MATHS

12th JEE

Matrices

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MATRICES

DPP-1

(Matrix, Types of The Matrices)

1. A 3×2 matrix whose elements are given by $a_{ij}=2i-j$ is:

(A) $\begin{bmatrix}1 & 2\\ 3 & 2\\ 5 & 4\end{bmatrix}$ (B) $\begin{bmatrix}1 & 2\\ 1 & 1\\ 0 & 3\end{bmatrix}$

(C) $\begin{bmatrix}1 & 0\\ 3 & -2\\ 5 & 4\end{bmatrix}$ (D) $\begin{bmatrix}1 & 0\\ 3 & 2\\ 5 & 4\end{bmatrix}$

2. If $\begin{bmatrix}16 & -10\\ -6 & 8\end{bmatrix}+2B=\begin{bmatrix}0 & 0\\ 0 & 0\end{bmatrix}$, then B is equal to:

(A) $\begin{bmatrix}8 & -5\\ -3 & 4\end{bmatrix}$ (B) $\begin{bmatrix}-8 & 5\\ -3 & 4\end{bmatrix}$

(C) $\begin{bmatrix}-8 & 5\\ 3 & -4\end{bmatrix}$ (D) $\begin{bmatrix}8 & -5\\ 3 & -4\end{bmatrix}$

3. $\begin{bmatrix}x^2+x & x\\ 3 & 2\end{bmatrix}+\begin{bmatrix}0 & -1\\ -x+1 & x\end{bmatrix}=\begin{bmatrix}0 & -2\\ 5 & 1\end{bmatrix}$, then x is equal to:

(A) –1 (B) 0

(C) 1 (D) No value of x

4. The matrix $\begin{bmatrix}2 & 0 & 0\\ 0 & 3 & 0\\ 0 & 0 & 3\end{bmatrix}$ is:

(A) Column matrix (B) Diagonal matrix

(C) Identity matrix (D) Null matrix

5. Values of x and y for which the following matrices $A=\begin{bmatrix}2x+1 & 2y\\ 0 & y^2-5y\end{bmatrix}$, $B=\begin{bmatrix}x+3 & y^2+2\\ 0 & -6\end{bmatrix}$ are equal:

(A) $x=2,\ y=3$

(B) $x=y=2$

(C) $x=y=0$

(D) $x=2$ and no real value of y

6. The matrix $\begin{bmatrix}-1 & 0 & 0\\ 0 & -1 & 0\\ 0 & 0 & -1\end{bmatrix}$ is:

(A) Column matrix

(B) Null matrix

(C) Scalar matrix

(D) Identity matrix

7. Find a_{22} in 3×4 matrix whose elements are given by $a_{ij}=\frac{1}{2}|-3i+j|$.

(A) 2 (B) 3

(C) 4 (D) 5

8. The matrix $\begin{bmatrix}-1 & 0 & 0\\ 2 & -1 & 0\\ 3 & -7 & -1\end{bmatrix}$ is:

(A) Upper triangular matrix

(B) Diagonal matrix

(C) Scalar matrix

(D) Lower triangular matrix

9. The total number of matrices that can be formed using all 12 different letters such that no letter is repeated in any matrix, is equal to:

(A) 12! (B) 6 (12!)

(C) 6.12^{12} (D) 12^{12}

10. Construct a 2×2 matrix whose elements are given by $a_{ij}=\frac{(i+2j)^2}{2}$.

(A) $\begin{bmatrix}\frac{9}{2} & \frac{25}{2}\\ 4 & 18\end{bmatrix}$ (B) $\begin{bmatrix}\frac{9}{2} & \frac{25}{2}\\ 8 & 18\end{bmatrix}$

(C) $\begin{bmatrix}\frac{3}{2} & \frac{25}{2}\\ 8 & 18\end{bmatrix}$ (D) $\begin{bmatrix}\frac{9}{2} & \frac{25}{4}\\ 8 & 18\end{bmatrix}$

DPP-2

(Equality of Matrices, Operation On Matrices (Addition, Subtraction and Multiplication)

1. If $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ a & b & -1 \end{bmatrix}$, then A^2 is equal to:

(A) 0 (B) –A
(C) I (D) 2A

2. If $A = \begin{bmatrix} 1 & -5 & 7 \\ 0 & 7 & 9 \\ 11 & 8 & 9 \end{bmatrix}$, then trace of matrix A is:

(A) 17 (B) 25
(C) 3 (D) 12

3. If $x\begin{bmatrix} -3 \\ 4 \end{bmatrix} + y\begin{bmatrix} 4 \\ 3 \end{bmatrix} = \begin{bmatrix} 10 \\ -5 \end{bmatrix}$, then:

(A) $x = -2, y = 1$
(B) $x = -9, y = 10$
(C) $x = 22, y = 1$
(D) $x = 2, y = -1$

4. If U = [2 – 3 4], X = [0 2 3], $V = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}$ and $Y = \begin{bmatrix} 2 \\ 2 \\ 4 \end{bmatrix}$, then UV + XY is equal to:

(A) [20] (B) 20
(C) [–20] (D) –20

5. If $A = \begin{bmatrix} 2 & -1 \\ 1 & 2 \end{bmatrix}$, then $A^2 + 2A - 3I$ is equal:

(A) $\begin{bmatrix} 4 & -6 \\ 6 & 4 \end{bmatrix}$ (B) 0

(C) $\begin{bmatrix} -6 & 2 \\ -2 & 6 \end{bmatrix}$ (D) 5I

6. If $A(\alpha) = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$, then the matrix of $A^2(\alpha)$ is equal to:

(A) $A(2\alpha)$ (B) $A(\alpha)$
(C) $A(3\alpha)$ (D) $A(4\alpha)$

7. If 1, ω and ω^2 are the cube roots of unity and $\begin{bmatrix} 1+\omega & 2\omega \\ -2\omega & -b \end{bmatrix} + \begin{bmatrix} a & -\omega \\ 3\omega & 2 \end{bmatrix} = \begin{bmatrix} 0 & \omega \\ \omega & 1 \end{bmatrix}$ then $a^2 + b^2$ is equal to:

(A) $1 + \omega^2$ (B) $\omega^2 - 1$
(C) $1 + \omega$ (D) $(1+\omega)^2$

8. Let A = $[a_{ij}]$ be a 3 × 3 matrix, where $a_{ij} = \lim_{x\to 0} \frac{(1+ix)^{\frac{1}{j}} - 1}{x}$ for all 1 ≤ i, j ≤ 3. If A^2 = kA, then the value of k is equal to:

(A) 1 (B) 2
(C) 3 (D) 4

9. If $A = \begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}$, and A^2 is the identity matrix, then x is equal to:

(A) –1 (B) 0
(C) 1 (D) 2

10. If $\begin{bmatrix} 1 & x & 1 \end{bmatrix}\begin{bmatrix} 1 & 2 & 3 \\ 0 & 5 & 1 \\ 0 & 3 & 2 \end{bmatrix}\begin{bmatrix} x \\ 1 \\ -2 \end{bmatrix} = 0$, then the value of x is:

(A) 0 (B) 2/3
(C) $\frac{5}{4}$ (D) –4/5

DPP-3
(Product of Matrices)

1. P is an orthogonal matrix and A is a periodic matrix with period 4 and $Q = PAP^T$, then $X = P^T Q^{2005} P$ will be equal to:

(A) A (B) A^2

(C) A^3 (D) A^4

2. Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ and $B = \begin{bmatrix} \alpha \\ \beta \end{bmatrix} \neq \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ such that AB = B and $a + d = 2021$, then the value of $ad-bc$ is equal to:

3. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$. If u_1 and u_2 are column matrices such that $Au_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$ and $Au_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$, then $u_1 + u_2$ is equal to:

(A) $\begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}$ (B) $\begin{bmatrix} -1 \\ 1 \\ -1 \end{bmatrix}$

(C) $\begin{bmatrix} -1 \\ -1 \\ 0 \end{bmatrix}$ (D) $\begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix}$

4. If $A = \begin{bmatrix} a & b \\ b & a \end{bmatrix}$ and $A^2 = \begin{bmatrix} \alpha & \beta \\ \beta & \alpha \end{bmatrix}$, then:

(A) $\alpha = 2ab, \beta = a^2 + b^2$

(B) $\alpha = a^2 + b^2, \beta = ab$

(C) $\alpha = a^2 + b^2, \beta = 2ab$

(D) $\alpha = a^2 + b^2, \beta = a^2 - b^2$

5. Simplify $\tan\theta \begin{bmatrix} \sec\theta & \tan\theta \\ \tan\theta & -\sec\theta \end{bmatrix} + \sec\theta \begin{bmatrix} -\tan\theta & -\sec\theta \\ -\sec\theta & \tan\theta \end{bmatrix}$

(A) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

(C) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ (D) $\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$

6. If $m[-3 \quad 4] + n[4 \quad -3] = [10 \quad -11]$, then $3m + 7n$ is equal to:

(A) 3 (B) 5

(C) 10 (D) 1

7. The number of solution of the matrix equation $X^2 = \begin{pmatrix} 1 & 1 \\ 2 & 3 \end{pmatrix}$ is:

(A) more than 2 (B) 2

(C) 1 (D) 0

8. Let $A = \begin{bmatrix} \frac{\sqrt{3}}{2} & \frac{1}{2} \\ \frac{-1}{2} & \frac{\sqrt{3}}{2} \end{bmatrix}$, $B = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ and $C = AB$ A^T, then $A^T C^3 A$ is equal to:

(A) $\begin{bmatrix} \frac{\sqrt{3}}{2} & \frac{1}{2} \\ 1 & 0 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 0 \\ \frac{\sqrt{3}}{2} & 1 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & \frac{\sqrt{3}}{2} \\ 0 & 3 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix}$

9. If $A = \begin{bmatrix} 1 & 2 & x \\ 3 & -1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} y \\ x \\ 1 \end{bmatrix}$ be such that $AB = \begin{bmatrix} 6 \\ 8 \end{bmatrix}$, then:

(A) $y = 2x$ (B) $y = -2x$

(C) $y = x$ (D) $y = -x$

10. If $A = \begin{bmatrix} 2 & 0 & 1 \\ 2 & 1 & 3 \\ 1 & -1 & 0 \end{bmatrix}$ and $f(x) = x^2 - 5x + 6$, then the value of $f(A)$ is:

(A) $\begin{bmatrix} 0 & -1 & 3 \\ 1 & 1 & -10 \\ 5 & 4 & 4 \end{bmatrix}$ (B) $\begin{bmatrix} 0 & 0 & -3 \\ 1 & 2 & 10 \\ 6 & 4 & 1 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & -1 & -3 \\ -1 & -1 & -10 \\ -5 & 4 & 4 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 2 & 3 \\ -1 & -1 & 0 \\ 4 & -5 & 4 \end{bmatrix}$

DPP-4

(Matrix Polynomial, Trace of A Matrix)

1. Let $A + 2B = \begin{bmatrix} 1 & 2 & 0 \\ 6 & -3 & 3 \\ -5 & 3 & 1 \end{bmatrix}$ and $2A - B = \begin{bmatrix} 2 & -1 & 5 \\ 2 & -1 & 6 \\ 0 & 1 & 2 \end{bmatrix}$.

If tr(A) denotes the sum of all diagonal elements of the matrix A, then tr(A)-tr(B) has value equal to:

(A) 1 (B) 2

(C) 0 (D) 3

2. Let $A + 2B = \begin{bmatrix} 1 & 2 & 3 \\ 6 & -3 & 6 \\ -5 & 3 & 1 \end{bmatrix}$ and $2A - B$

$= \begin{bmatrix} 2 & -1 & 0 \\ 2 & -1 & 2 \\ 0 & 1 & 2 \end{bmatrix}$ then find Tr (A) – Tr (B) + 1.

(A) 1 (B) 2

(C) 3 (D) 4

3. Let M be a 3 × 3 matrix satisfying

$$M\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} -1 \\ 2 \\ 3 \end{bmatrix}, M\begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix} and, M\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 12 \end{bmatrix},$$

Then the sum of the diagonal entries of M, is:

(A) 7 (B) 8

(C) 9 (D) 6

4. Consider three matrices $A = \begin{bmatrix} 2 & 1 \\ 4 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 3 & 4 \\ 2 & 3 \end{bmatrix}$, and $C = \begin{bmatrix} 3 & -4 \\ -2 & 3 \end{bmatrix}$. Then the value of the sum

$$\text{tr}(A) + \text{tr}\left(\frac{ABC}{2}\right) + \text{tr}\left(\frac{A(BC)^2}{4}\right) + \text{tr}\left(\frac{A(BC)^3}{8}\right) +$$

.....+ ∞ , is:

(A) 6 (B) 9

(C) 12 (D) none

5. If A is a 3 × 3 matrix whose elements are from the set {–1, 0, 1}. Find the number of matrices A such that $tr(AA^T) = 3$. Where $tr(A)$ is sum of diagonal element of matrix A.

(A) 572 (B) 612

(C) 672 (D) 682

6. If $A_1 = [a_1], A_2 = \begin{bmatrix} a_2 & a_3 \\ a_4 & a_5 \end{bmatrix}$,

$A_3 = \begin{bmatrix} a_6 & a_7 & a_8 \\ a_9 & a_{10} & a_{11} \\ a_{12} & a_{13} & a_{14} \end{bmatrix} \ldots A_n = [\ldots]$,

and so on, where $a_r = [\log_2 r]$ (where [.] denotes greatest integer function). $T_r(A_{10})$ is equal to;

(T_r stands for trace of the matrix)

(A) 800 (B) 80

(C) 792 (D) 160

***7.** Let $A = [a_{ij}]_{3\times 3}$ be a matrix such that $a_{ij} = 0\ \forall\ i \neq j$ and $a_{ij} > 0\ \forall\ i = j$. If adj A satisfies the equation $x^3 - 9x^2 + px - 27 = 0$, $p \in R$, then

(A) tr. (A) = $3\sqrt{3}$

(B) det. $(adj\ (adj\ A)) = 3^6$

(C) tr. $(A^{-1}) = \frac{1}{3\sqrt{3}}$

(D) det. (A) = $3\sqrt{3}$

[**Note:** adj. (P), tr. (P) and det. (P) denote adjoint matrix of matrix P, trace of matrix P and determinant of matrix P respectively.]

***8.** If $A = \begin{bmatrix} 3 & 0 & 0 \\ 2 & 2 & 0 \\ 4 & 5 & 3 \end{bmatrix}$, then which of the following is (are) true?

(A) A is invertible

(B) trace $(adj\ (adj\ A)) = 144$

(C) trace $(adj\ (adj\ A)) = 108$

(D) |adj A| is less than 400

***9.** Let f be cubic polynomial function such that

$$\begin{bmatrix} a^2 & 4a & 1 \\ b^2 & 4b & 1 \\ c^2 & 4c & 1 \end{bmatrix}\begin{bmatrix} f(-1) & 0 \\ f(1) & f(0) \\ f(2) & 1 \end{bmatrix} = \begin{bmatrix} 2a^2+16a+17 & 4a+1 \\ 2b^2+16b+17 & 4b+1 \\ 2c^2+16c+17 & 4c+1 \end{bmatrix},$$ then

(A) Number of real roots of f(x) = 0 is 1

(B) The sum of greatest and least values of f(x) in [–1, 1] is 5.

(C) y = f(x) is a bijective function.

(D) There are two values of k for which the equation f(x) = k has exactly two real and distinct roots.

***10.** Let A = $\begin{bmatrix} 1 & 2 & 0 \\ 0 & 2 & 0 \\ 0 & -1 & 2 \end{bmatrix}$ be a given matrix.

If P = $A^4 + 8A$ and Q = $-5A^3 + 8A^2 - 10A$, then

(A) tr.(P + Q) = 10 (B) tr.(P + Q) = 0

(C) det.(P + Q) = 8 (D) det.(P + Q) = 32

[**Note:** tr.(M) denotes the trace of matrix M and det.(M) denotes determinant of matrix M.]

DPP-5

(Transpose of A Matrix, Conjugate of A Matrix, Transposed Conjugate of A Matrix (A)

1. If for the matrix $A = \begin{bmatrix} 1 & -\alpha \\ \alpha & \beta \end{bmatrix}$, $AA^T = I_2$, then the value of $\alpha^2 + \beta^2$ is:

(A) 3
(B) 2
(C) 1
(D) 4

2. If $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$, then $A + A' = I$, if value of α is

(A) $\frac{\pi}{6}$
(B) $\frac{\pi}{3}$
(C) π
(D) $\frac{3\pi}{2}$

3. Let $A = \left[a_{ij}\right]_{3\times 3}$ be a matrix.

If $A + A^T = \begin{bmatrix} 6 & 4 & 4 \\ a_{21}+a_{12} & 10 & a_{23}+a_{32} \\ a_{31}+a_{13} & 4 & 8 \end{bmatrix}$,

where a_{12}, a_{23} and a_{31} are the positive root of the equation $x^3 - 6x^2 + px - 8 = 0$, $p \in R$, then the value of det. (A) is

(A) 28 (B) 24
(C) 1 (D) 0

4. If $A = \begin{bmatrix} 0 & 2y & z \\ x & y & -z \\ x & -y & z \end{bmatrix}$ satisfies the equation $A'A = I$, then the value of x, y and z are:

(A) $x = \pm\frac{1}{\sqrt{3}}, y = \pm\frac{1}{\sqrt{6}}, z = \pm\frac{1}{\sqrt{2}}$
(B) $x = \pm\frac{1}{\sqrt{2}}, y = \pm\frac{1}{\sqrt{3}}, z = \pm\frac{1}{\sqrt{6}}$
(C) $x = \pm\frac{1}{\sqrt{6}}, y = \pm\frac{1}{\sqrt{6}}, z = \pm\frac{1}{\sqrt{2}}$
(D) $x = \pm\frac{1}{\sqrt{2}}, y = \pm\frac{1}{\sqrt{6}}, z = \pm\frac{1}{\sqrt{3}}$

5. Let a, b, c, $\in$ R be all non-zero and satisfy $a^3 + b^3 + c^3 = 2$. If the matrix $A = \begin{pmatrix} a & b & c \\ b & c & a \\ c & a & b \end{pmatrix}$ satisfies $A^TA = I$, then value of abc can be:

(A) 3 (B) 1/3
(C) –1/3 (D) 2/3

6. If $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ a & 2 & b \end{bmatrix}$ is a matrix satisfying the equation $AA^T = 9I$, where I is 3 × 3 identity matrix, then the ordered pair (a, b) is equal to-

(A) (2, 1) (B) (–2, –1)
(C) (2, –1) (D) (–2, 1)

7. The total number of matrices $A = \begin{pmatrix} 0 & 2y & 1 \\ 2x & y & -1 \\ 2x & -y & 1 \end{pmatrix}$ $\left(x, y \in R,\ x \neq y\right)$ for Which $A^TA = 3I_3$ is:

(A) 3 (B) 4
(C) 2 (D) 6

8. If matrix $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$, where a, b, c are real positive numbers such that $abc = 1$ & $A.A^T = I$. Find the value of $a^3 + b^3 + c^3$.

9. If $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$, then for $n \in N$, A^n is equal to

(A) $\begin{bmatrix} 1+2n & -4n \\ n & 1-2n \end{bmatrix}$ (B) $\begin{bmatrix} 1-2n & 4n \\ n & 1+2n \end{bmatrix}$
(C) $\begin{bmatrix} 1+2n & 4n \\ -n & 1+2n \end{bmatrix}$ (D) $\begin{bmatrix} 1-2n & -4n \\ -n & -1+2n \end{bmatrix}$

***10.** Consider three square matrices A, B and C of order n such that $A^T = A - B$, $B^T = B - C$, then (n is odd natural number)

(A) $|C| = 2^n |B|$
(B) $|C| = 2^{n-1} |B|$
(C) $|A + B| = |A - 2B|$
(D) $|A| = 0$

DPP-6
(Symmetric and Skew Symmetric Matrix)

1. If A and B are symmetric matrices of the same order, then:
(A) AB is a symmetric matrix
(B) A – B is skew-symmetric matrix
(C) AB + BA is a symmetric matrix
(D) AB – BA is a symmetric matrix

2. Matrix A has m rows and n + 5 columns, matrix B has m rows and 11 – *n* columns. If both AB and BA exist, then:
(A) AB and BA are square matrices
(B) AB and BA are of order 8 × 8 and 3 × 13, respectively
(C) AB = BA
(D) None of these

3. The square matrix A = $[a_{ij}]$ given by $a_{ij} = (i - j)^3$ is a
(A) symmetric matrix
(B) skew-symmetric matrix
(C) diagonal matrix
(D) None of these

4. If $A = \begin{bmatrix} 6 & 8 & 5 \\ 4 & 2 & 3 \\ 9 & 7 & 1 \end{bmatrix}$ is the sum of a symmetric matrix B and skew –symmetric matrix C, then B is equal to

(A) $\begin{bmatrix} 6 & 6 & 7 \\ 6 & 2 & 5 \\ 7 & 5 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 0 & 2 & -2 \\ -2 & 5 & -2 \\ 2 & 2 & 0 \end{bmatrix}$

(C) $\begin{bmatrix} 6 & 6 & 7 \\ -6 & 2 & -5 \\ -7 & 5 & 1 \end{bmatrix}$ (D) $\begin{bmatrix} 0 & 6 & -2 \\ 2 & 0 & -2 \\ -2 & -2 & 0 \end{bmatrix}$

5. If A is a symmetric matrix and B is a skew-symmetric matrix such that $A + B = \begin{bmatrix} 2 & 3 \\ 5 & -1 \end{bmatrix}$, then AB is equal to -

(A) $\begin{bmatrix} -4 & -2 \\ -1 & 4 \end{bmatrix}$ (B) $\begin{bmatrix} 4 & -2 \\ -1 & -4 \end{bmatrix}$

(C) $\begin{bmatrix} 4 & -2 \\ 1 & -4 \end{bmatrix}$ (D) $\begin{bmatrix} -4 & 2 \\ 1 & 4 \end{bmatrix}$

***6.** Let A and B be two square matrix of order 3 then which of the following statement(s) is(are) correct?
(A) ABA^T is symmetric matrix.
(B) AB – BA is skew symmetric matrix.
(C) If B = | A | A^{-1} , | A | ≠ 0 then adj. (A^T) – B is skew symmetric matrix.
(D) If B + A^T = **O** and A is skew symmetric matrix then B^{15} is also skew symmetric matrix.

7. If a matrix A is both symmetric and skew-symmetric matrix, then:
(A) A is a diagonal matrix
(B) A is zero square matrix
(C) A is a square matrix
(D) None of the above

8. If A = $(a_{ij})_{3\times3}$ is a skew-symmetric matrix, Then:
(A) $a_{ii} = 0, \ \forall \ i$
(B) $A - A'$ is null matrix
(C) $|A| \neq 0$
(D) None of these

9. If A = $[a_{ij}]$ is a skew-symmetric matrix of order *n*, then a_{ii} is equal to:
(A) 0 for some *i*
(B) 0 for all *i* = 1, 2, …, *n*
(C) 1 for some *i*
(D) 1 for all *i* = 1, 2, ….., *n*

10. If $A = \begin{bmatrix} 0 & 3 & 3 \\ -3 & 0 & -4 \\ -3 & 4 & 0 \end{bmatrix}$ and B = $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$, then B'(AB) is:
(A) symmetric matrix
(B) zero matrix
(C) singular matrix
(D) unit matrix

DPP-7

(Hermitian and Skew-Hermitian Matrix, Orthogonal and Unitary Matrix, Involuntary matrix)

1. If an idempotent matrix is also skew symmetric then it must be-
(A) an involutary matrix
(B) an identity matrix
(C) an orthogonal matrix
(D) a null matrix.

2. The number of diagonal matrix A of order n for which $A^3 = A$ is-
(A) 1 (B) 0
(C) 2^n (D) 3^n

3. If Z is an idempotent matrix, then $(I + Z)^n$-
(A) $I + 2^nZ$ (B) $I + (2^n - 1)Z$
(C) $I - (2^n - 1)Z$ (D) none of these

***4.** Consider three square matrices A, B and C of order n such that $A^T = A - B$, $B^T = B - C$, then (n is odd natural number)
(A) $|C| = 2^n |B|$
(B) $|C| = 2^{n-1} |B|$
(C) $|A + B| = |A - 2B|$
(D) $|A| = 0$

5. Let $M = \begin{bmatrix} a & -360 \\ b & c \end{bmatrix}$, where a, b and c are integers. Find the smallest positive value of b such that $M^2 = O$, where O denotes 2×2 null matrix.

***6.** Let A is a diagonal matrix of order 3 having distinct diagonal entries. matrix B satisfy $AB = BA$. Then which of the following is/are true?
(A) B will be a diagonal matrix always
(B) B will be a unit matrix always
(C) B can be a scalar matrix
(D) B is symmetric matrix

***7.** Suppose that a, b, c are real numbers such that a + b + c = 1. If the matrix $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$ be an orthogonal matrix, then-
(A) A is an involutory matrix
(B) |A| is negative
(C) $a^3 + b^3 + c^3 - 3abc = 1$
(D) atleast one of a, b, c is negative

***8.** If A and B are $n \times n$ matrices with real entries and $|A|$ denotes determinant of A, then –
(A) $A^2.B^3 = O \Rightarrow$None of A or B is invertible.
(B) $\|AB\| AB\| = |AB|^{n+1}$
(C) If $|A| = 2$, A cannot be involutary matrix
(D) $B(AB)^{-1}A = I$, where I is the identity matrix.

9. A is an involuntary matrix given by $A = \begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$, then the inverse of $\frac{A}{2}$ will be
(A) 2A (B) $\frac{A^{-1}}{2}$
(C) $\frac{A}{2}$ (D) A^2

10. For two unimodular complex numbers z_1 and z_2, $\begin{bmatrix} \bar{z}_1 & -z_2 \\ \bar{z}_2 & z_1 \end{bmatrix}^{-1} \begin{bmatrix} z_1 & z_2 \\ -\bar{z}_2 & \bar{z}_1 \end{bmatrix}^{-1}$ is equal to-
(A) $\begin{bmatrix} z_1 & z_2 \\ \bar{z}_1 & \bar{z}_2 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
(C) $\begin{bmatrix} 1/2 & 0 \\ 0 & 1/2 \end{bmatrix}$ (D) none of these

DPP-8

(Elementary Operation (Transformation) of A Matrix)

1. Let A be an invertible matrix. Which of the is not true?
(A) $(A^T)^{-1} = (A^{-1})^T$ (B) $A^{-1} = |A|^{-1}$
(C) $(A^2)^{-1} = (A^{-1})^2$ (D) $|A^{-1}| = |A|^{-1}$

2. If A is non-singular and (A – 2I) (A – 4I) = O, then $\frac{1}{6}A + \frac{4}{3}A^{-1} =$
(A) I (B) O
(C) 2I (D) 6I

3. If $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & -2 & 4 \end{bmatrix}$, $6A^{-1} = A^2 + cA + dI$, then $(c, d) =$
(A) (–6, 11) (B) (–11, 6)
(C) (11, 6) (D) (6, 11)

***4.** Let A be a non-singular, symmetric matrix of order three such that $A = \text{adj.}\left(A + A^T\right)$, then
(A) $A^{-1} = \frac{A}{16}$
(B) $A^{-1} = 16A$
(C) adj. $\left(A^{-1}\right) = 64A$
(D) $\text{adj.}\left(A^{-1}\right) = \frac{A}{1024}$

5. The inverse of the matrix $A = \begin{bmatrix} 2 & 3 & -3 \\ -1 & -2 & 2 \\ 1 & 1 & -1 \end{bmatrix}$ is:
(A) $\begin{bmatrix} -1 & 2 & 3 \\ 1 & 0 & 1 \\ -1 & 2 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} -5 & -4 & 3 \\ -2 & 1 & 3 \\ 0 & 1 & 4 \end{bmatrix}$
(C) $\begin{bmatrix} -6 & -2 & 1 \\ 0 & 1 & 2 \\ 2 & -1 & -3 \end{bmatrix}$ (D) Does not exist

6. If A, B are two n × n non-singular matrices, then-
(A) AB is non-singular
(B) AB is singular
(C) $(AB)^{-1} = A^{-1} B^{-1}$
(D) $(AB)^{-1}$ does not exist

7. $A = \begin{pmatrix} 2 & 2 \\ 9 & 4 \end{pmatrix}$, and $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$, then 10 A^{-1} is equal to:
(A) A – 4I
(B) A – 6I
(C) 4I – A
(D) 6I – A

8. If A and B are two square matrices such that $B = -A^{-1}BA$, then $(A + B)^2$ is equal to-
(A) O
(B) $A^2 + B^2$
(C) $A^2 + 2AB + B^2$
(D) A + B

9. If A is a square matrix of order 3 such that det(A) = 2, then find $\det((\text{adj. } A^{-1})^{-1})$.
[Note: adj. P denotes adjoint of square matrix P.]
(A) 4 (B) 6
(C) 8 (D) 12

10. Let A = $\begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$ and 10 B = $\begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}$, if B is the inverse of matrix A, then α is:
(A) 5 (B) –1
(C) 2 (D) –2

DPP-9
(System of Equations)

1. The system of equations
$x + y + z = 5$
$x + 2y + 3z = 9$
$x + 3y + \lambda z = \mu$
has a unique solution, if-
(A) $\lambda = 5, \mu = 13$ (B) $\lambda \neq 5$
(C) $\lambda = 5, \mu \neq 13$ (D) $\lambda \neq 13$

2. If the trivial solution is the only solution of the system of equations
$x - ky + z = 0$
$kx + 3y - kz = 0$
$3x + y - z = 0$
then the set of values of k, is:
(A) R – {2} (B) R – {–3}
(C) {2, –3} (D) R – {2, – 3}

3. The number of values of k for which of the linear equations
$4x + ky + 2z = 0$
$kx + 4y + z = 0$
$2x + 2y + z = 0$,
possess a non-zero solution is:
(A) 3 (B) 2
(C) 1 (D) 0

4. Let a, b and c be positive real numbers, then the system of equations in x, y, z
$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1$, $\frac{x^2}{a^2} - \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$,
$\frac{-x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ has:
(A) no solution
(B) unique solution
(C) infinitely many solution
(D) finitely many solutions

Paragraph for Q. No. (05 to 07):
Consider a system of equations $2x + ay + 6z = 8$, $x + 2y + bz = 5$, $x + y + 3z = 4$ then answer question 7 to 9

5. The system of equations will have infinite solution if-
(A) $b = 4$ (B) $b = 2$
(C) $a = 3$ (D) $a = 2$

6. The system of equations will have no solution if-
(A) $a = 2, b \neq 3$ (B) $a \neq 2, b \neq 3$
(C) $a \neq 2, b = 3$ (D) $a = 2, b = 3$

7. The given system of equations will have unique solution if-
(A) $a \neq 2, b \neq 3$ (B) $a \neq 2$
(C) $a = 2, b = 3$ (D) $a = 2, b \neq 3$

8. If system of equations
$(\tan \alpha)x + (\cot \alpha)y + (8 \cos 2\alpha)z = 0$
$(\cot \alpha)x + (8 \cos 2\alpha)y + (\tan \alpha)z = 0$
$(8 \cos 2\alpha)x + (\tan \alpha)y + (\cot \alpha)z = 0$
have non-trivial solution, then $\sin(4\alpha)$ is equal to-
(A) $\frac{-\sqrt{3}}{2}$ (B) -1
(C) $\frac{-1}{2}$ (D) $\frac{1}{2}$

9. If the three linear equations
$x + 4ay + az = 0$
$x + 3by + bz = 0$
$x + 2cy + cz = 0$
Have a non-trivial solution, where $a \neq 0$, $b \neq 0$, $c \neq 0$, then $ab + bc$ is equal to:
(A) $2ac$ (B) $-ac$
(C) ac (D) $-2ac$

10. For a unique value of p and q, the system of equations given by
$x + y + z = 6$
$x + 2y + 3z = 14$
$2x + 5y + pz = q$
has infinitely many solutions, then the value of $(p + q)$ is equal to-
(A) 14 (B) 24
(C) 34 (D) 44