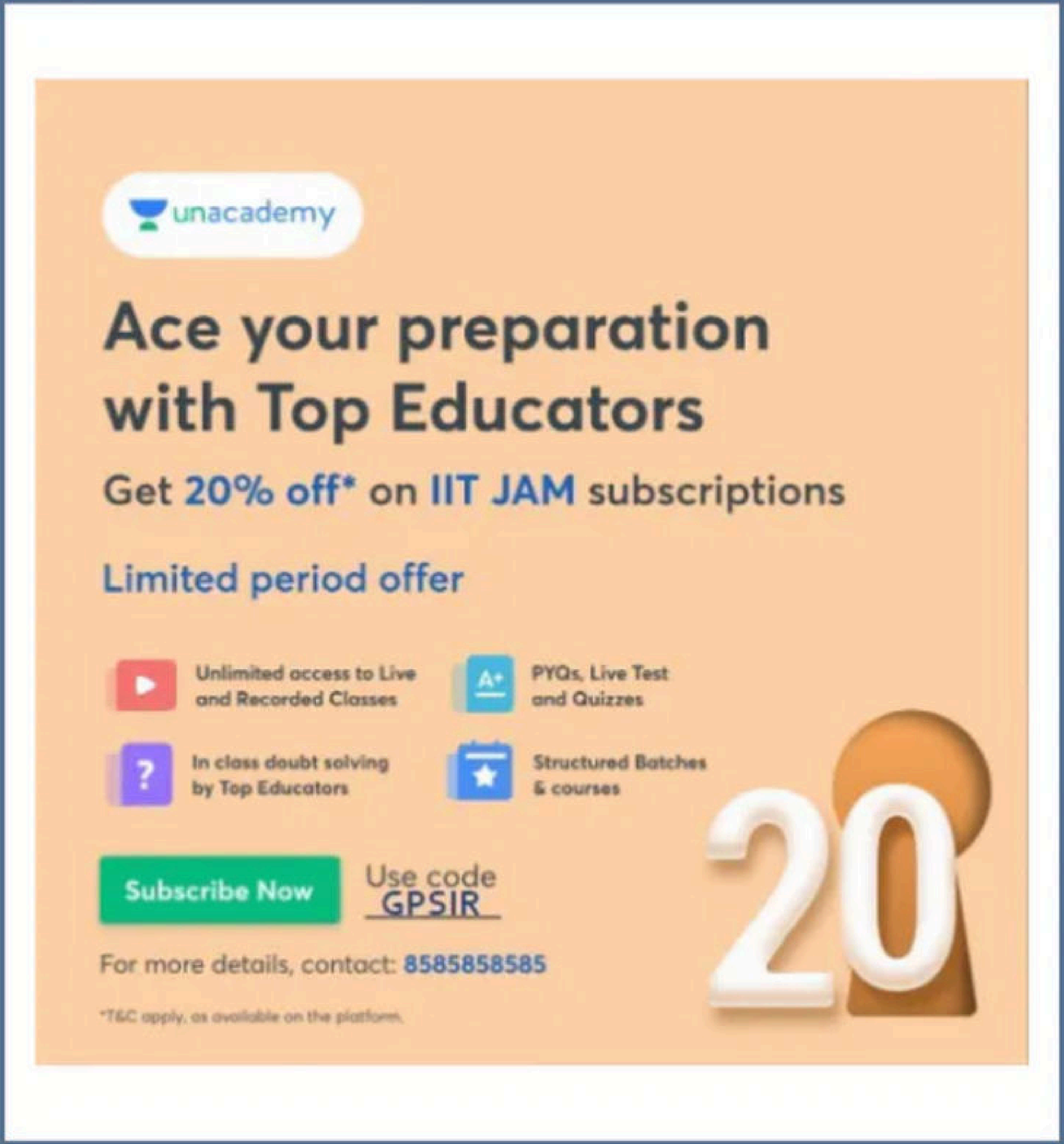
Matrix Representation - Part II

Detailed Course 2.0 on Linear Algebra For IIT JAM' 23

Gajendra Purohit • Lesson 8 • Sept 19, 2022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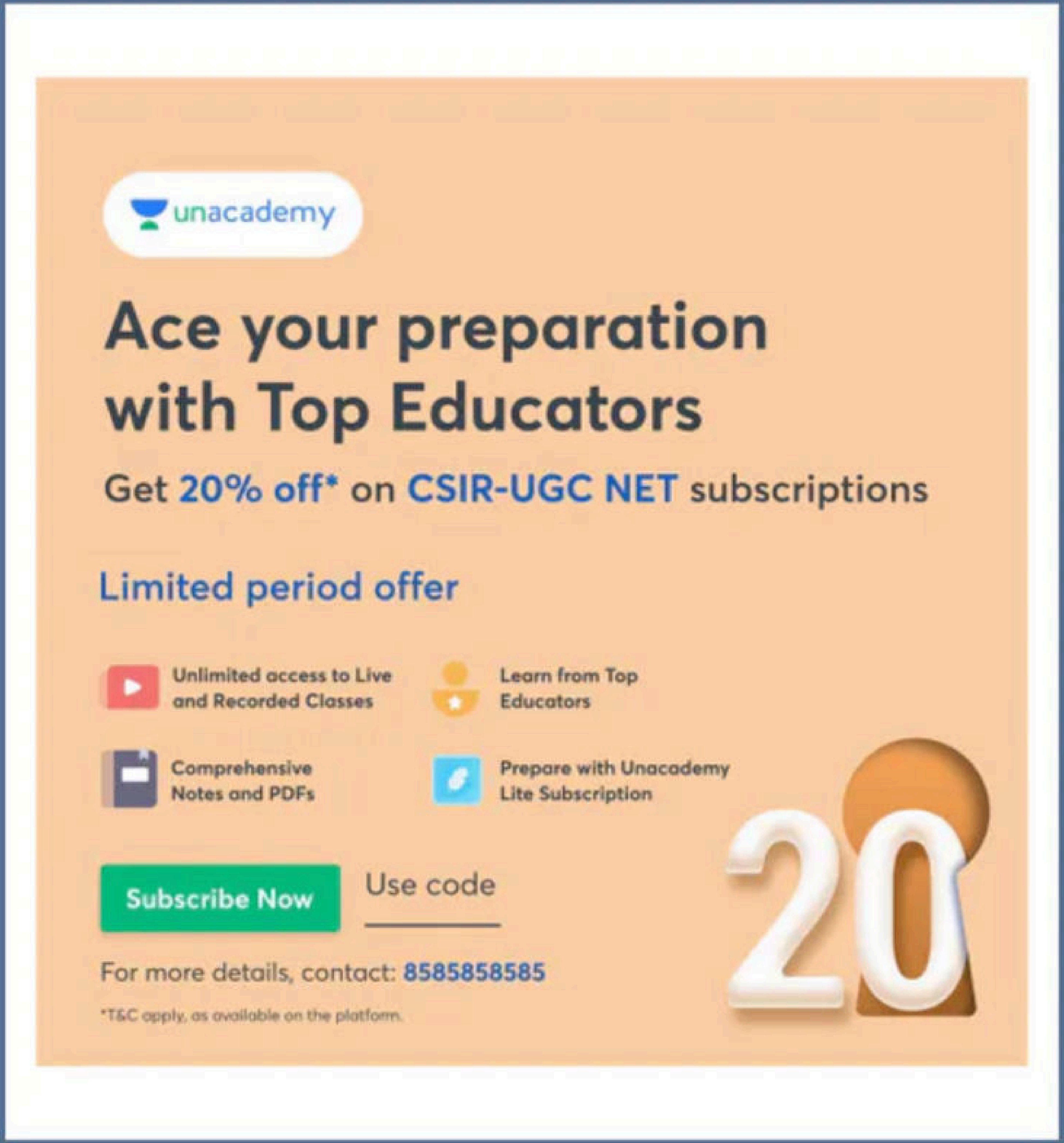
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Rank of matrix : If A is matrix then a non-negative integer is said to be rank of A. if $\exists$ a non-singular submatrix of order r of A and all matrix of order greater than r are singular.

Note :

(1) A matrix $A_{n \times n}$ is a non-singular iff rank(A) = n

(2) Rank of matrix is denoted by $\rho(A)$

(3) If $|A| \neq 0$ then $\rho(A) = n$ where n is order of A

Elementary Transformation : Those transformation that does not effect on rank of matrix are called elementary transformation.

There are 3 elementary row (column) transformation.

Elementary matrix : A matrix obtained by a single elementary operation over identity matrix is known as elementary matrix.

Q.1. Find elementary matrix

(a) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$

(c) $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} 3 & 2 & 0 \\ 1 & 2 & 0 \\ 1 & 2 & 2 \end{bmatrix}$

Note :

(1) Every elementary matrix is non-singular.

(2) Every permutation matrix is elementary matrix.

Q.2. Let $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 151 & 262 & 373 & 484 \end{bmatrix}$.

Then Rank(A) is

(a) 1 (b) 2

(c) 3 (d) 4

Q.3. Let $A = \begin{bmatrix} 1 & 1 & 1 & \cdots & 1 \\ 1 & 2 & 2 & \cdots & 2 \\ 1 & 2 & 3 & \cdots & 3 \\ 1 & 2 & 3 & \cdots & 4 \\ \vdots & & & & \\ 1 & 2 & 3 & \cdots & n \end{bmatrix}$, then $\rho(A)$ is

(a) 0 (b) 1

(c) 2 (d) n

Property :

1. A matrix is of Rank zero iff A is null matrix i.e. if A is non-null matrix then $\rho(A) \geq 1$

2. Rank of idempotent matrix of order n are always less then n except identity matrix.

3. Rank of involutory matrix of order are always n because determinant of involutory matrix are non-zero.

4. Rank of orthogonal matrix of order n is n.

5. Rank of nilpotent matrix of order n are always less than n.

Q.4. Let $S = \{A = [a_{ij}]_{n\times n} \mid A^k = 0 \;\&\; \rho(A) = n, \text{ for some } k\}$ then cardinality of S is

(a) ϕ (b) 1

(c) 2 (d) n

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1 • Asked by Nitesh

Please help me with this doubt

12:29 PM | 0.9KB/s

Test 5

Syllabus

Mathematics

- Range & Null Space
- Linear Independence of Vectors
- Basis & Dimension
- Linear Transformations
- Solution of Linear Eqn.
- Rank & Inverse of a Matrix
- Determinant
- Finite Dimension Vector Space
- Connected & Compact Sets
- Taylor's Series
- Power Series Differentiation
- Interior & Limit Points
- Integration of Power Series
- Eigenvalues & Eigenvectors
- Matrix Representation
- Radius & Interval Convergence
- Cayley-Hamilton Theorem
- Open, Closed & Bounded Sets
- Group Homomorphisms
- Completeness of R.Power Series
- Consistency Conditions
- Lagrange's Theory-Finite Group

Instructions

Time Duration = 30 minutes
Total number of questions = 20

Test Series

Result will be available after live test is over

(6) Let A be a matrix of order $m \times n$ then

$$\rho(A) \leq \min\{m, n\}$$

(7) Let A & B are matrix of order $m \times n$ & $n \times p$, then $\rho(A) + \rho(B) - n \leq \rho(AB) \leq \min\{\rho(A), \rho(B)\}$

(8) Let A and A^T are matrix then $\rho(A) = \rho(A^T)$

(9) $\rho(A + B) \leq \rho(A) + \rho(B)$

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TOPICS TO BE COVERED

- REAL ANALYSIS
- FUNCTION OF ONE & TWO VARIABLE
- LINAER ALGEBRA
- MODERN ALGEBRA

TOPICS TO BE COVERED

- SEQUENCE & SERIES
- INTEGRAL CALCULUS
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Q.5. Let $A = [a_1\ a_2\ \ldots\ldots\ a_n]^T_{1\times n}$ and $B = [b_1\ b_2\ \ldots\ldots\ b_n]_{1\times n}$ both are non-zero matrix then $\rho(AB)$ is

(a) 1 (b) n

(c) n + 1 (d) n – 1

Q.6 Let A be a 3×4 matrix and B be a 4×3 matrix with real entries such that AB is non- singular. Consider the following statements :

P : Nullity of A is 0.

Q : BA is a non-singular matrix.

Then

(a) both P and Q are true

(b) P is true and Q is false

(c) P is false and Q is true

(d) Both P and Q are false

Q.7. Let A be an $n \times n$ matrix such that the first 3 rows of A are linearly independent and the first 5 columns of A are linearly independent. Which of the following statements are true?

(a) A has at least 5 linearly independent rows

(b) $3 \leq \text{rank } A \leq 5$

(c) Rank $A \geq 5$ (d) Rank $A^2 \geq 5$

Q.8. What is the rank of the matrix $\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 2 \\ 1 & 2 & 3 & 3 & 3 \\ 1 & 2 & 3 & 4 & 4 \\ 1 & 2 & 3 & 4 & 5 \end{pmatrix}$.

(a) 2 (b) 3

(c) 4 (d) 5

Q.9 Let J denote the matrix of order $n \times n$ with all entries 1

and let B be a $(3n)\times(3n)$ matric given by $B = \begin{pmatrix} 0 & 0 & J \\ 0 & J & 0 \\ J & 0 & 0 \end{pmatrix}$

. Then the rank of B is

(a) $2n$ (b) $3n - 1$

(c) 2 (d) 3

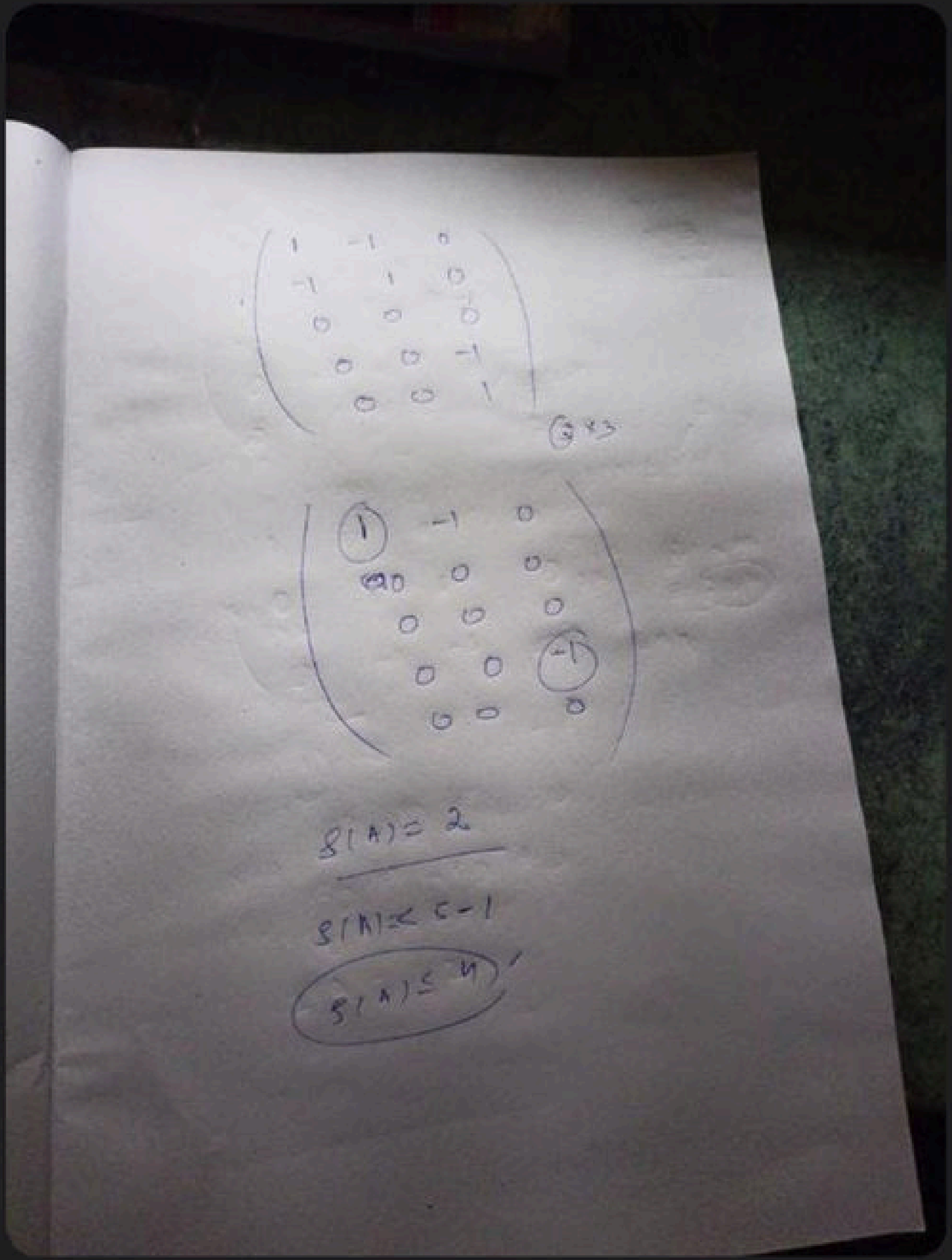
Q.10. Let A be an $n \times m$ matrix with each entry equal to +1, -1 or 0 such that every column has exactly one +1 and exactly one -1. We can conclude that

(a) Rank $A \leq n-1$ (b) Rank $A = m$

(c) $n \leq m$ (d) $n-1 \leq m$

1 • Asked by Srinibas

Please help me with this doubt



Q.11 Let A and B be $n \times n$ real matrices such that $AB = BA = 0$ and $A + B$ is invertible.

Which of the following are always true?

(a) Rank (A) = rank (B)

(b) Rank (A) + rank (B) = n

(c) Nullity (A) + nullity (B) = n

(d) $A - B$ is invertible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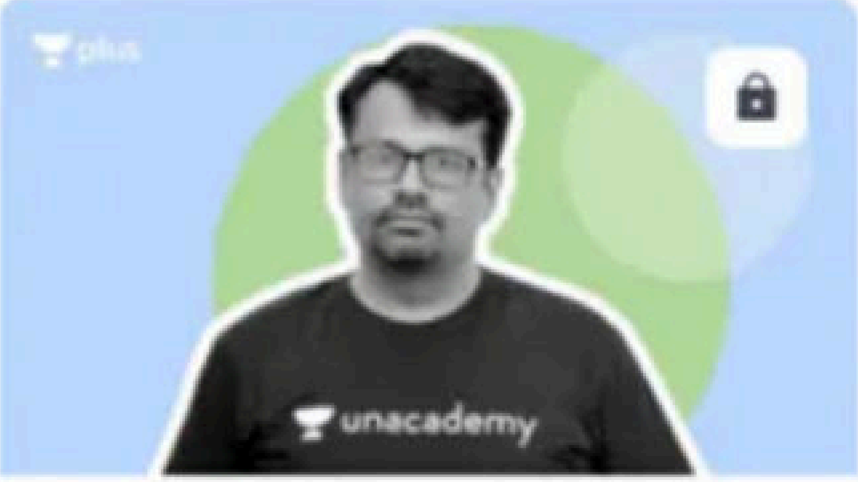

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- Works at **Pacific Science College**
- Studied at **M.Sc., NET, PhD(Algebra), MBA(Finance), BEd**
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