PART-I

ENGINEERING MATHEMATICS

(COMMON TO ALL CANDIDATES)

UNIT – I

DETERMINANTS AND MATRICES

SOLVING SYSTEM OF EQUATIONS – RANK OF THE MATRIX – EIGEN VALUES AND EIGEN VECTORS – REDUCTION OF QUADRATIC FORM TO CANONICAL FORM

1. If the order of matrix A is m × p. And the order of B is p × n. Then the order of AB is?
   A) n × p **B)** m × p
   C) m × n **D)** n × m

2. If A and B are matrices, then which of the following is true?
   A) A + B ≠ B + A **B)** $(A^t)^t \neq A$
   C) AB ≠ BA **D)** all are true

3. What is a, if $B = \begin{bmatrix} 1 & 4 \\ 2 & a \end{bmatrix}$ is a singular matrix?
   A) 6 **B)** 7
   C) 7 **D)** 8

4. If $A = \begin{bmatrix} 2i & i \\ i & -i \end{bmatrix}$ then $|A| = ?$
   A) 2 **B)** 3
   C) 4 **D)** 5

5. If $\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \\ a_{31} & a_{32} \end{bmatrix} A = \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix}$ then order of matrix A = ?
   A) 2 × 2 **B)** 2 × 3
   C) 3 × 2 **D)** 3 × 3

6. The number of non-zero rows in an echelon form is called?
   A) reduced echelon form
   B) rank of matrix
   C) conjugate of the matrix
   D) cofactor of the matrix

7. $(AB)^T = ?$
   A) B^TA^T **B)** A^TB^T
   C) AB **D)** BA

8. The matrix $A = \begin{bmatrix} 1 & 3 & 2 \\ 3 & 0 & 1 \\ 2 & 1 & 5 \end{bmatrix}$ is a?
   A) symmetric **B)** skew-symmetric
   C) hermitian **D)** skew-hermitian

9. If $A = \begin{bmatrix} 5 & 3 & 2 \\ 0 & 4 & 1 \\ 0 & 0 & 5 \end{bmatrix}$ then $|A| = ?$
   A) 30 **B)** 40
   C) 50 **D)** 60

10. The matrix $A = \begin{bmatrix} 9 & 0 \\ 0 & 9 \end{bmatrix}$ is a?
    A) scalar matrix **B)** identity matrix
    C) even matrix **D)** odd matrix

1. (C) 2. (C) 3. (D) 4. (B) 5. (D) 6. (B) 7. (A) 8. (A) 9. (D) 10. (A)

11. The larger root of the equation $(x + 4)(x - 3) = 0$ is
A) –4 B) –3
C) 3 D) 4

12. If $12x = 4(x + 3)$ then x is equal to
A) 1.5 B) 3/8
C) 5 D) 12/11

13. If you multiply an inequality by a negative number, when should you reverse the inequality symbol?
A) Always B) Never
C) Sometimes
D) Only if the negative number is a fraction

14. The quadratic form of the symmetric matrix diag $[\lambda_1, \lambda_2 \ldots\ldots \lambda_n]$
A) $\lambda_1 + \lambda_2 + \ldots\ldots + \lambda_n$
B) $\lambda_1{}^2x_1 + \lambda_2{}^2x_2 + \ldots\ldots + \lambda_n{}^2x_n$
C) $\lambda_1x_1{}^2 + \lambda_2x_2{}^2 + \ldots\ldots + \lambda_nx_n{}^2$
D) $\lambda_1x_1 + \lambda_2x_2 + \ldots\ldots + \lambda_nx_n$

15. Solve for c: $5c - 4 - 2c + 1 = 8c + 2$
A) 1 B) 2
C) –1 D) –2

16. Solve for x: $2x - 5 > x - 2$
A) $x < 3$ B) $x > 3$
C) $x < -5$ D) $x > -2$

17. Solve for y: $y^2 - 81 = 0$
A) {–1, 1} B) {9}
C) {–9, 9} D) {81}

18. Solve for m: $8(m + 5) = 16$
A) 11/8 B) –11/8
C) 3 D) –3

19. Solve for x: $0.7x + 2(x - 3) = 0.2x + 3$
A) 2.5 B) 3.5
C) 3.6 D) 4.5

20. Solve for y: $xy - d = m$
A) $y = \frac{m + d}{w}$ B) $y = \frac{m - d}{w}$
C) $yu = m + d - x$ D) $xy = m + d$

21. Solve for a: $a^2 = 36$
A) {6} B) {6}
C) {–6, 6} D) {4, 9}

22. Which point is a solution to this linear quadratic system? $y = x^2 + 4x + 3$ and $y = 2x + 6$
A) (–3, 0) B) (1, –8)
C) (3, 0) D) (0, –3)

23. Given $y = 3^x$, evaluate y when $x = 3$
A) 3 B) 9
C) 27 D) 81

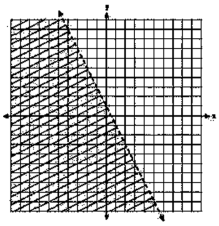
24. The graph of $y = 2^x$ contains which of these points?
A) (0, 0) B) (0, 1)
C) (0, 2) D) (1, 1)

25. Which value of x is in the solution set of the inequality: $-2x + 5 > 17$?
A) –8 B) –6
C) –4 D) 12

26. Solve for x: $\frac{x-2}{x-1} = \frac{x+4}{2x+2}$
A) {0} B) {5}
C) {0, –5} D) {0, 5}

27. Solve for y: $2y^2 + 4 = 9y$
A) {2, 4} B) {1/2, 2}
C) {2, 2} D) {1/2, 4}

28. Which inequality is represented by the graph at the right?



A) $y < 2x + 1$ B) $y < -2x + 1$
C) $y < \frac{1}{2}x + 1$ D) $y < -\frac{1}{2}x + 1$

11. (C) 12. (A) 13. (A) 14. (C) 15. (C) 16. (B) 17. (C) 18. (D) 19. (C) 20. (A)
21. (C) 22. (A) 23. (C) 24. (B) 25. (A) 26. (D) 27. (D) 28. (B)

29. The graph of $y = 2x$ lies in which Quadrants?

A) I, II **B)** I, III

C) I, IV **D)** II, III

30. Lightning quickly heats the air causing it to expand, which produces the sound of thunder. Sound travels approximately 1 miles in 5 seconds. Knowing $D = r \bullet t$ (where D = distance, r = rate, and t = time), how far away is a thunderstorm when you notice a 3-second delay between the flash of lightning and the sound of thunder?

A) 1 mile away **B)** 1/2 mile away

C) 3/5 mile away **D)** 1/5 mile away

31. Solve: Find A + B − C if $A = \begin{bmatrix} -8 & 5 \\ 9 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 7 & 4 \\ -4 & -5 \end{bmatrix}$, $C = \begin{bmatrix} 6 & 10 \\ 1 & 7 \end{bmatrix}$

A) $\begin{bmatrix} -9 & -1 \\ 4 & 12 \end{bmatrix}$ **B)** $\begin{bmatrix} -21 & -9 \\ 12 & -2 \end{bmatrix}$

C) $\begin{bmatrix} -7 & -1 \\ 4 & -12 \end{bmatrix}$ **D)** $\begin{bmatrix} -9 & 11 \\ 14 & 12 \end{bmatrix}$

32. Solve: Find A−B+C if $A = \begin{bmatrix} -10 & 5 \\ 4 & -8 \end{bmatrix}$, $B = \begin{bmatrix} 0 & -10 \\ 6 & -9 \end{bmatrix}$, $C = \begin{bmatrix} 1 & -4 \\ 2 & 7 \end{bmatrix}$

A) $\begin{bmatrix} -11 & 11 \\ 0 & -24 \end{bmatrix}$ **B)** $\begin{bmatrix} -11 & -1 \\ 8 & -24 \end{bmatrix}$

C) $\begin{bmatrix} -11 & 19 \\ -4 & -6 \end{bmatrix}$ **D)** $\begin{bmatrix} -9 & 11 \\ 0 & 8 \end{bmatrix}$

33. Find A + B if $A = \begin{bmatrix} 10 & 3 & -4 \\ -1 & -4 & 9 \end{bmatrix}$, $B = \begin{bmatrix} -8 & 1 & -5 \\ 1 & 4 & 9 \end{bmatrix}$

A) $\begin{bmatrix} 11 & -5 & 5 \\ 3 & -3 & 4 \end{bmatrix}$ **B)** $\begin{bmatrix} 10 & 3 & -4 \\ -1 & -4 & 9 \\ -8 & 1 & -5 \\ 1 & 4 & 9 \end{bmatrix}$

C) $\begin{bmatrix} 2 & 4 & -9 \\ 0 & 0 & 18 \end{bmatrix}$ **D)** $\begin{bmatrix} -8 & 1 & -5 \\ 1 & 4 & 9 \\ 10 & 3 & -4 \\ -1 & -4 & 9 \end{bmatrix}$

34. Find A + B if $A = \begin{bmatrix} -4 & 1 & -7 \\ -8 & -7 & 7 \end{bmatrix}$, $B = \begin{bmatrix} -3 & 4 & 10 \\ 5 & -4 & -9 \end{bmatrix}$

A) $\begin{bmatrix} -7 & 6 & 3 \\ -3 & -11 & -2 \end{bmatrix}$ **B)** $\begin{bmatrix} 1 & -2 & -16 \\ -12 & -2 & 17 \end{bmatrix}$

C) $\begin{bmatrix} -4 & 1 & -7 \\ -8 & -7 & 7 \\ -3 & 5 & 10 \\ 5 & -4 & -9 \end{bmatrix}$ **D)** $\begin{bmatrix} -3 & 2 & 0 \\ -15 & 1 & 1 \end{bmatrix}$

35. Find A + B if $A = \begin{bmatrix} 7 & -2 \\ -8 & -6 \\ -1 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 7 & -9 \\ 0 & -4 \\ 5 & 7 \end{bmatrix}$

A) $\begin{bmatrix} 7 & -2 & 7 & -9 \\ -8 & -6 & 0 & -4 \\ -1 & 0 & 5 & 7 \end{bmatrix}$

B) $\begin{bmatrix} 5 & -2 \\ -14 & -4 \\ -1 & 12 \end{bmatrix}$

C) $\begin{bmatrix} 14 & -11 \\ -8 & -10 \\ -4 & 7 \end{bmatrix}$ **D)** $\begin{bmatrix} -2 & 5 \\ -12 & -6 \\ 6 & 5 \end{bmatrix}$

29. (A) 30. (C) 31. (C) 32. (D) 33. (C) 34. (A) 35. (C)

36. Find A – B if

$$A=\begin{bmatrix}-10 & 10\\ -2 & -6\\ -10 & 2\end{bmatrix}, B=\begin{bmatrix}-9 & 5\\ 1 & 8\\ 0 & -8\end{bmatrix}$$

A) $\begin{bmatrix}-10 & 10 & 9 & -5\\ -2 & -6 & -1 & -8\\ 10 & 2 & 0 & 8\end{bmatrix}$

B) $\begin{bmatrix}-15 & 19\\ -10 & -7\\ 18 & 2\end{bmatrix}$

C) $\begin{bmatrix}9 & -5 & -10 & 10\\ -1 & -8 & -2 & -6\\ 0 & 8 & 10 & 2\end{bmatrix}$

D) $\begin{bmatrix}-1 & 5\\ -3 & -14\\ 10 & 10\end{bmatrix}$

37. Find A – B – C if

$$A=\begin{bmatrix}1 & 5\\ 7 & -1\end{bmatrix}, B=\begin{bmatrix}5 & 7\\ 7 & 5\end{bmatrix}, C=\begin{bmatrix}3 & 5\\ 10 & 2\end{bmatrix}$$

A) $\begin{bmatrix}-1 & 3\\ 10 & -4\end{bmatrix}$ **B)** $\begin{bmatrix}9 & 17\\ 24 & 6\end{bmatrix}$

C) $\begin{bmatrix}-7 & -7\\ -10 & -8\end{bmatrix}$ **D)** $\begin{bmatrix}9 & -7\\ 24 & -8\end{bmatrix}$

38. Find A – B – C if

$$A=\begin{bmatrix}-1 & 1\\ 4 & 3\end{bmatrix}, B=\begin{bmatrix}-9 & 8\\ -9 & -7\end{bmatrix}, C=\begin{bmatrix}4 & -10\\ 10 & -1\end{bmatrix}$$

A) $\begin{bmatrix}12 & -17\\ 3 & 9\end{bmatrix}$ **B)** $\begin{bmatrix}4 & 3\\ 23 & 11\end{bmatrix}$

C) $\begin{bmatrix}-14 & 3\\ 5 & 11\end{bmatrix}$ **D)** $\begin{bmatrix}-6 & 3\\ -15 & 11\end{bmatrix}$

39. Find A – B if

$$A=\begin{bmatrix}3 & 10\\ 8 & 7\\ 0 & -1\end{bmatrix}, B=\begin{bmatrix}-5 & -8\\ -3 & 3\\ 5 & -1\end{bmatrix}$$

A) $\begin{bmatrix}5 & 8 & 3 & 10\\ 3 & -3 & 8 & 7\\ -5 & 1 & 0 & -1\end{bmatrix}$

B) $\begin{bmatrix}3 & 10 & 5 & 8\\ 8 & 7 & 3 & -3\\ 0 & -1 & -5 & 1\end{bmatrix}$

C) $\begin{bmatrix}8 & 18\\ 11 & 4\\ -5 & 0\end{bmatrix}$ **D)** $\begin{bmatrix}-7 & 3\\ 1 & -6\\ 1 & 6\end{bmatrix}$

40. Find A + B if

$$A=\begin{bmatrix}5 & 6 & 4\\ 2 & -9 & 2\end{bmatrix}, B=\begin{bmatrix}3 & 2 & 2\\ 0 & -6 & 8\end{bmatrix}$$

A) $\begin{bmatrix}5 & 6 & 4\\ 2 & -9 & 2\\ 3 & 2 & 2\\ 0 & -6 & 8\end{bmatrix}$ **B)** $\begin{bmatrix}8 & 8 & 6\\ 2 & -15 & 10\end{bmatrix}$

C) $\begin{bmatrix}11 & 5 & 6\\ -7 & -6 & 10\end{bmatrix}$ **D)** $\begin{bmatrix}3 & 2 & 2\\ 0 & -6 & 8\\ 5 & 6 & 4\\ 2 & -9 & 2\end{bmatrix}$

41. Find A – B – C if

$$A=\begin{bmatrix}2 & 4\\ -1 & -6\end{bmatrix}, B=\begin{bmatrix}8 & 2\\ -6 & 8\end{bmatrix}, C=\begin{bmatrix}-2 & 4\\ 8 & 8\end{bmatrix}$$

A) $\begin{bmatrix}8 & 10\\ 1 & 10\end{bmatrix}$ **B)** $\begin{bmatrix}8 & -2\\ 1 & -22\end{bmatrix}$

C) $\begin{bmatrix}-8 & 6\\ 13 & -6\end{bmatrix}$ **D)** $\begin{bmatrix}-4 & -2\\ -3 & -22\end{bmatrix}$

36. (D) 37. (C) 38. (B) 39. (C) 40. (B) 41. (D)

42. Find A + B + C if

$A = \begin{bmatrix} -10 & -3 \\ 6 & 4 \end{bmatrix}, B = \begin{bmatrix} 2 & 3 \\ 6 & 7 \end{bmatrix}, C = \begin{bmatrix} -8 & -7 \\ 2 & 4 \end{bmatrix}$

A) $\begin{bmatrix} -20 & -13 \\ 2 & 1 \end{bmatrix}$ **B)** $\begin{bmatrix} 0 & 7 \\ 10 & 7 \end{bmatrix}$

C) $\begin{bmatrix} -4 & 1 \\ -2 & -7 \end{bmatrix}$ **D)** $\begin{bmatrix} -16 & -7 \\ 14 & 15 \end{bmatrix}$

43. Find A + B if

$A = \begin{bmatrix} 9 & 7 & 1 \\ 9 & 2 & -7 \end{bmatrix}, B = \begin{bmatrix} -2 & 4 & 8 \\ -8 & 3 & 0 \end{bmatrix}$

A) $\begin{bmatrix} 13 & 5 & 1 \\ 12 & -6 & 1 \end{bmatrix}$ **B)** $\begin{bmatrix} 9 & 7 & 1 \\ 9 & 2 & -7 \\ -2 & 4 & 8 \\ -8 & 3 & 0 \end{bmatrix}$

C) $\begin{bmatrix} 7 & 11 & 9 \\ 1 & 5 & -7 \end{bmatrix}$ **D)** $\begin{bmatrix} 16 & 2 & -6 \\ 11 & -5 & 8 \end{bmatrix}$

44. Find A + B if

$A = \begin{bmatrix} -3 & -6 \\ 9 & -10 \\ -10 & 3 \end{bmatrix}, B = \begin{bmatrix} -3 & -9 \\ -7 & -1 \\ 1 & 1 \end{bmatrix}$

A) $\begin{bmatrix} -9 & -12 \\ -1 & -8 \\ -7 & 2 \end{bmatrix}$

B) $\begin{bmatrix} -3 & -6 & -3 & -9 \\ 9 & -10 & -7 & -1 \\ -10 & 3 & 1 & 1 \end{bmatrix}$

C) $\begin{bmatrix} -6 & -15 \\ 2 & -11 \\ -9 & 4 \end{bmatrix}$ **D)** $\begin{bmatrix} -12 & -9 \\ 8 & -17 \\ -9 & 4 \end{bmatrix}$

45. Find the matrix product AB, if it is defined.

$A = \begin{bmatrix} 1 & 3 & -3 \\ 3 & 0 & 5 \end{bmatrix}, B = \begin{bmatrix} 3 & 0 \\ -3 & 1 \\ 0 & 5 \end{bmatrix}$

A) $\begin{bmatrix} -12 & -6 \\ 25 & 9 \end{bmatrix}$ **B)** $\begin{bmatrix} 3 & -9 & 0 \\ 0 & 0 & 25 \end{bmatrix}$

C) AB is undefined **D)** $\begin{bmatrix} -6 & -12 \\ 9 & 25 \end{bmatrix}$

46. Let $A = \begin{bmatrix} -5 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 \end{bmatrix}$.
Find 2A + 3B

A) $\begin{bmatrix} -10 & 4 \end{bmatrix}$ **B)** $\begin{bmatrix} -2 & 2 \end{bmatrix}$

C) $\begin{bmatrix} -9 & 4 \end{bmatrix}$ **D)** $\begin{bmatrix} -7 & 4 \end{bmatrix}$

47. Find the inverse of the matrix, if it exists

$A = \begin{bmatrix} -5 & 4 \\ 0 & 4 \end{bmatrix}$

A) $\begin{bmatrix} -\frac{1}{5} & -\frac{1}{5} \\ 0 & \frac{1}{4} \end{bmatrix}$ **B)** $\begin{bmatrix} -\frac{1}{5} & \frac{1}{5} \\ 0 & \frac{1}{4} \end{bmatrix}$

C) $\begin{bmatrix} \frac{1}{4} & \frac{1}{5} \\ 0 & -\frac{1}{5} \end{bmatrix}$ **D)** $\begin{bmatrix} 0 & \frac{1}{4} \\ -\frac{1}{5} & \frac{1}{5} \end{bmatrix}$

48. Decide whether the matrices are inverses of each other or not

$\begin{bmatrix} -2 & 4 \\ 4 & -4 \end{bmatrix}$ and $\begin{bmatrix} \frac{1}{2} & \frac{1}{4} \\ \frac{1}{2} & \frac{1}{4} \end{bmatrix}$

A) Yes **B)** No

49. Determine whether the matrix is invertible:

$\begin{bmatrix} 6 & 1 \\ 3 & 4 \end{bmatrix}$

A) Yes **B)** No

42. (D) 43. (C) 44. (C) 45. (D) 46. (D) 47. (B) 48. (B) 49. (A)

50. Determine whether the matrix is invertible:

$$\begin{bmatrix} 8 & 5 & -8 \\ 7 & 2 & -7 \\ -4 & 0 & 4 \end{bmatrix}$$

A) No **B)** Yes

51. Compute the determinant of the matrix by cofactor expansion:

$$\begin{bmatrix} 4 & 2 & 7 \\ 9 & 3 & 5 \\ 7 & 9 & 4 \end{bmatrix}$$

A) 1084 **B)** –286
C) 286 **D)** 146

52. Compute the determinant of the matrix by cofactor expansion:

$$\begin{bmatrix} 5 & 2 & -2 & 5 & -4 \\ 0 & 4 & 2 & 1 & 0 \\ 0 & 0 & -2 & 3 & 7 \\ 0 & 0 & 0 & -1 & -5 \\ 0 & 0 & 0 & 0 & 2 \end{bmatrix}$$

A) 0 **B)** –80
C) 80 **D)** –40

53. Compute the determinant of the matrix by cofactor expansion:

$$\begin{bmatrix} 3 & 1 & 2 \\ -3 & -1 & -6 \\ 6 & 5 & 3 \end{bmatrix}$$

A) –9 **B)** –36
C) 0 **D)** 36

54. Compute the determinant of the matrix by cofactor expansion:

$$\begin{bmatrix} 2 & -2 & 6 & 4 \\ 2 & 2 & 7 & 1 \\ 6 & -6 & 13 & 14 \\ -2 & 2 & -6 & 1 \end{bmatrix}$$

A) –200 **B)** 100
C) –100 **D)** –50

55. Let $A = \begin{bmatrix} 4 & -2 & 1 \\ 2 & 0 & 1 \\ 2 & -2 & 3 \end{bmatrix}$, $v_1 = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$, $v_2 = \begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix}$, $v_3 = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$ and $v_4 = \begin{bmatrix} 1 \\ 1 \\ 4 \end{bmatrix}$. Which of the following statements is correct?

A) v_1 and v_2 are eigenvectors of A
B) v_1 and v_3 are eigenvectors of A
C) v_2 and v_3 are eigenvectors of A
D) v_3 and v_4 are eigenvectors of A

56. What are the eigenvalues of $\begin{bmatrix} 4 & 7 & 1 \\ 0 & -3 & 8 \\ 0 & 0 & 2 \end{bmatrix}$?

A) 1, 4, 7 **B)** 0, 4
C) –3, 2, 4 **D)** –3, 0, 1

57. Given that 1 is an eigenvalue of $A = \begin{bmatrix} 2 & 5 & -6 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$. Find the other two eigenvalues.

A) 2 and –3 **B)** –2 and 3
C) 0 and 3 **D)** 0 and 2

58. If $A = \begin{bmatrix} 4 & -1 & 6 \\ 2 & 1 & 5 \\ 2 & -1 & 0 \end{bmatrix}$, which one of the following is $|A - \lambda I|$?

A) $-\lambda^3 + 5\lambda^2 + \lambda - 14$
B) $-\lambda^3 + 5\lambda^2 + \lambda - 4$
C) $-\lambda^3 + 5\lambda^2 - 4\lambda$
D) $-\lambda^3 + 5\lambda^2 - 21\lambda + 42$

59. Find the eigenvalues of $B = \begin{bmatrix} 1 & 2 & -4 \\ -1 & 4 & 8 \\ 0 & 1 & -1 \end{bmatrix}$

A) –1, 1, 4 **B)** –4, –1, 1
C) –5, 1, 2 **D)** –2, 1, 5

50. (A) 51. (C) 52. (C) 53. (D) 54. (A) 55. (A) 56. (C) 57. (B) 58. (A) 59. (D)

60. Given that 5 is an eigenvalue of $\begin{bmatrix} 1 & 2 & -4 \\ -1 & 4 & 8 \\ 0 & 1 & -1 \end{bmatrix}$. Which of the following systems of equations should be solved to find the corresponding eigenvalues?

A) $\begin{bmatrix} -4 & -3 & -9 \\ -6 & -1 & 3 \\ -5 & -4 & -6 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

B) $\begin{bmatrix} -4 & 2 & -4 \\ -1 & -1 & 8 \\ 0 & 1 & -6 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$

C) $\begin{bmatrix} -4 & 2 & -4 \\ -1 & -1 & 8 \\ 0 & 1 & -6 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

D) $\begin{bmatrix} 1 & 2 & -4 \\ -1 & 4 & 8 \\ 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

E) $\begin{bmatrix} 1 & 2 & -4 \\ -1 & 4 & 8 \\ 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 5 \\ 5 \end{bmatrix}$

61. A particular 3 × 3 matrix A has an eigenvalue of –1. The matrix A + I reduces to $\begin{bmatrix} 1 & 0 & -2 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$. Corresponding to the eigenvalue –1, all the eigenvalues of A are non-zero vectors of the form

A) $\begin{bmatrix} 2t \\ 0 \\ t \end{bmatrix}, t \in R$ B) $\begin{bmatrix} 2t \\ s \\ t \end{bmatrix}, s, t \in R$

C) $\begin{bmatrix} t \\ 0 \\ -2t \end{bmatrix}, t \in R$ D) $\begin{bmatrix} t \\ s \\ 2t \end{bmatrix}, s, t \in R$

62. An animal population with three age groups has Leslie matrix $\begin{bmatrix} 0 & 0 & 3.6 \\ 0.8 & 0 & 0 \\ 0 & 0.6 & 0 \end{bmatrix}$. Find the proportion of the population in each of the age groups once the population has stablised.

A) Age group 1:$\frac{1}{3}$ Age group 2:$\frac{1}{3}$ Age group 3:$\frac{1}{3}$

B) Age group 1:$\frac{1}{6}$ Age group 2:$\frac{1}{3}$ Age group 3:$\frac{1}{2}$

C) Age group 1:$\frac{1}{4}$ Age group 2:$\frac{1}{2}$ Age group 3:$\frac{1}{4}$

D) Age group 1:$\frac{1}{2}$ Age group 2:$\frac{1}{3}$ Age group 3:$\frac{1}{6}$

63. The eigenvalues of $\begin{bmatrix} 5 & 6 & 17 \\ 0 & -19 & 23 \\ 0 & 0 & 37 \end{bmatrix}$ are

A) –19, 5, 37 B) 19, –5, –37
C) 2, –3, 7 D) 3, –5, 37

64. Eigenvalues of a symmetric matrix are all

A) Real B) Complex
C) Zero D) Positive

65. The Eigenvalues of the matrix

$A = \begin{bmatrix} a & h & g \\ 0 & b & 0 \\ 0 & c & c \end{bmatrix}$ are

A) a, h, g
B) a, h, c
C) a, g, c
D) a, b, c

60. (C) 61. (B) 62. (D) 63. (A) 64. (A) 65. (D)

66. If $\begin{bmatrix} -4.5 \\ -4 \\ 1 \end{bmatrix}$ is an eigenvector of the matrix $\begin{bmatrix} 8 & -4 & 2 \\ 4 & 0 & 2 \\ 0 & -2 & -4 \end{bmatrix}$, the eigenvalue corresponding to the eigenvector is

A) 1 **B)** 4
C) −4.5 **D)** 6

67. The eigenvalues of the following matrix $\begin{bmatrix} 3 & 2 & 9 \\ 7 & 5 & 13 \\ 6 & 17 & 19 \end{bmatrix}$ are given by solving the cubic equation

A) $\lambda^3 - 27\lambda^2 + 167\lambda - 285$
B) $\lambda^3 - 27\lambda^2 - 122\lambda - 313$
C) $\lambda^3 + 27\lambda^2 + 167\lambda + 285$
D) $\lambda^3 - 23.23\lambda^2 + 158.3\lambda + 313$

68. The eigenvalues of a 4×4 matrix [A] are given as 2, −3, 13 and 7. The $|\det(A)|$ then is

A) 546 **B)** 19
C) 25
D) cannot be determined

69. If one of the eigenvalues of $[A]_{n\times n}$ is zero, it implies

A) The solution to [A] [X] = [C] system of equations is unique
B) The determinant of [A] is zero
C) The solution to [A] [X] = [0] system of equations is trivial
D) The determinant of [A] is non zero.

70. Given that matrix [A] = $\begin{bmatrix} 8 & -4 & 2 \\ 4 & 0 & 2 \\ 0 & -2 & -3 \end{bmatrix}$ has an eigenvalue value of 4 with the corresponding eigen vector is

A) $\begin{bmatrix} -18 \\ -16 \\ 4 \end{bmatrix}$ **B)** $\begin{bmatrix} -4.5 \\ -4 \\ 1 \end{bmatrix}$

C) $\begin{bmatrix} -4608 \\ -4096 \\ 1024 \end{bmatrix}$ **D)** $\begin{bmatrix} -0.004395 \\ -0.003906 \\ 0.0009766 \end{bmatrix}$

71. The minimum and maximum eigenvalues of the matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ are −2 and 6 respectively. What is the other eigenvalue?

A) 5 **B)** 3
C) 1 **D)** −1

72. Indicate which of the following statements are true?

A) A singular matrix must have a zero Eigenvalue
B) A singular matrix must have a negative Eigenvalue
C) A singular matrix must have a complex Eigenvalue
D) All of the above

73. The Eigenvectors of the matrix $\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ are

A) $(1\ 1\ 1)$, $(1\ 0\ 1)$ and $(1\ 1\ 0)$
B) $(1\ 1\ -1)$, $(1\ 0\ -1)$ and $(1\ 1\ 0)$
C) $(-1\ 1\ -1)$, $(1\ 0\ 1)$ and $(1\ 1\ 0)$
D) $(1\ 1\ 1)$, $(-1\ 0\ 1)$ and $(-1\ 1\ 0)$

74. The Eigenvalues of the matrix $\begin{bmatrix} 2 & -1 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & -2 & 0 \\ 0 & 0 & 1 & 4 \end{bmatrix}$ are

A) 2, −2, 1, −1 **B)** 2, 3, −2, 4
C) 2, 3, 1, 4 **D)** none of these

66. (B) 67. (B) 68. (A) 69. (B) 70. (C) 71. (B) 72. (A) 73. (D) 74. (B)

75. Indicate which of the following statements are true?

A) A and A*A have same Eigenvectors

B) If m is an Eigenvalue of A, then m ^ 2 is an Eigenvalue A*A

C) Both A and B **D)** Neither A nor B

76. The Eigenvectors of $\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ **are**

A) –1, 1 and 2 **B)** 1, 1 and –2

C) –1, –1 and 2 **D)** 1, 1 and 2

77. Indicate which of the following statements are true?

A) If m is an Eigenvalue of A, then m is an Eigenvalue of A'

B) If m is an Eigenvalue of A, then 1/m is the Eigenvalue of inv(A)

C) Both A and B **D)** Neither A nor B

78. The Eigenvalues of a matrix $\begin{bmatrix} 2 & 7 \\ -1 & -6 \end{bmatrix}$ **are**

A) 3 and 0 **B)** –2 and 7

C) –5 and 1 **D)** 3 and –5

79. The eigenvalues of a matrix $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ **are**

A) 0, 0, 0 **B)** 0, 0, 1

C) 0, 0, 3 **D)** 1, 1, 1

80. Let λ be an eigenvalue of the square matrix A

A) $k\lambda$ is an eigenvalue of kA for any scalar k

B) There is exactly one eigenvector of A corresponding to λ

C) λ^2 is an eigenvalue of A

D) $\lambda + 1$ is an eigenvalue of A

81. Let A be a diagonalizable n × n matrix.

A) A is symmetric

B) A^T is not diagonalizable

C) kA is diagonalizable for each scalar k

D) A has distinct eigenvalues

82. The matrix for the quadratic form $6x_1^2 + 3x_2^2 + 14x_3^2 + 4x_2x_3 + 18x_3x_1 + 4x_1x_2$ **is**

A) $\begin{bmatrix} 6 & 2 & 9 \\ 2 & 3 & 2 \\ 9 & 2 & 14 \end{bmatrix}$ **B)** $\begin{bmatrix} 6 & 4 & 18 \\ 4 & 3 & 4 \\ 18 & 4 & 14 \end{bmatrix}$

C) $\begin{bmatrix} -6 & -2 & -9 \\ -2 & -3 & -2 \\ 9 & 2 & -14 \end{bmatrix}$ **D)** $\begin{bmatrix} -6 & 4 & 18 \\ 4 & -3 & 4 \\ 18 & 4 & -14 \end{bmatrix}$

83. The quadratic form of the symmetric matrix diag $[\lambda_1, \lambda_2, \ldots\ldots \lambda_n]$ is

A) $\lambda_1 + \lambda_2 + \ldots\ldots + \lambda_n$

B) $\lambda_1^2 x_1 + \lambda_2^2 x_2 + \ldots\ldots + \lambda_n^2 x_n$

C) $\lambda_1 x_1^2 + \lambda_2 x_2^2 + \ldots\ldots + \lambda_n x_n^2$

D) $\lambda_1 x_1 + \lambda_2 x_2 + \ldots\ldots + \lambda_n x_n$

84. If the sum of the eigenvalues of the matrix of the quadratic form is equal to zero, the nature of the quadratic form is

A) Positive definite **B)** Negative definite

C) Indefinite

D) Positive semidefinite

85. The matrix form of quadratic equations $6x_1^2+3x_2^2+14x_3^2+4x_2x_3+18x_3x_1+4x_1x_2$

A) $\begin{bmatrix} 6 & 2 & 9 \\ 2 & 3 & 2 \\ 9 & 2 & 14 \end{bmatrix}$ **B)** $\begin{bmatrix} -6 & -2 & -9 \\ -2 & -3 & -2 \\ 9 & 2 & -14 \end{bmatrix}$

C) $\begin{bmatrix} 6 & 4 & 18 \\ 4 & 3 & 4 \\ 18 & 4 & 14 \end{bmatrix}$ **D)** $\begin{bmatrix} -6 & 4 & 18 \\ 4 & -3 & 4 \\ 18 & 4 & -14 \end{bmatrix}$

75. (C) 76. (C) 77. (C) 78. (C) 79. (B) 80. (A) 81. (C) 82. (A) 83. (C) 84. (C) 85. (A)