MATHS

BOOKS - VIKAS GUPTA MATHS (HINGLISH)

MATRICES

Exercise 1 Single Choice Problems

1. Let $A = BB^T + CC^T$, where $B = \begin{bmatrix} \cos\theta \\ \sin\theta \end{bmatrix}, C = \begin{bmatrix} \sin\theta \\ -\cos\theta \end{bmatrix}, \theta \in R.$

Then A is :

A. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

B. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$

Answer: C

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2. Let $A = \begin{bmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{bmatrix}$

Then only correct statement about the matrix A is

A. A is a zero matrix

B. $A^2 = I$, where I is a unit matrix

C. A^{-1} does not exist

D. $A = (-1)I$, where I is a unit matrix

Answer: B

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3. Let $A = [a_{ij}]_{3 \times 3}$ be such that $a_{ij} = \begin{bmatrix} 3 & \text{when} & \hat{i} = \hat{j} \\ 0 & & \hat{i} \neq \hat{j} \end{bmatrix}$ then $\left\{ \dfrac{\det\,(\text{adj}(\text{adj A}))}{5} \right\}$ equals :

(where {.} denotes fractional part function)

A. $\frac{2}{5}$

B. $\frac{1}{5}$

C. $\frac{2}{3}$

D. $\frac{1}{3}$

Answer: B

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4. If $A^{-1} = \begin{bmatrix} \sin^2\alpha & 0 & 0 \\ 0 & \sin^2\beta & 0 \\ 0 & 0 & \sin^2\gamma \end{bmatrix}$ and $B^{-1} = \begin{bmatrix} \cos^2\alpha & 0 & 0 \\ 0 & \cos^2\beta & 0 \\ 0 & 0 & \cos^2\gamma \end{bmatrix}$ where α, β, γ are any real numbers and

$$C = A^{-5} + B^{-5} + 5A^{-1}B^{-1}(A^{-3} + B^{-3}) + 10A^{-2}B^{-2}(A^{-1} + B^{-1})$$

then find |C|

A. 0

B. 1

C. 2

D. 3

Answer: B

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5. If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$, then $A^{-1} =$

A. A

B. A^2

C. A^3

D. A^4

Answer: C

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6. Let $M = [a_{ij}]_{3 \times 3}$ where $a_{ij} \in \{-1, 1\}$. Find the maximum possible value of det(M).

A. 3

B. 4

C. 5

D. 6

Answer: B

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7. Let matrix $A = \begin{bmatrix} x & 3 & 2 \\ 1 & y & 4 \\ 2 & 2 & z \end{bmatrix}$, if $xyz = 2\lambda$ and $8x + 4y + 3x = \lambda + 28$, then $(adjA)A$ equals :

A. $\begin{bmatrix} \lambda + 1 & 0 & 0 \\ 0 & \lambda + 1 & 0 \\ 0 & 0 & \lambda + 1 \end{bmatrix}$

B. $\begin{bmatrix} \lambda & 0 & 0 \\ 0 & \lambda & 0 \\ 0 & 0 & \lambda \end{bmatrix}$

C. $\begin{bmatrix} \lambda^2 & 0 & 0 \\ 0 & \lambda^2 & 0 \\ 0 & 0 & \lambda^2 \end{bmatrix}$

D. $\begin{bmatrix} \lambda + 2 & 0 & 0 \\ 0 & \lambda + 2 & 0 \\ 0 & 0 & \lambda + 2 \end{bmatrix}$

Answer: B

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8. If the trace of the matrix $A = \begin{bmatrix} x - 2 & e^x & -\sin x \\ \cos x^2 & x^2 - x + 3 & \text{In}|x| \\ \cot x & \tan^{-1} x & x - 7 \end{bmatrix}$ is zero, then x is equal to :

A. -2 or 3

B. -3 or -2

C. -3 or 2

D. 2 or 3

Answer: C

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9. if $A = [a_{ij}]_{2\cdot 2}$ where $a_{ij} = \{i + j, i \neq j$ and $a_{ij} = i^2 - 2j, i = j$ then A^{-1} is equal to

A. $\frac{1}{9}\begin{bmatrix} 0 & 3 \\ 3 & 1 \end{bmatrix}$

B. $\frac{1}{9}\begin{bmatrix} 0 & -3 \\ 3 & -1 \end{bmatrix}$

C. $\frac{1}{9}\begin{bmatrix} 0 & -3 \\ -3 & -1 \end{bmatrix}$

D. $\frac{1}{3}\begin{bmatrix} 0 & 3 \\ 3 & 1 \end{bmatrix}$

Answer: A

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10. If $\begin{bmatrix} 1 & -\tan\theta \\ \tan\theta & 1 \end{bmatrix}\begin{bmatrix} 1 & \tan\theta \\ -\tan\theta & 1 \end{bmatrix}^{-1} = \begin{bmatrix} a & -b \\ b & a \end{bmatrix}$, then

A. $a = b = 1$

B. $a = \cos 2\theta, b = \sin 2\theta$

C. $a = \sin 2\theta, b = \cos 2\theta$

D. $a = 1, b = \sin 2\theta$

Answer: B

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11. A square matrix P satisfies $P^2 = I - P$ where I is identity matrix. If $P^n = 5I - 8P$, then n is

A. 4

B. 5

C. 6

D. 7

Answer: C

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12. Let matrix $A = \begin{bmatrix} x & y & -z \\ 1 & 2 & 3 \\ 1 & 1 & 2 \end{bmatrix}$ where $x, y, z \varepsilon N$. If $\det.\ (adj(adj.\ A)) = 2^8.\ (3^4)$ then the number of such matrices A is :

A. 220

B. 45

C. 55

D. 110

Answer: C

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13. If A is a 2×2 non singular matrix, then adj(adj A) is equal to :

A. A^2

B. A

C. A^{-1}

D. $\left(A^{-1}\right)^2$

Answer: B

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14. $A = \begin{bmatrix} a & b \\ b & -a \end{bmatrix}$ and $MA = A^{2m}$, $m \in N$ for some matrix M, then which one of the following is correct ?

A. $M = \begin{bmatrix} a^{2m} & b^{2m} \\ b^{2m} & -a^{2m} \end{bmatrix}$

B. $M = \left(a^2 + b^2\right)^m \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

C. $M = (a^m + b^m) \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

D. $M = (a^2 + b^2)^{m-1} \begin{bmatrix} a & b \\ b & -a \end{bmatrix}$

Answer: D

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15. Let A be a square matrix satisfying $A^2 + 5A + 5I = 0$ the inverse of $A + 2l$ is equal to

A. $A - 2I$

B. $A + 3I$

C. $A - 3I$

D. non-existent

Answer: B

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16. Let $A = \begin{bmatrix} 3 & -5 \\ 7 & -12 \end{bmatrix}$ and $B = \begin{bmatrix} 12 & -5 \\ 7 & -3 \end{bmatrix}$ bc two given matrices, then $(AB)^{-1}$ is :

A. $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

C. $\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

Answer: B

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17. If matrix $A = \begin{bmatrix} 2 & 2 \\ 2 & 3 \end{bmatrix}$ then the value of [adj. A] equals to :

A. 2

B. 3

C. 4

D. 6

Answer: A

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18. If for the matrix $A = \begin{bmatrix} \cos\theta & 2\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}, A^{-1} = A^T$ then number of possible value(s) of θ in $[0, 2\pi]$ is :

A. 2

B. 3

C. 1

D. 4

Answer: B

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19. Let M be a column vector (not null vector) and $A = \frac{MM^T}{M^TM}$ the matrix A is : (where M^T is transpose matrix of M)

A. idempotant

B. nilpotent

C. involutary

D. none of these

Answer: A

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20. If $A = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$ $P = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$, $Q = P^TAP$ find $PQ^{2014}P^T$

A. $\begin{pmatrix} 1 & 2^{2014} \\ 0 & 1 \end{pmatrix}$

B. $\begin{pmatrix} 1 & 4028 \\ 0 & 1 \end{pmatrix}$

C. $(P^T)^{2013}A^{2014}P^{2013}$

D. $P^T A^{2014} P$

Answer: B

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21. If M be a square matrix of order 3 such that $|M| = 2$, then $\left|adj\left(\frac{M}{2}\right)\right|$ equals to :

A. $\frac{1}{2}$

B. $\frac{1}{4}$

C. $\frac{1}{8}$

D. $\frac{1}{16}$

Answer: D

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22. If A is matrix of order 3 such that $|A| = 5$ and $B =$ adj A, then the value of $\left||A^{-1}|(AB)^T\right|$ is equal to (where |A| denotes determinant of matrix A. A^T denotes transpose of matrix A, A^{-1} denotes inverse of matrix A. adj A denotes adjoint of matrix A)

A. 5

B. 1

C. 25

D. $\frac{1}{25}$

Answer: B

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Exercise 2 One Or More Than One Answer Is Are Correct

1. If A and B are two orthogonal matrices of order n and $\det(A) + \det(B) = 0$; then which of the following must be correct ?

A. $\det(A+B)=\det(A)+\det(B)$

B. $\det(A+B)=0$

C. A and B both are singular matrices

D. $A+B=0$

Answer: A::B

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2. Let M be a 3×3 matrix satisfying $M^3=0$. Then which of the following statement(s) are true:

A. $\left|\frac{1}{2}M^2+M+I\right|\neq0$

B. $\left|\frac{1}{2}M^2-M+I\right|=0$

C. $\left|\frac{1}{2}M^2+M+I\right|=0$

D. $\left|\frac{1}{2}M^2-M+I\right|\neq0$

Answer: A::D

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3. Let $A_\alpha = \begin{bmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then :

A. $A_{\alpha+\beta} = A_\alpha A_\beta$

B. $A_\alpha^{-1} = A_{-\alpha}$

C. $A_\alpha^{-1} = -A_\alpha$

D. $A_\alpha^2 = -I$

Answer: A::B

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4. $A^3 - 2A^2 - A + 2I = 0$ if $A =$

A. I

B. 2I

C. $\begin{bmatrix} 2 & -1 & 2 \\ -1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$

D. $\begin{bmatrix} 2 & 1 & -2 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$

Answer: A::B::C::D

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5. Let A be 3×3 symmetric invertible matrix with real positive elements. Then the number of zero elements in A^{-1} are less than or equal to :

A. 0

B. 1

C. 2

D. 3

Answer: D

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Exercise 4 Subjective Type Problems

1. A and B are two square matrices such that $A^2B = BA$ and if $(AB)^{10} = A^k B^{10}$ then the value of $k - 1020$ is.

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2. Let A_n and B_n be square matrices of order 3, which are defined as :

$A_n = [a_{ij}]$ and $B_n = [b_{ij}]$ where $a_{ij} = \frac{2i + j}{3^{2n}}$ and $b_{ij} = \frac{3i - j}{2^{2n}}$ for all i and j, $1 \leq i, j \leq 3$.

If

$l = \lim_{n \to \infty} Tr. \left(3A_1 + 3^2A_2 + 3^3A_3 + \ldots\ldots. + 3^nA_n\right)$ and $m = \lim_{n \to \infty} T$

, then find the value of $\frac{(l+m)}{3}$

[Note : Tr (P) denotes the trace of matrix P.]

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3. Let A be a 2×3 matrix, whereas B be a 3×2 amtrix. If $\det.(AB) = 4$, then the value of $\det.(BA)$ is

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4. Let $M = [a_{ij}]_{3 \times 3}$ where $a_{ij} \in \{-1, 1\}$. Find the maximum possible value of det(M). (A) 3 (B) 4 (C) 5 (D) 6

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5. The set of natural numbers is divided into array of rows and columns in the form of matrices as $A_1 = [1], A_2 = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}, A_3 = \begin{bmatrix} 6 & 7 & 8 \\ 9 & 10 & 11 \\ 12 & 13 & 14 \end{bmatrix}$ and so on. Let the trace of A_{10} be λ . Find unit digit of λ ?

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