{-1,2,0\}\} \quad \{2,\{-1,1,2\}\}$$

(c) The eigenvalues are $\{-1,1,1\}$ and the eigenvector(s) are

$$\{-1,\{2,1,2\}\} \quad \{1,\{1,1,2\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,0,1\}\} \quad \{-1,\{2,1,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,1\}\}$$

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[148] **Answers for Set No: CXLVIII**

(a) The eigenvalues are $\{3,2,0\}$ and the eigenvector(s) are

$$\{3,\{4,-2,1\}\} \quad \{2,\{3,-2,1\}\} \quad \{0,\{-1,1,0\}\}$$

(b) The eigenvalues are $\{-3,-3,-1\}$ and the eigenvector(s) are

$$\{-3,\{0,-1,1\}\} \quad \{-3,\{1,0,0\}\} \quad \{-1,\{2,0,1\}\}$$

(c) The eigenvalues are $\{-1,-1,0\}$ and the eigenvector(s) are

$$\{-1,\{1,0,0\}\} \quad \{0,\{2,2,1\}\}$$

(d) The eigenvalues are $\{-1,-1,-1\}$ and the eigenvector(s) are

$$\{-1,\{0,1,2\}\} \quad \{-1,\{1,0,0\}\}$$

(e) The eigenvalues are $\{-2,-2,-2\}$ and the eigenvector(s) are

$$\{-2,\{2,1,2\}\}$$

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[149] **Answers for Set No: CXLIX**

(a) The eigenvalues are $\{7, 1, 0\}$ and the eigenvector(s) are

$$\{7, \{-1, -1, 1\}\} \quad \{1, \{0, -1, 1\}\} \quad \{0, \{1, 1, 0\}\}$$

(b) The eigenvalues are $\{-3, -2, -2\}$ and the eigenvector(s) are

$$\{-3, \{-1, 1, 1\}\} \quad \{-2, \{-3, 0, 2\}\} \quad \{-2, \{0, 1, 0\}\}$$

(c) The eigenvalues are $\{2, 1, 1\}$ and the eigenvector(s) are

$$\{2, \{-1, 1, 0\}\} \quad \{1, \{1, 0, 1\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\} \quad \{1, \{2, 1, 0\}\}$$

(e) The eigenvalues are $\{-1, -1, -1\}$ and the eigenvector(s) are

$$\{-1, \{1, 0, 1\}\}$$

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[150] **Answers for Set No: CL**

(a) The eigenvalues are $\{3, -2, 1\}$ and the eigenvector(s) are

$$\{3, \{-3, -1, 1\}\} \quad \{-2, \{0, 1, 1\}\} \quad \{1, \{1, 1, 0\}\}$$

(b) The eigenvalues are $\{3, -2, -2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{-2, \{-1, 0, 1\}\} \quad \{-2, \{1, 1, 0\}\}$$

(c) The eigenvalues are $\{3, 3, 2\}$ and the eigenvector(s) are

$$\{3, \{-1, -1, 1\}\} \quad \{2, \{1, 1, 0\}\}$$

(d) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{2, 0, 1\}\} \quad \{1, \{0, 1, 0\}\}$$

(e) The eigenvalues are $\{1, 1, 1\}$ and the eigenvector(s) are

$$\{1, \{0, 0, 1\}\}$$

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