UNIVERSITY OF HYDERABAD
School of Physics

M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[1]

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.

[1] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work**[2]

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.

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

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

[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.

[2]**Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work**[3]

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.

[3]**Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work[4]**

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.

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

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

[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.

[4]**Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work**[5]

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.

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

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

[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.

[5] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I ∷ Home Work**[6]

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.

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

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

[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.

[6]**Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work**[7]

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.

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

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

[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.

[7] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work**[8]

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.

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

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

[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.

[8]**Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work**[9]

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.

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

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

[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.

[9]**Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work**[10]

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.

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

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

[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.

[10]**Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work**[11]

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.

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

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

[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 **Set−I :: Home Work**[12]

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.

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

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

[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 **Set−I :: Home Work**[13]

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.

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

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

[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 **Set−I :: Home Work**[14]

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.

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

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

[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.

[14] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work**[15]

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.

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

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

[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.

[15]**Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set–I :: Home Work**[16]

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.

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

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

[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 **Set−I :: Home Work**[17]

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.

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

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

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

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Quantum Mechanics-I **Set−I :: Home Work**[18]

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.

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

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

[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 **Set−I :: Home Work**[19]

EIGENVALUES AND EIGENVECTORS

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

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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.

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

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

[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.

[19] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[20]

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.

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

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

[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.

[20] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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Quantum Mechanics-I **Set−I :: Home Work**[21]

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.

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

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

[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 **Set−I :: Home Work**[22]

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.

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

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

[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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Quantum Mechanics-I **Set−I :: Home Work**[23]

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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.

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

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

[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 **Set−I :: Home Work**[24]

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.

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

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

[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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Quantum Mechanics-I **Set−I :: Home Work**[25]

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.

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

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

[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 **Set–I :: Home Work**[26]

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.

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

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

[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 **Set−I ∷ Home Work**[27]

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.

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

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

[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 **Set−I :: Home Work**[28]

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.

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

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

[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 II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I ∷ Home Work**[29]

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.

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

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

[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 II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[30]

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.

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

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

[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 II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[31]

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.

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

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

[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 II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[32]

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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.

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

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

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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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Quantum Mechanics-I **Set−I :: Home Work**[34]

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

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

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Quantum Mechanics-I **Set−I :: Home Work**[35]

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

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

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Quantum Mechanics-I **Set−I :: Home Work**[36]

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.

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

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

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Quantum Mechanics-I **Set−I ∷ Home Work**[37]

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

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

[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 **Set−I :: Home Work**[38]

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.

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

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

[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 **Set−I :: Home Work**[39]

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.

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

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

[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 **Set−I :: Home Work**[40]

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.

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

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

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

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Quantum Mechanics-I **Set−I :: Home Work**[41]

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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.

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

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

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Quantum Mechanics-I **Set–I :: Home Work**[42]

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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.

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

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

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

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Quantum Mechanics-I **Set−I :: Home Work**[43]

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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.

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

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

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Quantum Mechanics-I Set−I :: Home Work[44]

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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.

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

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

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Quantum Mechanics-I   Set−I :: Home Work[45]

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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.

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

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

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

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Quantum Mechanics-I **Set−I :: Home Work**[46]

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.

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

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

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Quantum Mechanics-I **Set−I :: Home Work**[47]

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

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

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

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Quantum Mechanics-I **Set–I :: Home Work**[48]

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

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

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

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Quantum Mechanics-I **Set–I :: Home Work**[49]

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

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

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

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

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M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[50]

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.

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

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

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Quantum Mechanics-I **Set−I :: Home Work**[51]

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

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

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

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Quantum Mechanics-I **Set−I :: Home Work**[52]

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

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

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

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

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

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

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

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

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

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

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

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Quantum Mechanics-I **Set−I :: Home Work**[57]

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

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

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

[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.

[57] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

UNIVERSITY OF HYDERABAD
School of Physics

M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I — Set−I :: Home Work[58]

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.

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

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

[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.

[58] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

UNIVERSITY OF HYDERABAD
School of Physics

M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[59]

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.

[59]**Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

UNIVERSITY OF HYDERABAD
School of Physics

M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[60]

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.

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

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

[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.

[60] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[61]

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.

[61]**Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[62]

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.

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

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

[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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[62] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

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M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[63]

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.

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

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

[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.

[63] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

UNIVERSITY OF HYDERABAD
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M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[64]

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.

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

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

[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.

[64] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

UNIVERSITY OF HYDERABAD
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M.Sc.Physics II Semester **Dec 2009-Apr 2010**

Quantum Mechanics-I **Set−I :: Home Work**[65]

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.

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

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

[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.

[65] **Date: Dec 19, 2009; Dead Line : 27 Dec 27 2009**

ANSWERS (01):

(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

$$\{-3, \{-1, 2, 0\}\}$$

ANSWERS (02):

(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

$$\{-2, \{-1, -1, 1\}\}$$

ANSWERS (03):

(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

$$\{-2, \{-1, 1, 0\}\}$$

ANSWERS (04):

(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

$$\{-2, \{2, 1, 1\}\}$$

ANSWERS (05):

(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

$$\{-2, \{2, 1, 2\}\}$$

ANSWERS (06):

(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

$$\{-1, \{1, 0, 1\}\}$$

ANSWERS (07):

(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

$$\{1, \{0, 0, 1\}\}$$

ANSWERS (08):

(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

$$\{2, \{-1, 0, 2\}\}$$

ANSWERS (09):

(a) The eigenvalues are $\{3, -1, 0\}$ and the eigenvector(s) are

$$\{3, \{1, -1, 1\}\} \quad \{-1, \{-1, 1, 0\}\} \quad \{0, \{-1, 2, 1\}\}$$

S

(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

$$\{2, \{-1, 0, 2\}\}$$

ANSWERS (10):

(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

$$\{3, \{1, 0, 1\}\}$$

ANSWERS (11):

(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

$$\{3, \{1, 0, 1\}\}$$

ANSWERS (12):

(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

$$\{-3, \{-1, 2, 0\}\}$$

ANSWERS (13):

(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

$$\{-2, \{-1, -1, 1\}\}$$

ANSWERS (14):

(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

$$\{-2, \{-1, 1, 0\}\}$$

ANSWERS (15):

(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

$$\{-2, \{2, 1, 1\}\}$$

ANSWERS (16):

(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

$$\{-2, \{2, 1, 2\}\}$$

ANSWERS (17):

(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

$$\{-1,\{1,0,1\}\}$$

ANSWERS (18):

(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

$$\{1,\{0,0,1\}\}$$

ANSWERS (19):

(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

$$\{2,\{-1,0,2\}\}$$

ANSWERS (20):

(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

$$\{2, \{-1, 0, 2\}\}$$

ANSWERS (21):

(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

$$\{3, \{1, 0, 1\}\}$$

ANSWERS (22):

(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

$$\{3, \{1, 0, 1\}\}$$

ANSWERS (23):

(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
$$\{-3,\{-1,2,0\}\}$$

ANSWERS (24):

(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
$$\{-2,\{-1,-1,1\}\}$$

ANSWERS (25):

(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
$$\{-2,\{-1,1,0\}\}$$

ANSWERS (26):

(*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

$$\{-2, \{2, 1, 1\}\}$$

ANSWERS (27):

(*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

$$\{-2, \{2, 1, 2\}\}$$

ANSWERS (28):

(*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

$$\{-1, \{1, 0, 1\}\}$$

ANSWERS (29):

(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

$$\{1,\{0,0,1\}\}$$

ANSWERS (30):

(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

$$\{2,\{-1,0,2\}\}$$

ANSWERS (31):

(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

$$\{2,\{-1,0,2\}\}$$

ANSWERS (32):

(*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

$$\{3, \{1, 0, 1\}\}$$

ANSWERS (33):

(*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

$$\{3, \{1, 0, 1\}\}$$

ANSWERS (34):

(*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

$$\{-3, \{-1, 2, 0\}\}$$

ANSWERS (35):

(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

$$\{-2, \{-1, -1, 1\}\}$$

ANSWERS (36):

(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

$$\{-2, \{-1, 1, 0\}\}$$

ANSWERS (37):

(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

$$\{-2, \{2, 1, 1\}\}$$

ANSWERS (38):

(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

$$\{-2,\{2,1,2\}\}$$

ANSWERS (39):

(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

$$\{-1,\{1,0,1\}\}$$

ANSWERS (40):

(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

$$\{1,\{0,0,1\}\}$$

ANSWERS (41):

(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

$$\{2, \{-1, 0, 2\}\}$$

ANSWERS (42):

(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

$$\{2, \{-1, 0, 2\}\}$$

ANSWERS (43):

(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

$$\{3, \{1, 0, 1\}\}$$

ANSWERS (44):

(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

$$\{3, \{1, 0, 1\}\}$$

ANSWERS (45):

(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

$$\{-3, \{-1, 2, 0\}\}$$

ANSWERS (46):

(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

$$\{-2, \{-1, -1, 1\}\}$$

ANSWERS (47):

(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

$$\{-2, \{-1, 1, 0\}\}$$

ANSWERS (48):

(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

$$\{-2, \{2, 1, 1\}\}$$

ANSWERS (49):

(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

$$\{-2, \{2, 1, 2\}\}$$

ANSWERS (50):

(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

$$\{-1, \{1, 0, 1\}\}$$

ANSWERS (51):

(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

$$\{1, \{0, 0, 1\}\}$$

ANSWERS (52):

(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

$$\{2, \{-1, 0, 2\}\}$$

ANSWERS (52):

(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

$$\{2, \{-1, 0, 2\}\}$$

ANSWERS (54):

(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

$$\{3, \{1, 0, 1\}\}$$

ANSWERS (55):

(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

$$\{3,\{1,0,1\}\}$$

ANSWERS (56):

(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

$$\{-3,\{-1,2,0\}\}$$

ANSWERS (57):

(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

$$\{-2,\{-1,-1,1\}\}$$

ANSWERS (58):

(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

$$\{-2,\{-1,1,0\}\}$$

ANSWERS (59):

(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

$$\{-2,\{2,1,1\}\}$$

ANSWERS (60):

(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

$$\{-2,\{2,1,2\}\}$$

ANSWERS (61):

(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

$$\{-1, \{1, 0, 1\}\}$$

ANSWERS (62):

(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

$$\{1, \{0, 0, 1\}\}$$

ANSWERS (63):

(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

$$\{2, \{-1, 0, 2\}\}$$

ANSWERS (64):

(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

$$\{2,\{-1,0,2\}\}$$

ANSWERS (65):

(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

$$\{3,\{1,0,1\}\}$$