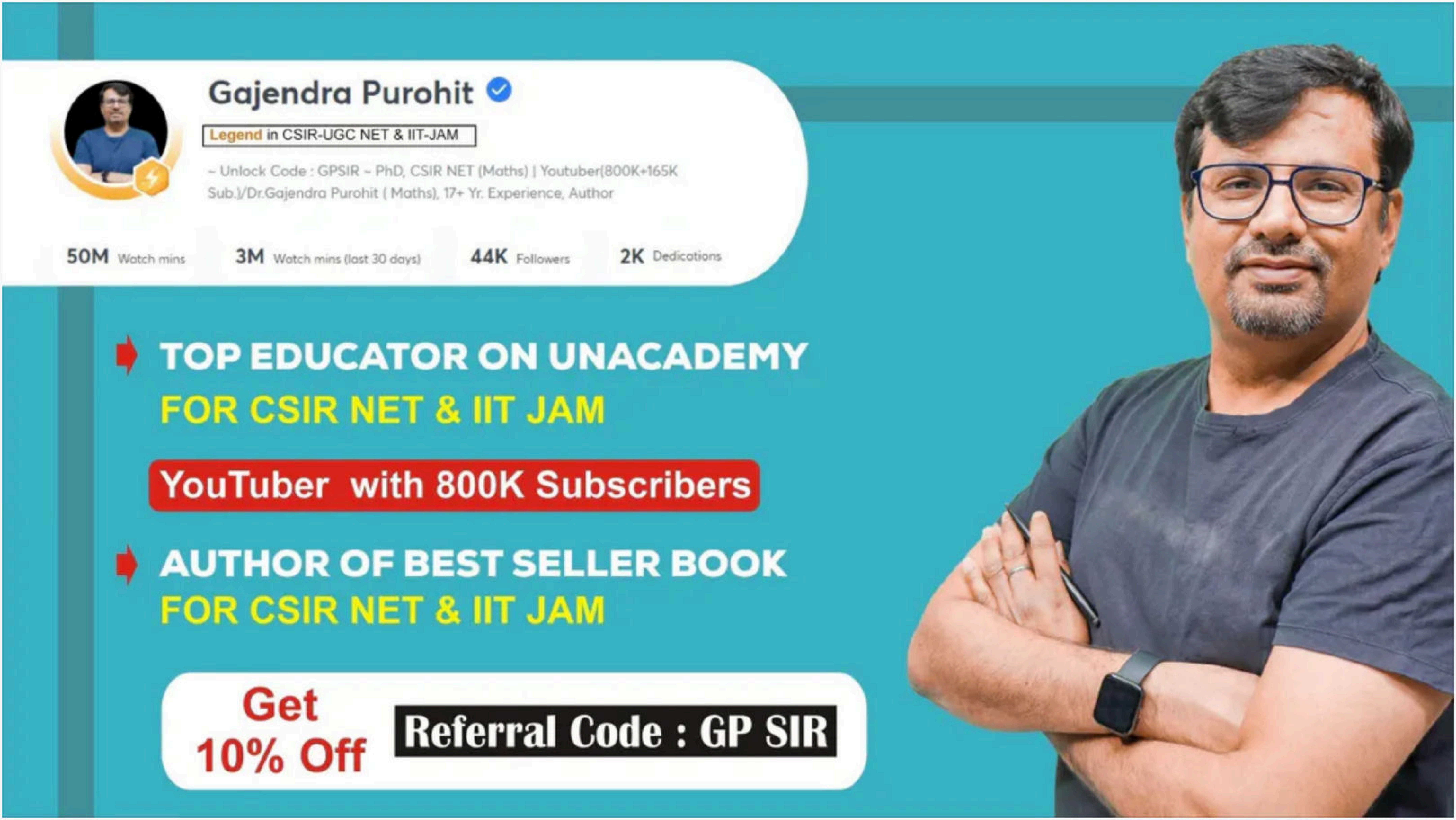

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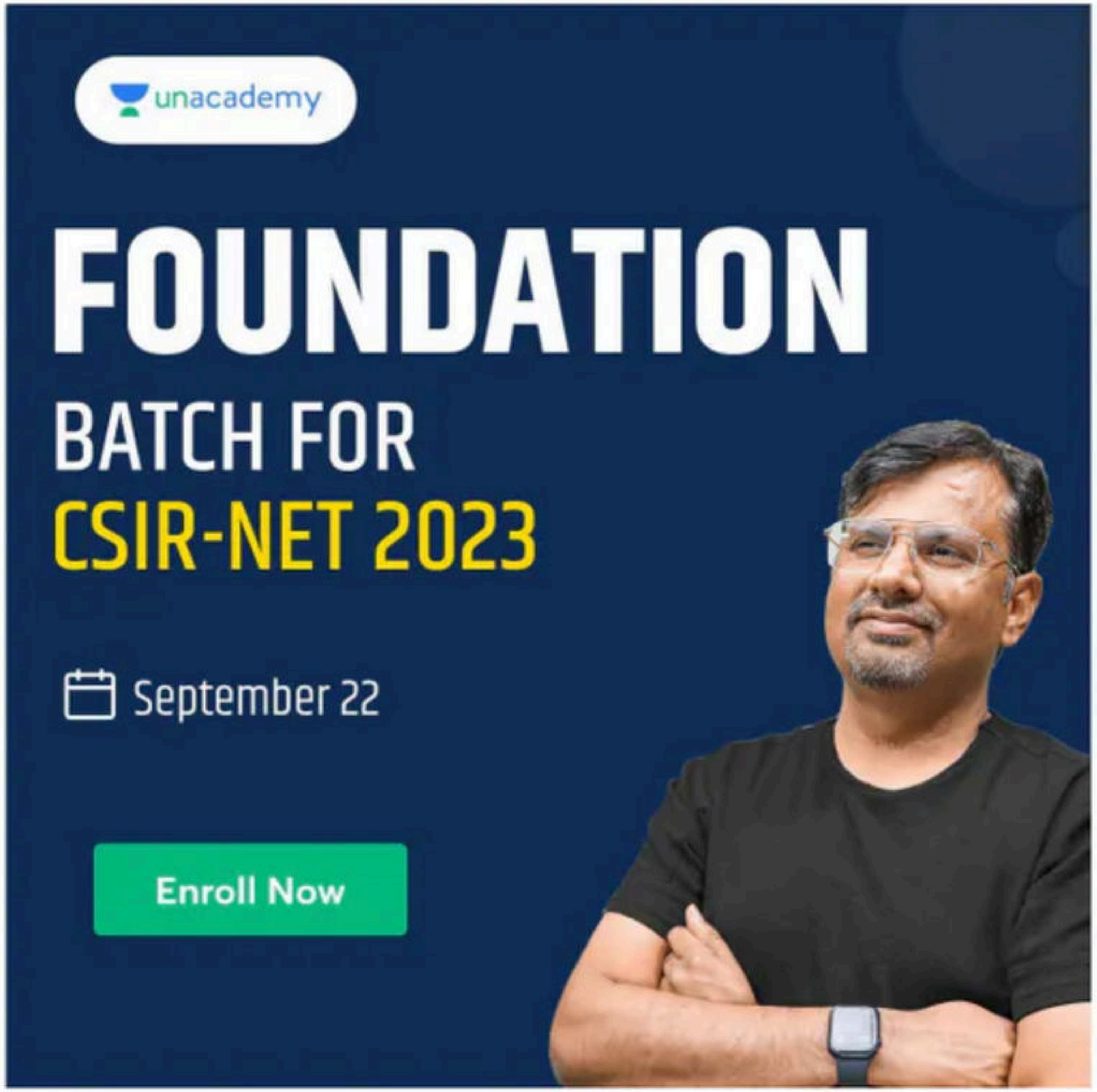
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Bases & Dimension

Basis of vector space : A subset 'S' of a vector space V(F) is said to be basis of V(F), if

(i) S consist of LI vectors.

(ii) L(S) = V i.e. each vector in V is a linear combination of a finite number of element of S.

Dimension : Let V(F) be a vector space over F then number of elements in basis of V(F) is called dimension of V(F)

Finitely generated & infinitely generated vector space :

If dimension of any vector space is finite then this type of vector space is called finitely generated vector space. Otherwise it is infinitely generated vector space.

Result : Number of LI arbitrary in V constant is dimension of V

Q.1. Let us define a sequence $(a_n)_{n \in N}$ of real number to be a Fibonacci like sequence if $a_n = a_{n-1} + a_{n-2}$ for $n \geq 3$. What is the dimension of the R-vector space of Fibonacci like sequence?

(a) 1 (b) 2

(c) Infinnite & countable

(d) Infinite & uncountable

Some Important Example :

(1) Let V = $C^n(C)$/ $R^n(R)$

Results :

$$W=\{(a_1,a_2,\dots,a_n)\,|\,'k'\ LI\ condition\}\text{then } \mathrm{Dim}W = n - k$$

(b) $W_2=\left\{(a_1,a_2,\dots,a_n)\,|\,\sum_{i=1}^{n} ia_i=0\right\}$ then $\mathrm{Dim}W_2 = n - 1$

(a) $W_1 = \left\{(a_1, a_2, \ldots, a_n) \mid \sum_{i=1}^{n} a_i = 0\right\}$ then $\text{Dim}W_1 = n - 1$

(b) $W_2 = \left\{(a_1, a_2, \ldots, a_n) \mid \sum_{i=1}^{n} i a_i = 0\right\}$ then $\text{Dim}W_2 = n - 1$

(c) $W_3 = \{(a_1, a_2, \ldots, a_n) \mid a_{2i} = 0\}, i = 1, 2, \ldots \left\lfloor \frac{n}{2} \right\rfloor$

then $\text{Dim}W_3 = \left\lceil \frac{n+1}{2} \right\rceil$

(d) $W_4 = \{(a_1, a_2, \ldots, a_n) \mid a_i = 0 \text{ if } i|n\}, i = 1, 2, \ldots, n$

then $\text{Dim } W_4 = n - \tau(n)$

(2) Let $V = C^n(R)$

(a) $W_1 = \left\{(a_1, a_2, \ldots, a_n) \mid \sum_{i=1}^{n} a_i = 0\right\}$ then $\text{Dim}W_1 = 2(n-1)$

(b) $W_2 = \left\{(a_1, a_2, \ldots, a_n) \mid \sum_{i=1}^{n} i a_i = 0\right\}$ then $\text{Dim}W_2 = 2(n-1)$

(c) $W_3 = \{(a_1, a_2, \ldots, a_n) \mid a_{2i} = 0\}, i = 1, 2, \ldots \left\lceil \frac{n+1}{2} \right\rceil$

then $\text{Dim}W_3 = 2\left\lceil \frac{n+1}{2} \right\rceil$

(d) $W_4 = \{(a_1, a_2, \ldots, a_n) \mid a_i = 0 \text{ if } i/n\}, i = 1, 2, \ldots, n$

then $\text{Dim } W_4 = 2(n - \tau(n))$

(3) Let V = $C^{m\times n}(C)$/ $R^{m\times n}(R)$

(a) $W_1 = \left\{[a_{ij}] \mid \sum_{j=1}^{n} a_{ij} = 0, i = 1,2,\dots,m\right\}$ then Dim W_1 = mn – m

(b) $W_2 = \left\{[a_{ij}] \mid \sum_{i=1}^{m} a_{ij} = 0, j = 1,2,\dots,n\right\}$ then Dim W_1 =mn – n

(c) $W_3 = \{[a_{ij}] \mid a_{ij} = 0 \; if \; i \mid n\}$ then Dim W_3 = mn – n.τ(m)

(d) $W_4 = \{A = [a_{ij}]_{n\times n} / Tr(A) = 0\}$ then Dim W_3 = $n^2 - 1$

(e) $W_5 = \{A = [a_{ij}]_{m\times n} / A^T = A\}$ then Dim $W_3 = \dfrac{n(n+1)}{2}$

(f) $W_6 = \{A = [a_{ij}]_{m\times n} / A^T = -A\}$ then Dim W₃ $= \dfrac{n(n-1)}{2}$

(g) $W_7 = \{A = [a_{ij}]_{n\times n} / \text{A is upper triangle}\}$

then Dim $W_3 = \dfrac{n(n+1)}{2}$

(h) $W_8 = \{A = [a_{ij}]_{n\times n} / \text{A is diagonal}\}$ then Dim $W_3 = n$

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(4) Let V = R[x]

(a) $W_1 = \{p(x) / \deg(p(x)) \leq n\}$ then Dim $W_3 = n + 1$

(b) $W_5 = \{p(x) \in F_n[x] / p(\alpha) = 0, \alpha \in F\}$ then Dim $W_3 = n$

(c) $W_7 = \{p(x) \in F_n[x] / p(x) = p(1 - x)\}$

then Dim $W_3 = \left[\frac{n}{2}\right] + 1$

(d) $W_8 = \{p(x) \in F_n[x] \mid p(\alpha) = p(\beta)$ then $\text{Dim} = n$

(e) $W_{11} = \{p(x) \in F_n[x] \mid p(x) = p(-x)\}$

Q.1 Let V be the vector space of all 6×6 real matrices then dimension of subspace of V consisting of all symmetric matrices is

(a) 15 (b) 18

(c) 21 (d) 35

Q.2. Let V denote the vector space of real valued continuous functions on the closed interval [0, 1]. Let W be the subspace of V spanned by $\{\sin(x), \cos(x), \tan(x)\}$. Then the dimension of W over R is

(a) 1 (b) 2

(c) 3 (d) infinite

Q.3. Let $M_2(R)$ be the vector space of 2×2 real matrices. Let V be a subspace of $M_2(R)$ defined by

$$V = \left\{ A \in M_2(R); A\begin{bmatrix} 0 & 2 \\ 3 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ 3 & 1 \end{bmatrix} A \right\}$$

Then the dimension of V is

(a) 1 (b) 2

(c) 3 (d) 4

Q.4. Consider the following subspace of R^3

$$W = \{(x, y, z) \in R^3 \mid 2x + 2y + z = 0, 3x + 3y - 2z = 0, x + y - 3z = 0\}$$

Then dimension of W is

(a) 0 (b) 1

(c) 2 (d) 3


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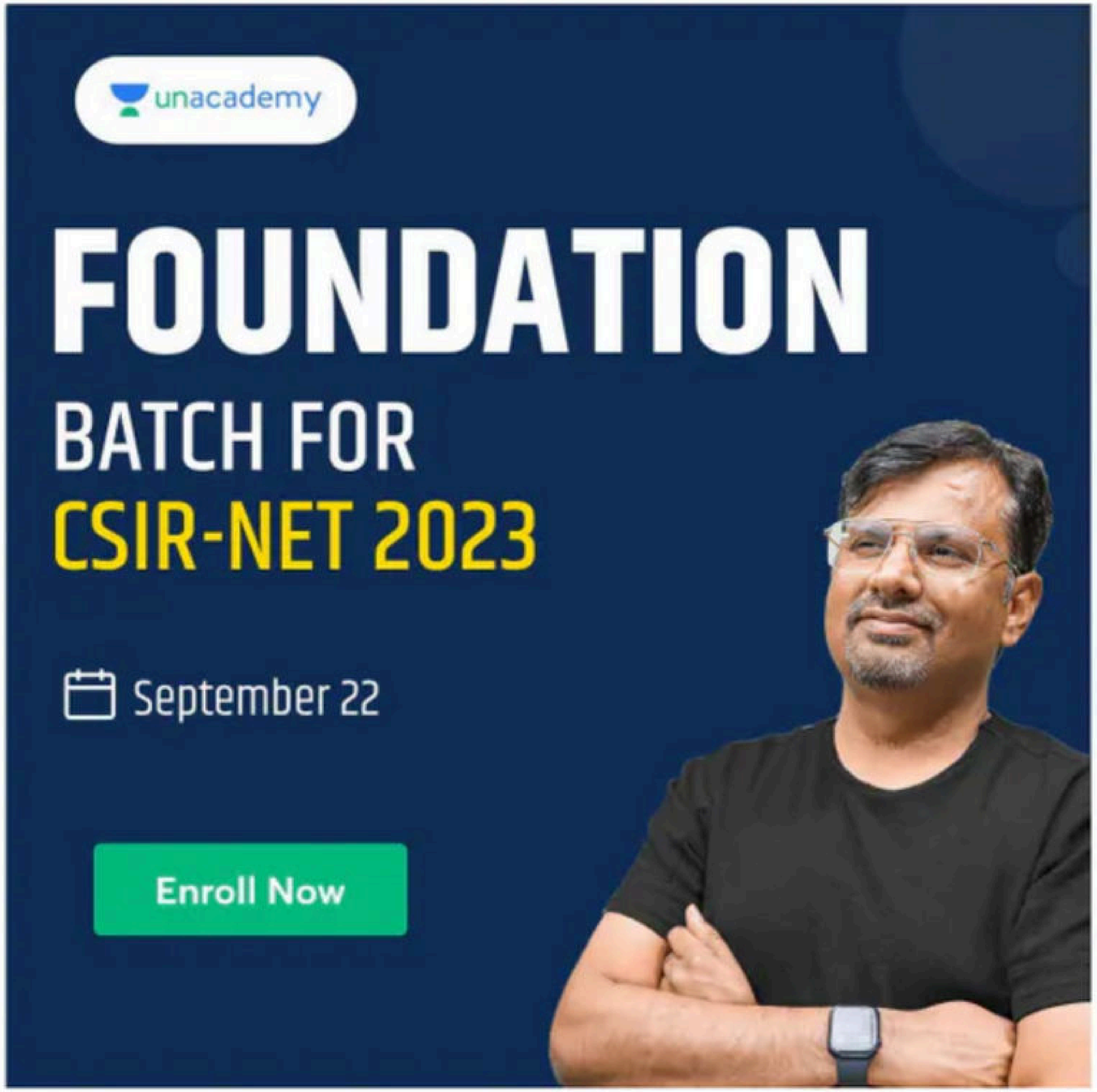
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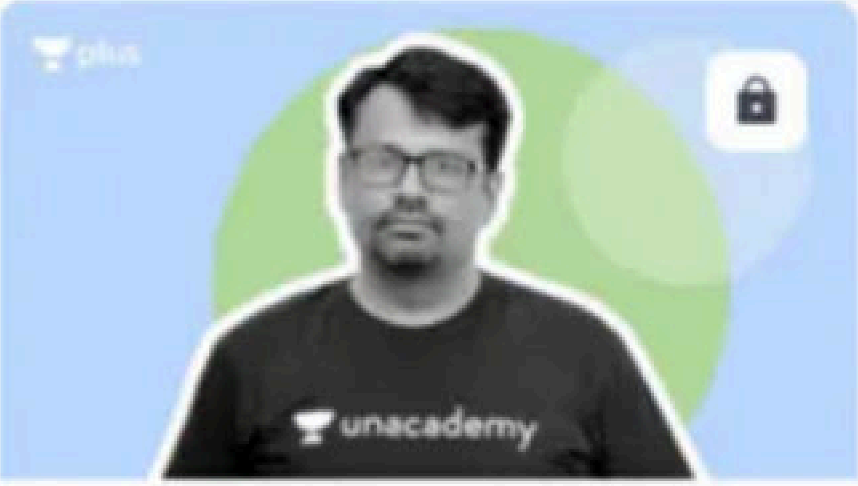

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