

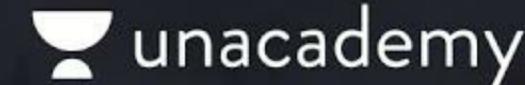
GATE 2021

GENERAL APTITUDE

धमाकेदार ट्रिक के साथ 🔥🔥

**NUMBER SYSTEM -6, DIVISIBILITY
RULE, REMAINDER THEOREM**

23



AVINASH SIR

AVINASH SINGH SIR

GATE | EE (CE)



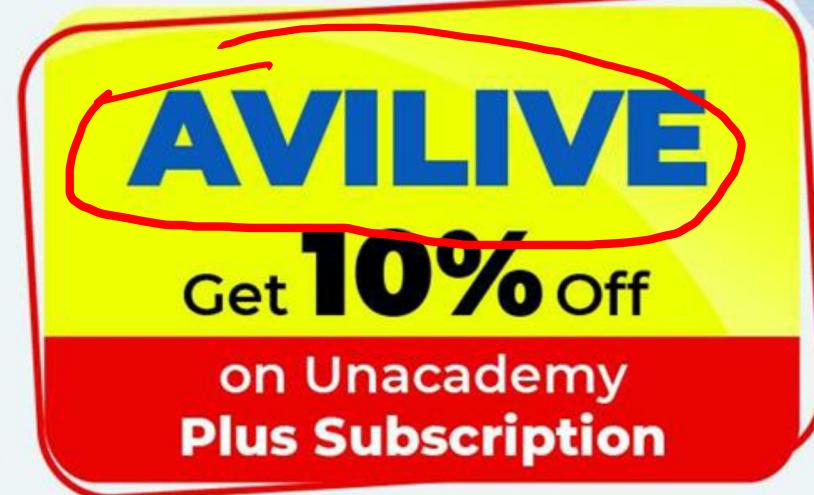
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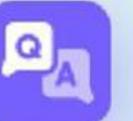
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Home Work Question

How many numbers of zeros are there in following expression?

$$2^{11} \times 125^3 \times 7^{11} + 3^{11} \times 7^{11} \times 2^{10} \times 5^1 + 11^{12} \times 2^{13} \times 5^{125}$$

9 zero

13 zero

13 zeros

13 zeros

$$\begin{array}{r} 9 \\ \overbrace{0 \cdot 0 \cdots 0}^{\text{9}} \\ + \\ \cdots \square \square 0 \\ \hline \square 0 \end{array}$$

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What will study in
Number System?

- Classification of number
- Sum of series
- Concept of LCM & HCF
- Concept of Unit digit
- Reminder theorem
- Divisibility Rule
- Factorization
- Factorial
- Bases & Base conversion

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Today's Class Agenda

✓ Remainder

✓ Remainder Theorem

✓ Divisibility Rule

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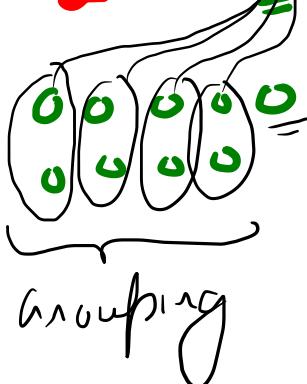
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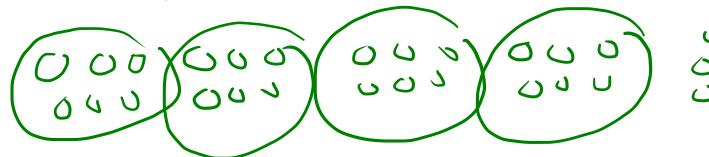
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Reminder

$$\frac{9}{2} = 4 R 1$$



$$\frac{27}{6} = 4 R 3$$



Division

$$9 = 2 \times 4 + 1$$

Dividend Quotient Remainder

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Concept of negative Remainder:-

$$\frac{9}{2} \mid_R = 1 \text{ or } -1$$

Diagram: A red circle containing the number 9 is divided into two equal halves by a vertical line. The left half is labeled "0" and the right half is labeled "1".

$$\frac{27}{6} \mid_R = 3 \text{ or } -3$$

Diagram: A red circle containing the number 27 is divided into six equal circles. Each small circle contains a "3". Below these six circles, there are three more small circles, each containing a "0".

$$\frac{72}{10} \mid_R = 2 \text{ or } -8$$

Diagram: A red circle containing the number 72 is divided into ten equal circles. Each small circle contains a "2". Below these ten circles, there are two more small circles, each containing a "0".

$$\frac{11}{8} \mid_R = 7 \text{ or } -1$$

Ex: $\frac{273}{11} \mid_R = 9 \text{ or } -2$

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Remainder Theorem

$$\textcircled{1} \quad \frac{\cancel{73} + \cancel{23}}{5} \Big|_R = \frac{3+3}{5} \Big|_R = \frac{6}{5} \Big|_R = \textcircled{1}$$

$$\textcircled{2} \quad \frac{\cancel{73} \times \cancel{23}}{5} \Big|_R = \frac{3 \times 3}{5} \Big|_R = \frac{9}{5} \Big|_R = \textcircled{4}$$

$$\textcircled{3} \quad \frac{\cancel{73} - \cancel{23}}{5} \Big|_R = \frac{3-3}{5} \Big|_R = \frac{0}{5} \Big|_R = \textcircled{0}$$

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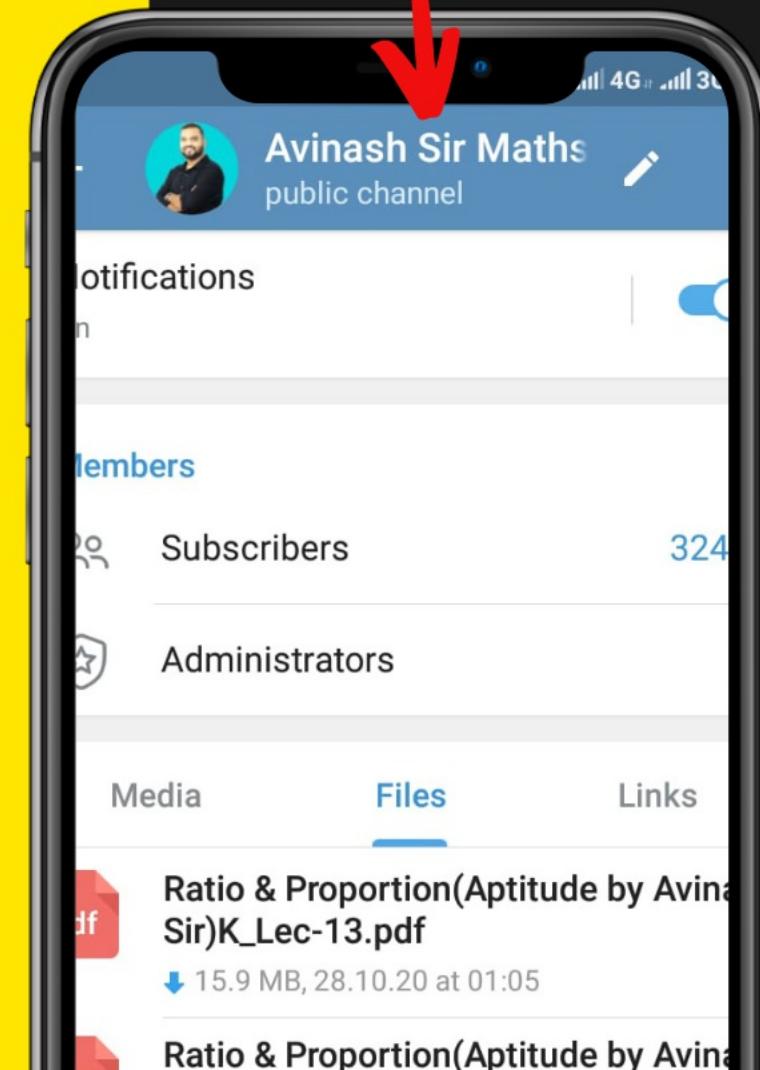


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Ex

$$\frac{(94)^5}{19} \Big|_R = \frac{94 \times 94 \times 94 \times 94 \times 94}{19} \Big|_R = \frac{(18)^5}{19} \Big|_R = \frac{324 \times 324 \times 18}{19} \Big|_R$$

→

$$= \frac{(-1)^5}{19} \Big|_R = \frac{-1}{19} \Big|_R = \underline{\underline{-1}} \text{ or } \underline{\underline{18}}$$
$$= \frac{1 \times 1 \times 18}{19} \Big|_R = \underline{\underline{18}}$$

$$\frac{94}{19} = 18 \text{ or } -1$$



1) If p is prime number greater than 3, then what would be remainder if p is divided by 6?

A) 1

B) 5

C) 5 or 1

D) NOTA

Prime Number $\geq 3 \Rightarrow \underline{6n+1} \text{ or } \underline{6n-1}$

$$\frac{6n+1}{6} \Big|_R = \frac{0+1}{6} \Big|_R = [1]$$

$$\frac{6n-1}{6} \Big|_R = \frac{0-1}{6} \Big|_R = [-1] \text{ or } [5]$$

or

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2) The remainder when 5^{20} is divided by 7 is:

(A)-1

(B) 4

(C) -4

(D) NOTA

$$\frac{5^{20}}{7} \mid_R = \frac{(5^2)^{10}}{7} \mid_R = \frac{(25)^{10}}{7} \mid_R = \frac{(4)^{10}}{7} \mid_R = \frac{(16)^5}{7} \mid_R = \frac{2^5}{7} \mid_R = \frac{32}{7} \mid_R = 4$$

$$\rightarrow \frac{(-2)^{20}}{7} \mid_R = \frac{2^{20}}{7} \mid_R = \frac{4^{10}}{7} \mid_R = \frac{16^5}{7} \mid_R = \frac{2^5}{7} \mid_R = \frac{32}{7} \mid_R = 4$$

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Remainder Theorem

Fact:-

$$\left[\frac{4}{6}|_R = 4, \frac{4^2}{6}|_R = 4, \frac{4^3}{6}|_R = 4, \dots, \frac{4^N}{6}|_R = 4 \right]$$
$$\left[\frac{9}{6}|_R = 3, \frac{9^2}{6}|_R = 3, \frac{9^3}{6}|_R = 3, \dots, \frac{9^N}{6}|_R = 3 \right]$$

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3) Find the remainder when $9^{400} + 9^{401} + 9^{402} + \dots + 9^{410}$ is divided by 6?

(A) 0

(B) 1

(C) 2

(D) 3

$$\frac{9^{400} + 9^{401} + 9^{402} + \dots + 9^{410}}{6} = R$$

$$\frac{3 + 3 + 3 + \dots + 3}{6} | R = \frac{3 \times 11}{6} | R$$

$$= \frac{33}{6} | R = 3 | R$$

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4) What is remainder when $7^7 + 7^{77} + 7^{777} + 7^{7777} + \dots + 7^{77777777}$ is divided by 8?

(A) -1

(B) 1

(C) 7

(D) 18

$$\frac{7}{8} \mid R = 7 \text{ or } -1$$

$$\frac{7^7 + 7^{77} + 7^{777} + 7^{7777} + \dots + 7^{77777777}}{8} \mid R$$

$$\frac{(-1)^7 + (-1)^{77} + (-1)^{777} + (-1)^{7777} + \dots + (-1)^{77777777}}{8} \mid R$$

$$\frac{(-1) + (-1) + (-1) + (-1) + \dots + (-1)}{8} \mid R$$

$$= \frac{(-1) \times 8}{8} \mid R = 0 \mid R$$

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Divisibility Rule

$$\frac{12}{2} \mid_R = 0$$

$$\frac{132\boxed{5}}{2} \mid_R = 1$$

$$\frac{133}{3} \mid_R = 1$$

$$\frac{13397989}{3} \mid_R$$

For 2

↳ unit digit

Ex: $\frac{127523\boxed{9}}{2} \mid_R = 1$

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For 3

Sum of digits

Eg $\frac{123459}{3} \mid R = \frac{1+2+3+4+5+9}{3} \mid R = \frac{29}{3} \mid R = 0$

For 9

Sum of digit

$$\frac{23578}{9} \mid R = \frac{2+3+5+7+8}{9} \mid R = \frac{25}{9} \mid R = 7$$

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For 4

↳ Last two digit

$$\text{Q.E.D.} \quad \frac{1794\boxed{78}}{4} \Big|_R = 2$$

$$\frac{9824799\boxed{99}}{4} \Big|_R = 3$$

For 8

↳ Last three digit

$$\text{Q.E.D.} \quad \frac{2947\boxed{865}}{8} \Big|_R = 1$$

For 5

↳ last digit

$$\frac{247978\square}{5} \mid_R = 3$$

$$\frac{75987654320\square}{5} \mid_R = 0$$

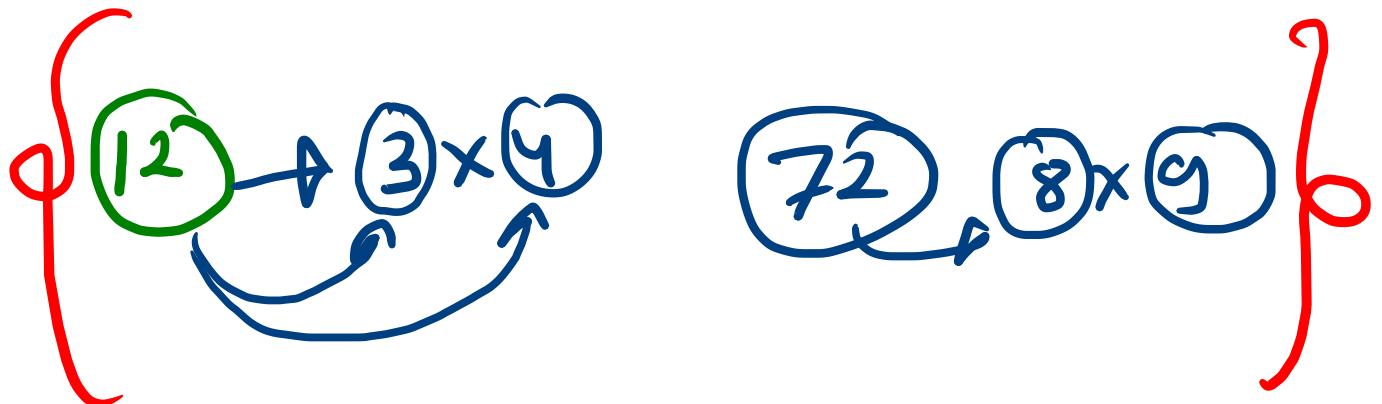
For 6

$$6 = 2 \times 3$$

For 11 → $\frac{(\text{Sum of odd place digit}) - (\text{Sum of even place digit})}{11}$

e.g.

$$125294328 \mid_R = \frac{(1+5+9+3+8) - (2+4+2+1)}{11} \mid_R = \frac{26 - 14}{11} = \frac{12}{11} \mid_R = 10 \mid_R$$



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5) If the number 87543X is divisible by 3, then find how many possible values can X take.

A) 3

B) 4

C) 2

D) NOTA

$$\begin{array}{r} 87543X \\ \hline 3 \end{array} \mid_R = 0$$

$$x = \begin{matrix} \checkmark & \cancel{x}, \cancel{3}, \checkmark & \cancel{x}, \cancel{x} \\ 0, & 1, & 3, & 6, & 9 \end{matrix}$$

$$\frac{8+7+5+4+3+x}{3} \mid_R = \frac{27+x}{3} \mid_R = \frac{0+x}{3} \mid_R = \frac{1}{3} \mid_R$$

$x \rightarrow 0, 3, 6, 9$

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6) How many values can 'X' take if the number 78765X4 is divisible by 12?

A) 2

B) 3

C) 4

D) 5

$$\frac{78765\boxed{X}4}{12} \mid R = 0$$

$$12 \rightarrow \underline{3} \times \underline{4}$$

For 4

$$\frac{X4}{4} \mid R = 0$$

$$X = \boxed{0, 2, 4, 6, 8}$$

For 3

$$\frac{7+8+7+6+5+X+4}{3} \mid R$$

$$\frac{37+1}{3} \mid R$$

$$DL = \cancel{0}, \checkmark 2, \cancel{4}, \cancel{6}, \cancel{8}$$

$$DL = \boxed{2, 8}$$

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**

7) If the number $18601X57Y$ is divisible by 72, Find the value of $(X + Y)$?

A) 6

B) 2

C) 8

D) 4

1WD -1

72 → (8) × (9)

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HW Q-2

Home Work Question

If the number $715X423$ is divisible by 3 (X denotes the missing digit in the thousandths place),
then the smallest whole number in the place of X is _____. [GATE 2018, 1 MARK (EC)]

- A) 0
- B) 2
- C) 5
- D) 6

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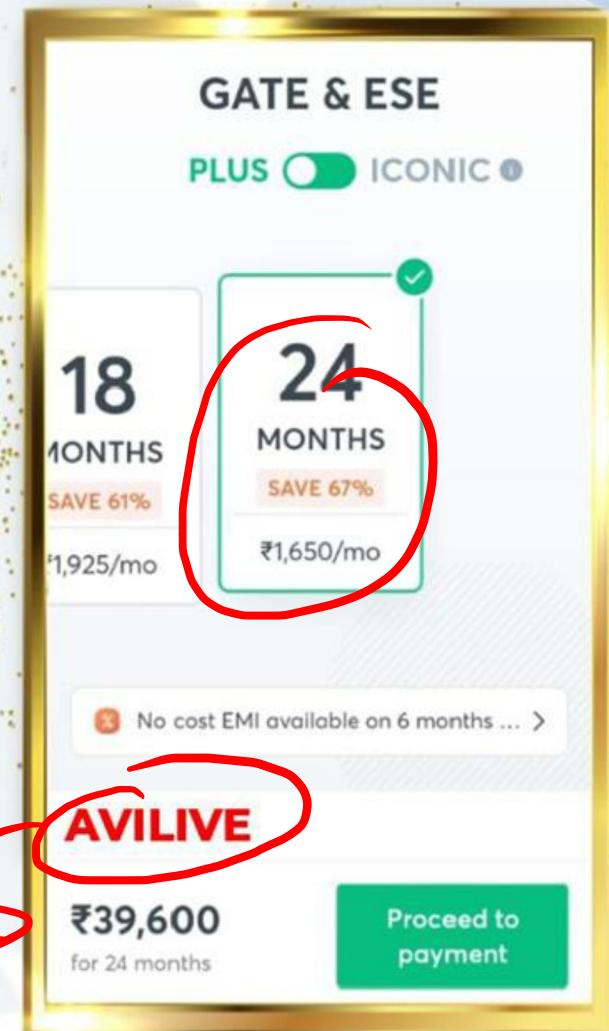
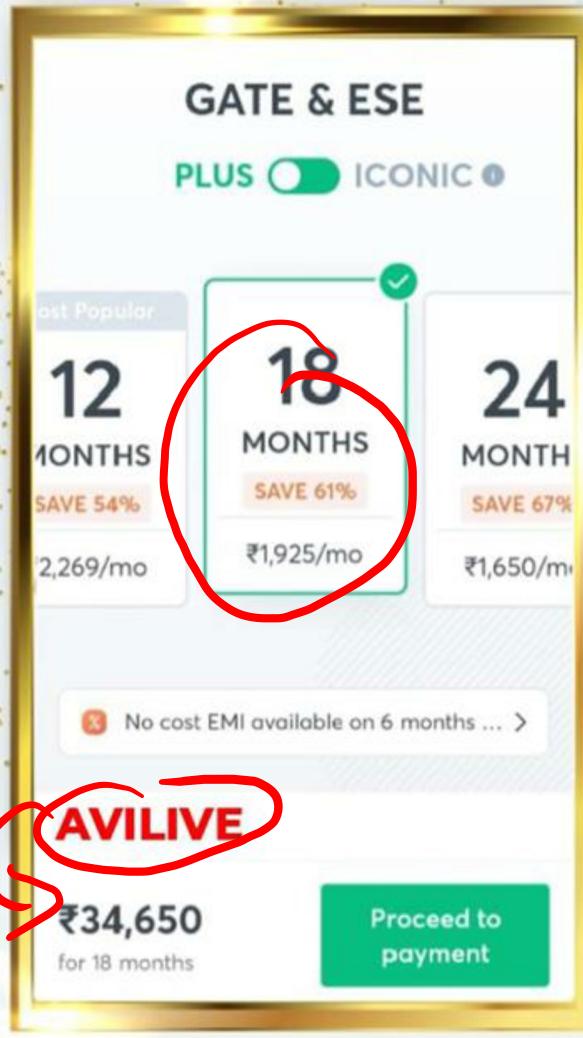
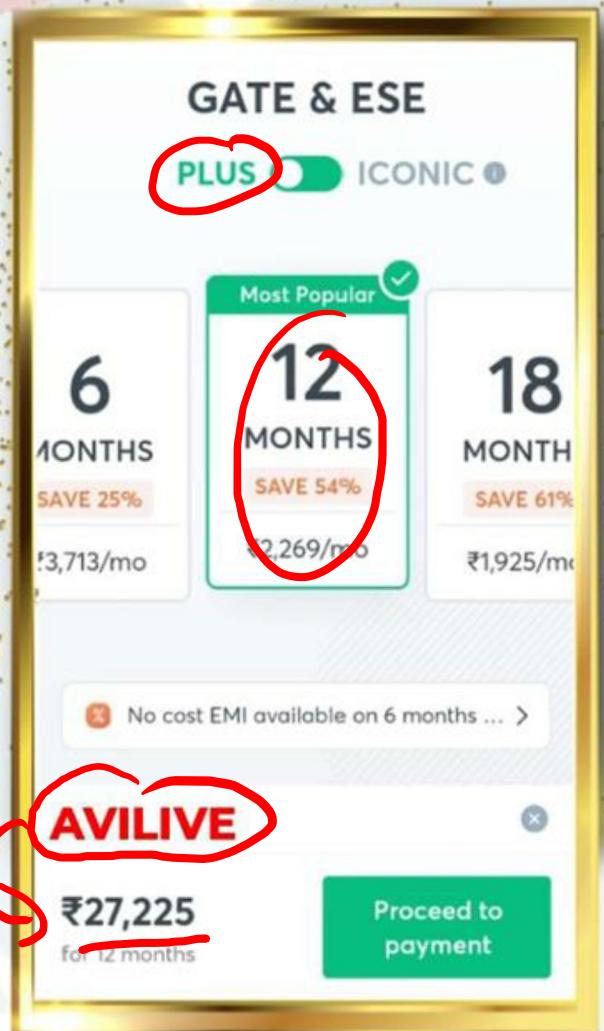
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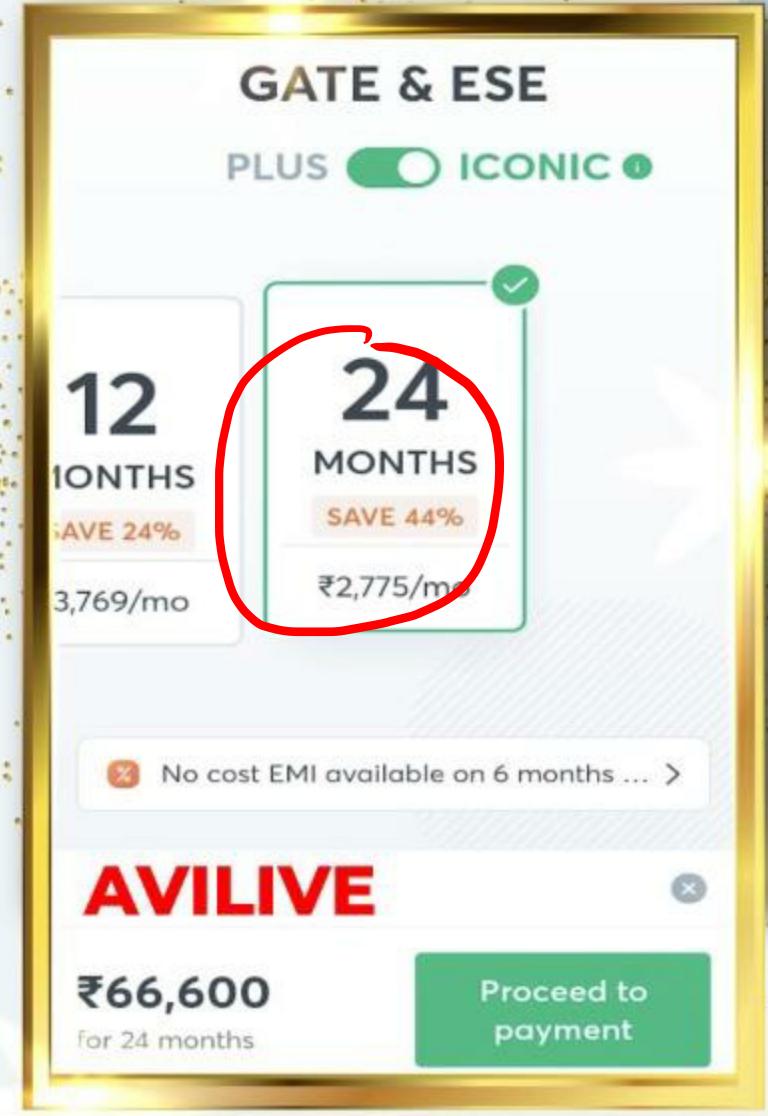
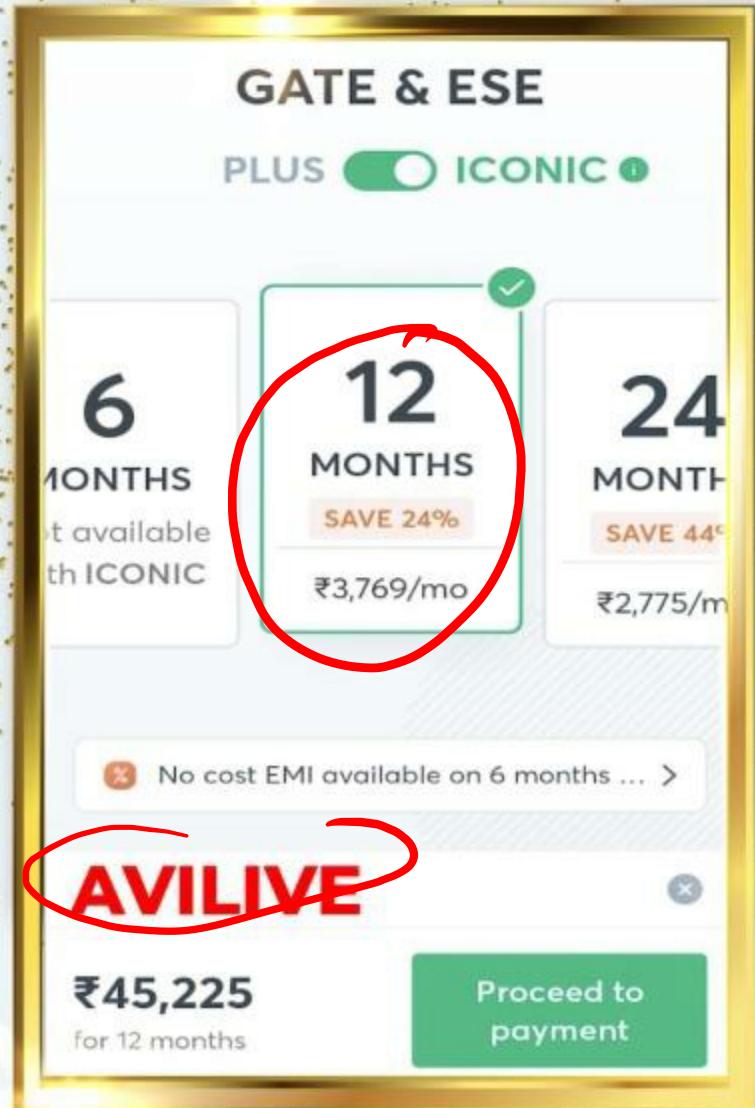
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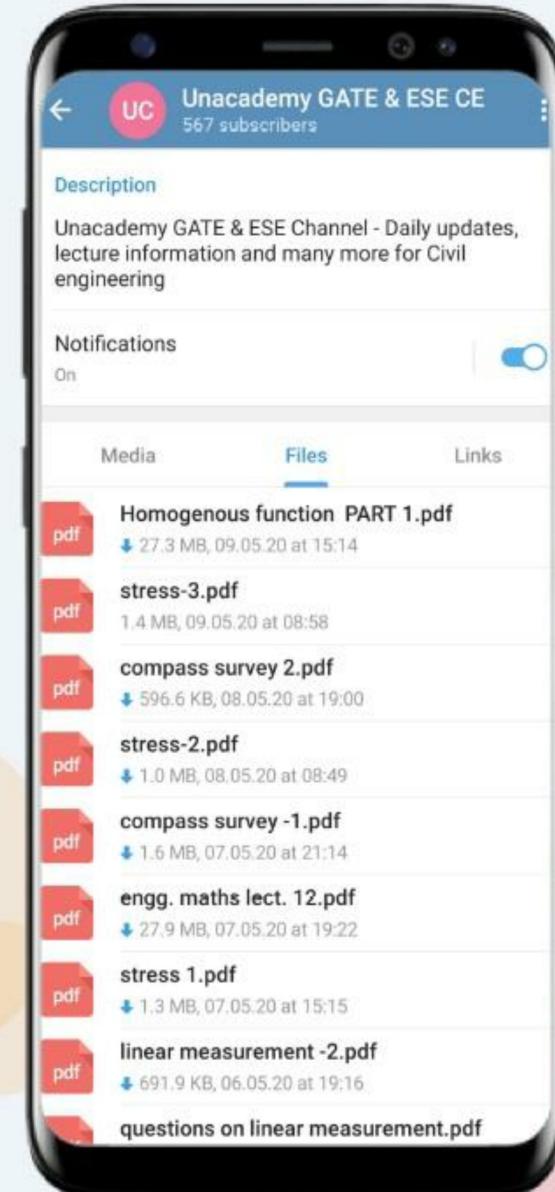
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