

## 50 questions on linear algebra for NET and GATE aspirants

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*Find the correct options:*

1)  $M = \begin{pmatrix} 1 & 2 & 2 \\ 0 & 2 & 2 \\ 0 & 1 & 1 \end{pmatrix}$  and  $V = \{ Mx^T : x \in \mathbb{R}^3 \}$ . Then  $\dim V$  is

(a) 0 (b) 1 (c) 2 (d) 3

2)  $A^2 - A = 0$ , where  $A$  is a  $9 \times 9$  matrix. Then

(a)  $A$  must be a zero matrix (b)  $A$  is an identity matrix

(c) rank of  $A$  is 1 or 0 (d)  $A$  is diagonalizable

3) The number of linearly independent eigen vectors of  $\begin{pmatrix} 1 & 1 & 0 & 0 \\ 2 & 0 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 5 & 5 & 5 \end{pmatrix}$  is

(a) 1 (b) 2 (c) 3 (d) 4

4) The minimal polynomial of  $\begin{pmatrix} 2 & 1 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 0 & 5 \end{pmatrix}$  is

(a)  $(x-2)$  (b)  $(x-2)(x-5)$  (c)  $(x-2)^2(x-5)$  (d)  $(x-2)^3(x-5)$

5)  $A$  is a unitary matrix. Then eigen value of  $A$  are

(a) 1, -1 (b) 1, -i (c) i, -i (d) -1, i

6)  $\begin{pmatrix} 2 & -3 \\ 2 & -2 \end{pmatrix}$  is an operator on  $\mathbb{R}^2$ . The invariant subspaces of the operator are

(a)  $\mathbb{R}^2$  and the subspace with base  $\{(0,1)\}$  (b)  $\mathbb{R}^2$  and the zero subspace

(c)  $\mathbb{R}^2$ , the zero subspace and the subspace with base  $\{(1,1)\}$  (d) only  $\mathbb{R}^2$

7) Rank of the matrix  $\begin{pmatrix} 21 & -7 & 0 & 0 & 0 \\ -11 & 9 & 0 & 0 & 0 \\ 0 & -19 & 35 & 0 & 0 \\ 0 & 15 & 0 & 12 & 20 \\ 0 & 0 & -24 & 21 & 35 \end{pmatrix}$  is

(a) 2 (b) 3 (c) 4 (d) 5

8) The dimension of the subspace of  $M_{2 \times 2}$  spanned by  $\begin{pmatrix} 1 & -5 \\ -4 & 2 \end{pmatrix}$ ,  $\begin{pmatrix} 1 & 1 \\ -1 & 5 \end{pmatrix}$  and  $\begin{pmatrix} 2 & -4 \\ -5 & 7 \end{pmatrix}$  is

(a) 1 (b) 2 (c) 3 (d) 4

9) U and V are subspace of  $\mathbb{R}^4$  such that

$$U = \text{span} [(1,2,3,4), (5,7,2,1), (3,1,4,-3)]$$

$$V = \text{span} [(2,1,2,3), (3,0,1,2), (1,1,5,3)].$$

Then the dimension of  $U \cap V$  is

(a) 1 (b) 2 (c) 3 (d) 4

10) Let  $M_n$  be the set of all n-square symmetric matrices and the characteristic polynomial of each  $A \in M_n$  is of the form

$t^n + t^{n-2} + a_{n-3}t^{n-3} + \dots + a_1t + a_0$ . Then the dimension of  $M_n$  over  $\mathbb{R}$  is

(a)  $\frac{(n-1)n}{2}$  (b)  $\frac{(n-2)n}{2}$  (c)  $\frac{(n-1)(n+2)}{2}$  (d)  $\frac{(n-1)^2}{2}$

11) A is a  $3 \times 3$  matrix with  $\sigma(A) = \{1, -1, 0\}$ . Then  $|I + A^{100}|$  is

- (a) 6 (b) 4 (c) 9 (d) 100

12) A is a  $5 \times 5$  matrix, all of whose entries are 1, then

- (a) A is not diagonalizable (b) A is idempotent (c) A is nilpotent  
(d) The minimal polynomial and the characteristics polynomial of A are not equal.

13) A is an upper triangular with all diagonal entries zero, then  $I + A$  is

- (a) invertible (b) idempotent (c) singular (d) nilpotent

14) Number of linearly independent eigen vectors of  $\begin{pmatrix} 2 & 2 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 1 & 4 \end{pmatrix}$  is

- (a) 1 (b) 2 (c) 3 (d) 4

15) A is a  $5 \times 5$  matrix over  $\mathbb{R}$ , then  $(t^2 + 1)(t^2 + 2)$

- (a) is a minimal polynomial (b) is a characteristics polynomial  
(c) both (a) and (b) are true (d) none of (a) and (b) is true

16) M is a 2-square matrix of rank 1, then M is

- (a) diagonalizable and non singular (b) diagonalizable and nilpotent  
(c) neither diagonalizable nor nilpotent (d) either diagonalizable or nilpotent

17) A be a n-square matrix with integer entries and  $B = A + \frac{1}{2} I$ . Then

- (a) B is idempotent (b)  $B^{-1}$  exist (c) B is nilpotent (d)  $B - I$  is idempotent

18) Let  $A \in M_{3 \times 3}(\mathbb{R})$ , then  $t^2 + 1$  is

- (a) a minimal polynomial of A (b) a characteristics polynomial of A  
(c) both (a) and (b) are true (d) none of (a) and (b) is true

19) A is a 4-square matrix and  $A^5 = 0$ . Then

- (a)  $A^4 = I$  (b)  $A^4 = A$  (c)  $A^4 = 0$  (d)  $A^4 = -I$

20)  $A = \begin{pmatrix} 0 & 1 & a \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$  and  $B = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$ . Then

- (a) A and B are similar (b) A and B are not similar  
(c) A and B are nilpotent (d) A and AB are similar

21) Let  $S = \{ 2-x+3x^2, x+x^2, 1-2x^2 \}$  be subset of  $P_2(\mathbb{R})$ . Then

- (a) S is linearly independent (b) S is linearly dependent  
(c) (2,-1,3), (0,1,1), (1,0,-2) are linearly dependent (d) S is a basis of  $P_2(\mathbb{R})$

22)  $T: P_2(\mathbb{R}) \rightarrow P_3(\mathbb{R})$  such that  $T(f(x)) = 2f'(x) + 3 \int_0^x f(t) dt$ . Then rank of T is

- (a) 1 (b) 2 (c) 3 (d) 4

23)  $T_i: P(\mathbb{R}) \rightarrow P(\mathbb{R})$  such that  $T_1(f(x)) = \int_0^x f(t) dt$  and  $T_2(f(x)) = f'(x)$ . Then

- (a)  $T_1$  is 1-1,  $T_2$  is not (b)  $T_2$  is 1-1,  $T_1$  is not  
(c)  $T_1$  is onto and  $T_2$  is 1-1 (d)  $T_1$  and  $T_2$  both are 1-1

24)  $T: P_3(\mathbb{R}) \rightarrow M_{2 \times 2}(\mathbb{R})$ , such that  $T(f(x)) = \begin{pmatrix} f(1) & f(2) \\ f(3) & f(4) \end{pmatrix}$ , then

- (a) T is 1-1 (b) T is onto (c) T is both 1-1 and onto (d) T is neither 1-1 nor onto

25)  $W = L\{(1,0,0,0), (0,1,0,0)\}$ , then

- (a)  $\frac{\mathbb{R}^4}{W} = L\{W+(2,0,0,0), W+(0,2,0,0)\}$   
 (b)  $\frac{\mathbb{R}^4}{W} = L\{W+(1,2,3,4), W+(2,3,4,5)\}$   
 (c)  $\frac{\mathbb{R}^4}{W} = L\{W+(0,0,2,0), W+(0,0,0,2)\}$   
 (d)  $\{W+(1,2,3,4), W+(2,3,4,5)\}$  is a basis of  $\frac{\mathbb{R}^4}{W}$

26)  $A = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$ , then

- (a) A has zero image (b) all the eigen value of A are zero  
 (c) A is idempotent (d) A is nilpotent

27)  $T: \mathbb{R}^4 \rightarrow \mathbb{R}^4$ , defined by  $T(e_1) = e_2, T(e_2) = e_3, T(e_3) = 0, T(e_4) = e_3$ . Then

- (a) T is nilpotent (b) T has at least one non-zero eigen value  
 (c) index of nilpotent is three (d) T is not nilpotent

28)  $A = \begin{pmatrix} a & a & a \\ a & a & a \\ a & a & a \end{pmatrix}$ , where  $a \neq 0$ , then

- (a) A is not diagonalizable (b) A is idempotent  
 (c) A is nilpotent (d) minimal polynomial ? characteristics polynomial

29)  $A \in M_{2 \times 2}(\mathbb{R})$  and rank of A is 1, then

- (a) A is diagonalizable (b) A is nilpotent  
 (c) both (a) and (b) are true (d) none of (a) and (b) is true

30) A is a 3-square matrix and the eigen values of A are -1, 0, 1 with respect to the eigen vectors  $(1, -1, 0)^T, (1, 1, -2)^T, (1, 1, 1)^T$ . then  $6A$  is

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

31) The sum of eigen values of  $\begin{pmatrix} -1 & -2 & -1 \\ -2 & 3 & 2 \\ -1 & 2 & -3 \end{pmatrix}$  is

- (a) -3 (b) -1 (c) 3 (d) 1

32) The matrix  $\begin{pmatrix} a^2 & ab & ac \\ ab & b^2 & bc \\ ac & bc & c^2 \end{pmatrix}$ , where  $a, b, c \in \mathbb{R} - \{0\}$  has

- (a) three real, non-zero eigen values (b) complex eigen values  
 (c) two non-zero eigen values (d) only one non-zero eigen value

33)  $\begin{pmatrix} 2 & 0 & 0 \\ 1 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$  is

- (a) diagonalizable (b) nilpotent (c) idempotent (d) not diagonalizable

34) If a square matrix of order 10 has exactly 5 distinct eigen values, then the degree of the minimal polynomial is

(a) at least 5 (b) at most 5 (c) always 5 (d) exactly 10

35) Let  $T: \mathbb{R}^{2 \times 2} \rightarrow \mathbb{R}^{2 \times 2}$ , defined by  $T(A) = BA$ , where  $B = \begin{pmatrix} 1 & -2 \\ -2 & 4 \end{pmatrix}$ . Then rank of  $T$  is

(a) 1 (b) 2 (c) 3 (d) 4

36) Let  $A = \begin{pmatrix} 1 & a & b \\ 0 & 10 & c \\ 0 & 0 & 100 \end{pmatrix}$ . Then

(a) both  $A$  and  $A^2$  are diagonalizable (b)  $A$  is diagonalizable but not  $A^2$

(c)  $A$  and  $A^2$  have the same minimal polynomial (d)  $A^2$  is diagonalizable but not  $A$

37) Rank of  $A_{7 \times 5}$  is 5 and that of  $B_{5 \times 7}$  is 3, then rank of  $AB$  is

(a) 1 (b) 2 (c) 3 (d) 4

38)  $A$  and  $B$  are  $n$ -square positive definite matrices. Then which of the following are positive definite.

(a)  $A+B$  (b)  $ABA$  (c)  $AB$  (d)  $A^2 + I$

39) Let  $A \in M_3(\mathbb{R})$  and  $A = \begin{pmatrix} 2 & 1 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$ , then which of the following are subspaces of  $M_3(\mathbb{R})$

(a)  $\{X \in M_3(\mathbb{R}) : XA = AX\}$  (b)  $\{X \in M_3(\mathbb{R}) : X+A = A+X\}$

(c)  $\{X \in M_3(\mathbb{R}) : \text{trace}(AX) = 0\}$  (d)  $\{X \in M_3(\mathbb{R}) : \det(AX) = 0\}$

40) Let  $T$  be a linear operator on the vector space  $V$  and  $W$  be invariant under  $T$ . Then

(a)  $T(W) \subseteq W$  (b)  $W \subseteq T(W)$  (c)  $T(W) = W$  (d) None of these

41)  $A : \mathbb{R}^4 \rightarrow \mathbb{R}^3$ , where  $A = \begin{pmatrix} 1 & 2 & 3 & 1 \\ 1 & 3 & 5 & -2 \\ 3 & 8 & 13 & -3 \end{pmatrix}$ . Then the dimension of kernel of A is

- (a) 1 (b) 2 (c) 3 (d) 4

42)  $A : \mathbb{R}^3 \rightarrow \mathbb{R}^4$ , where  $A = \begin{pmatrix} 1 & 1 & 3 \\ 2 & 3 & 8 \\ 3 & 5 & 13 \\ 1 & -2 & -3 \end{pmatrix}$ . Then the dimension of image of A is

- (a) 1 (b) 2 (c) 3 (d) 4

43) Let  $u, v, w$  be three non-zero vectors which are linearly independent, then

- (a)  $u$  is linear combination of  $v$  and  $w$  (b)  $v$  is linear combination of  $u$  and  $w$   
(c)  $w$  is linear combination of  $u$  and  $v$  (d) none of these

44) Let  $U$  and  $W$  be subspaces of a vector space  $V$  and  $U \cup W$  is also a subspace of  $V$ , then

- (a) either  $U \subseteq W$  or  $W \subseteq U$  (b)  $U \cap W = \phi$  (c)  $U = W$  (d) None of these

45) Let  $I$  be the identity transformation of the finite dimensional vector space  $V$ , then the nullity of  $I$  is

- (a)  $\dim V$  (b) 0 (c) 1 (d)  $\dim V - 1$

46)  $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$  such that  $T(a,b,c) = (0,a,b)$ , for  $(a,b,c) \in \mathbb{R}^3$ . Then  $T + I$  is a zero of the polynomial:

- (a)  $t$  (b)  $t^2$  (c)  $t^3$  (d) none of above

47) The sum of the eigen values of the matrix  $\begin{pmatrix} 4 & 7 & 11 \\ 7 & 1 & -21 \\ 11 & -21 & 6 \end{pmatrix}$  is



(a) 4 (b) 23 (c) 11 (d) 12

48) Let A and B are square matrices such that  $AB=I$ , then zero is an eigen value of

(a) A but not of B (b) B but not of A (c) both A and B (d) neither A nor B

49) The eigen values of a skew-symmetric matrix are

(a) negative (b) real (c) absolute value of 1 (d) purely imaginary or zero

50) The characteristics equation of a matrix A is  $t^2-t-1=0$ , then

(a)  $A^{-1}$  does not exist (b)  $A^{-1}$  exist but cannot be determined from the data

(c)  $A^{-1}=A+1$  (d)  $A^{-1}=A-1$

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The answers can be found [here](#).

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