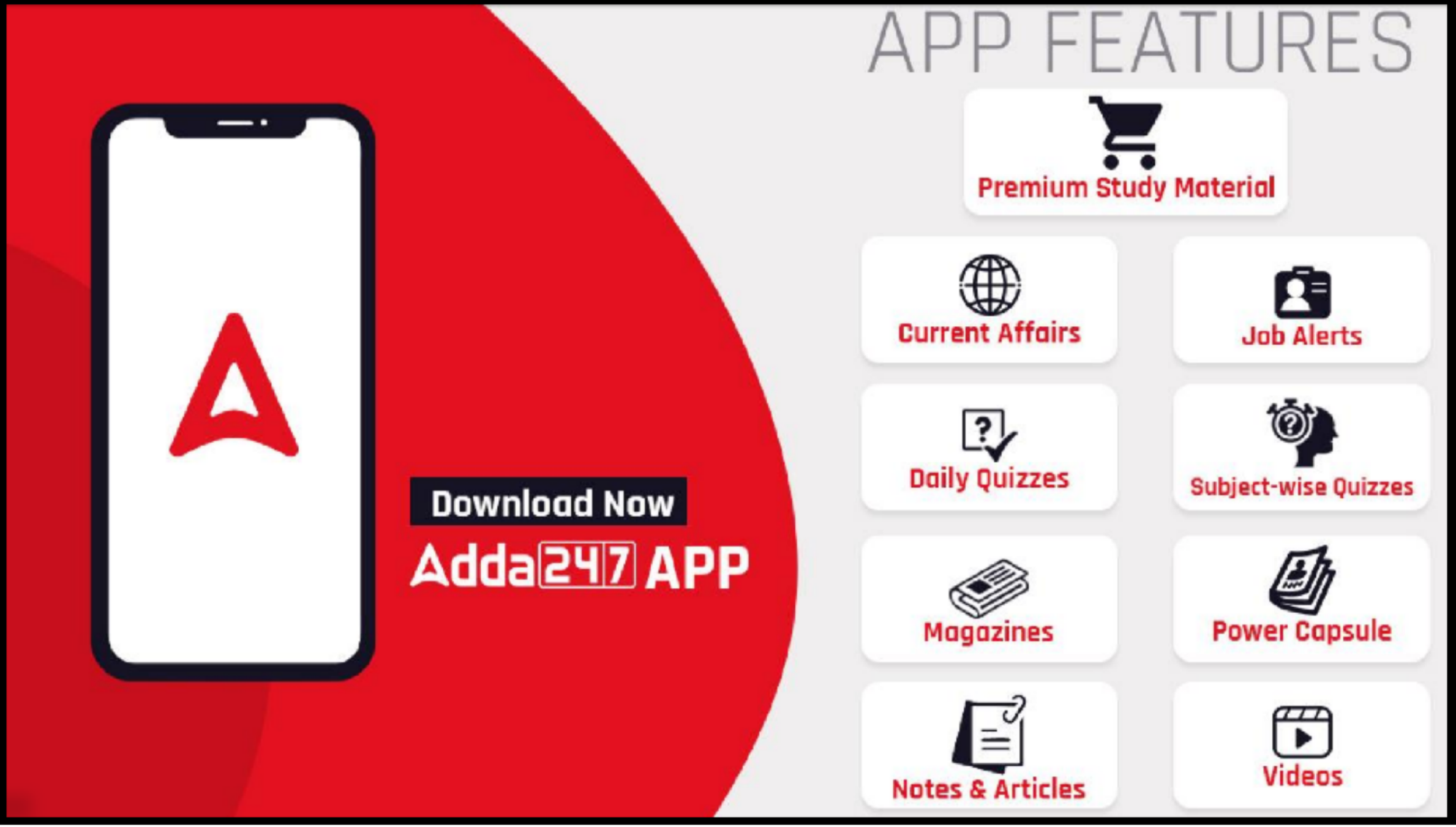
Today Topic is

Properties of Capacitor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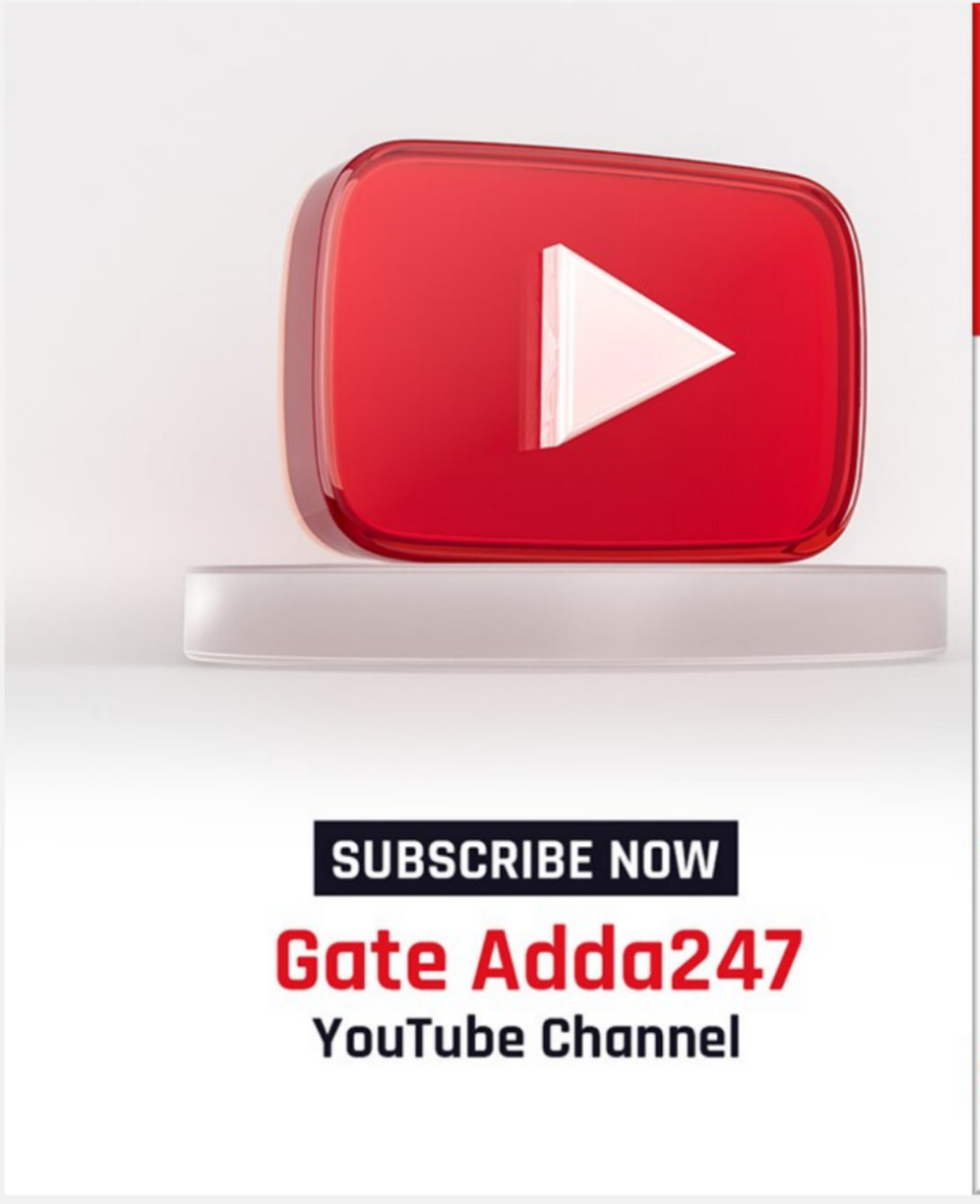

GATE 2023 RESULT

GATE

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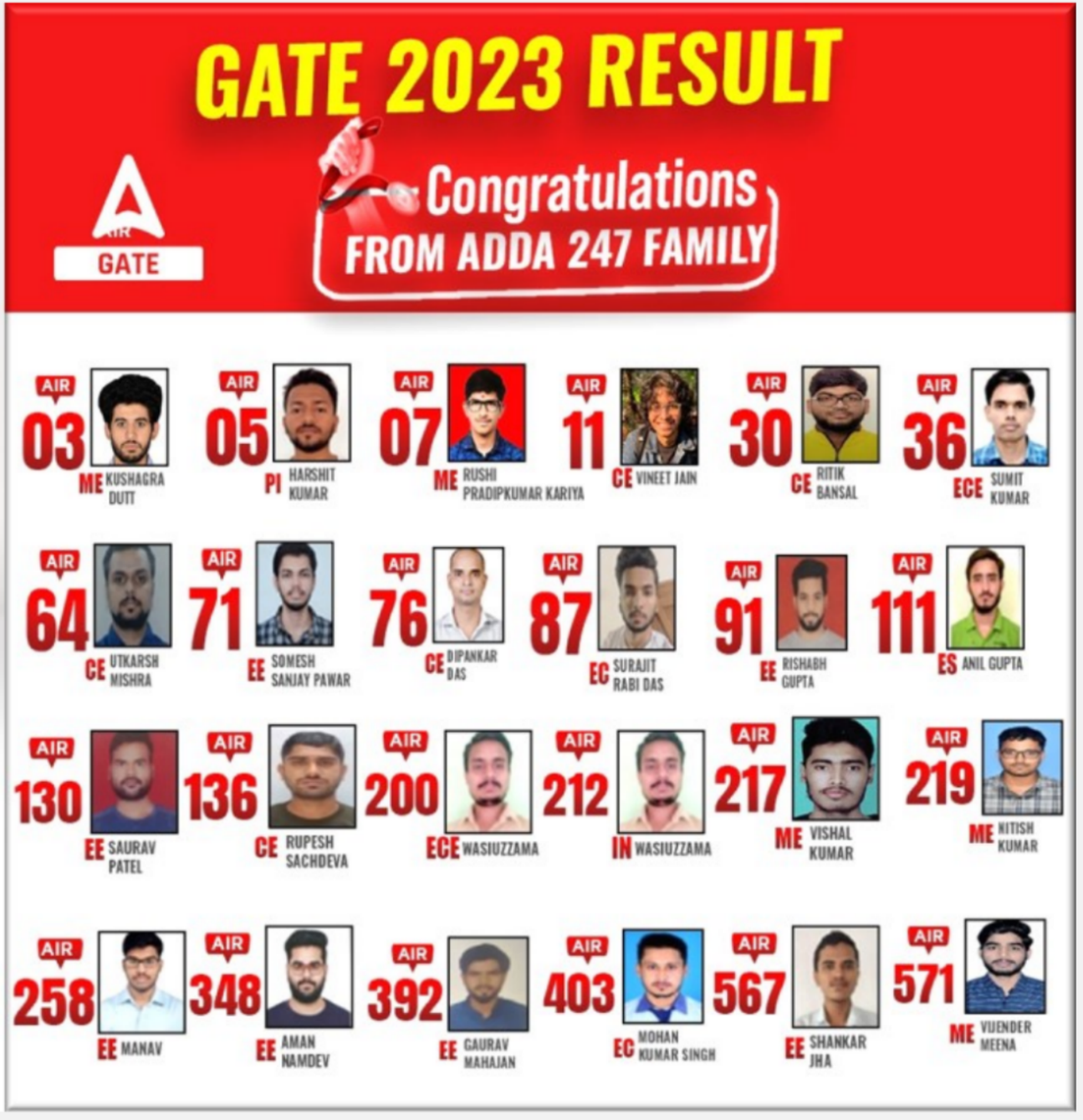


GATE 2024

Adda 247

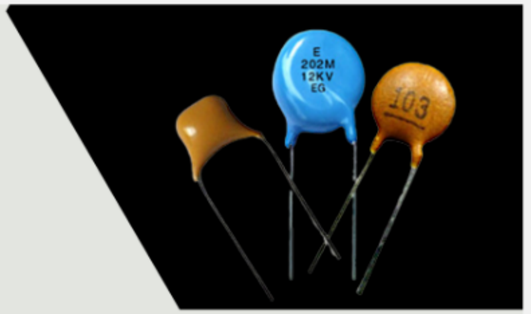
WELCOME TO GATE ADDA 247

TODAY TOPIC IS

PROPERTIES OF

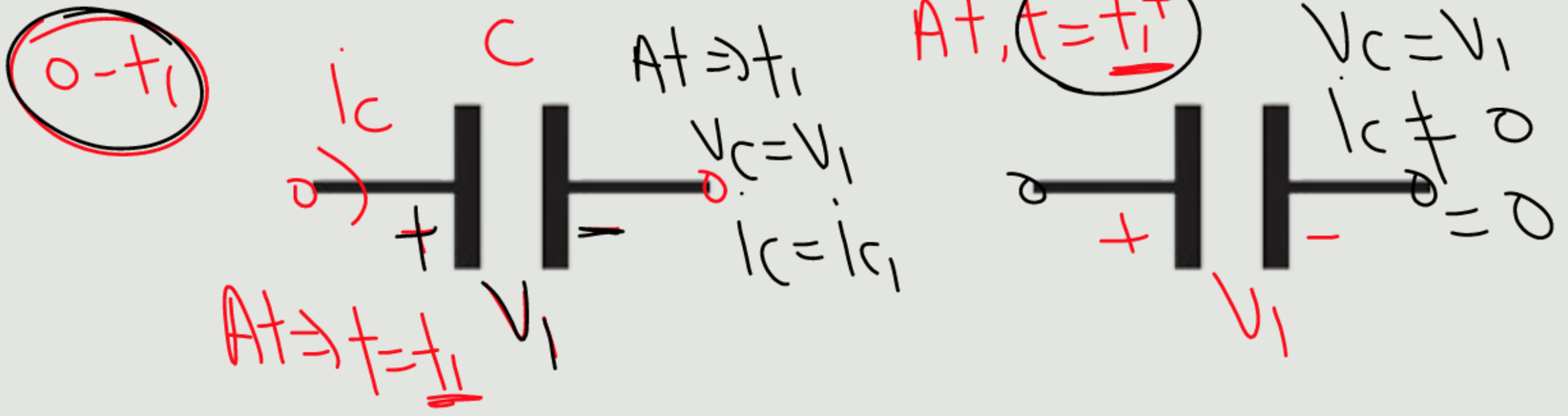
CAPACITOR

PROPERTIES OF CAPACITOR



1. CAPACITOR IS PASSIVE & ENERGY STORING ELEMENT
2. IT IS BILATERAL ELEMENT
3. CAPACITOR DOES NOT ALLOW SUDDEN CHANGE OF MAGNITUDE OF VOLTAGE

$i_C \neq 0$ Amp, when cap. is charging or discharging

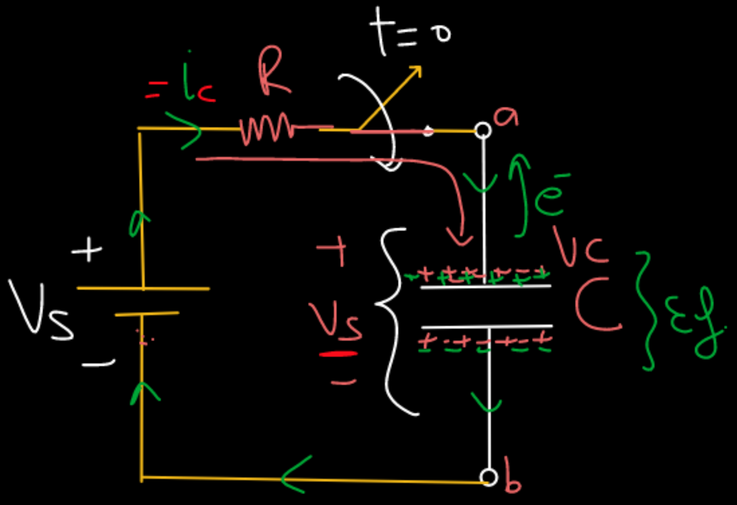


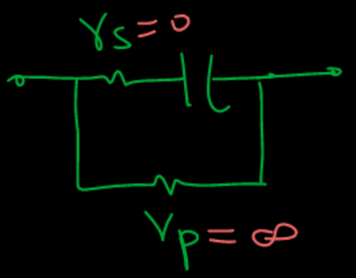
Capacitor

let, $q_{0^-} = 0\ C$

We know that, charge stored by cap.

$$q_{0^-} = C V_{C0^-}$$





if $q_{0^-} = 0\ C$

i.e $V_{C0^-} = 0\ V$.

The time instant at which, $V_C = V_s$ Volts

$i_C = 0$ Amp

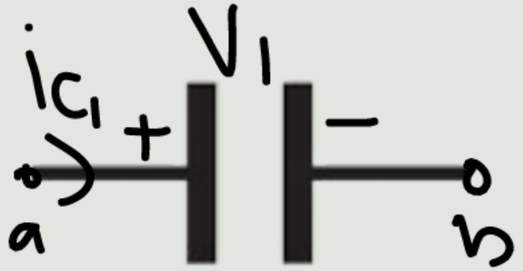
$$\Rightarrow [V_{C0^-} = V_{C0^+}]$$

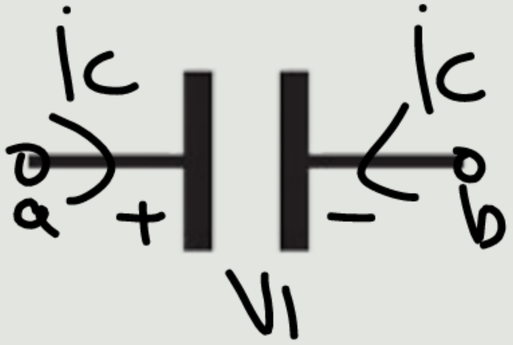
$$\therefore \boxed{V_C(t^-) = V_C(t^+)}$$

PROPERTIES OF CAPACITOR

4 CAPACITOR DOES NOT ALLOW SUDDEN CHANGE OF POLARITY OF VOLTAGE

At $t=t_1^-$

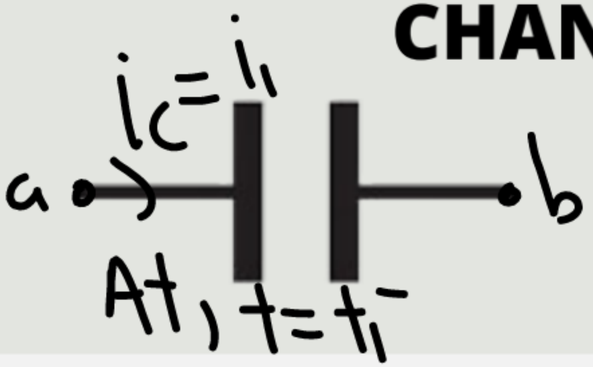




At $t=t_1^+$

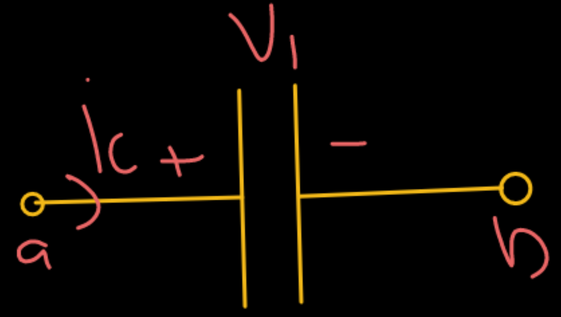
i_C ⇒ may or may not be zero

5 CAPACITOR'S CURRENT MAGNITUDE CAN CHANGE SUDDENLY

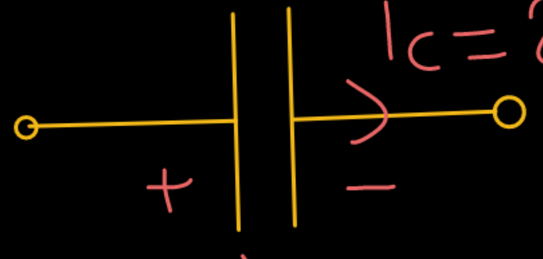


At, $t=t_1^+$

$$v_c\big|_{mag(t=t_1^-)} = v_c\big|_{mag(t=t_1^+)}$$

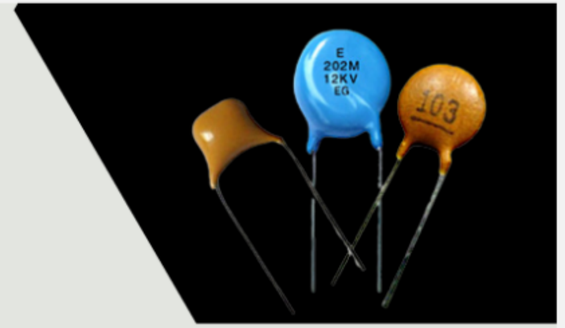


At, $t=t^1$

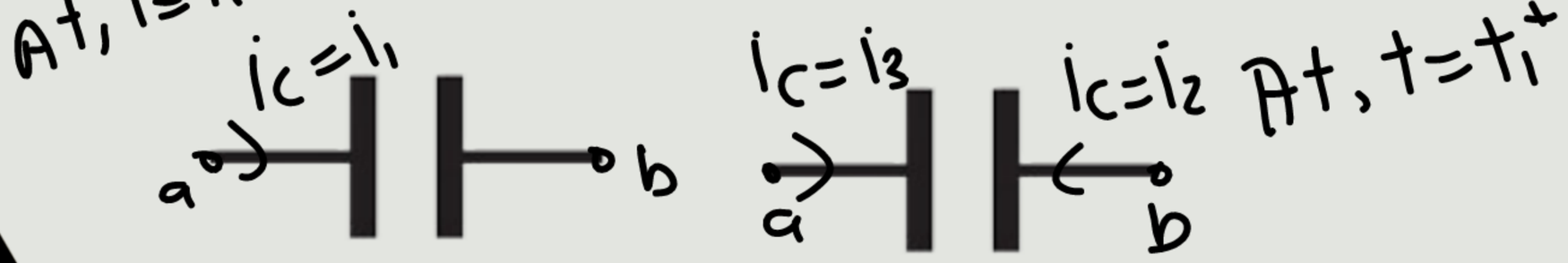


V_1 At, $t=t_1^+$

PROPERTIES OF CAPACITOR

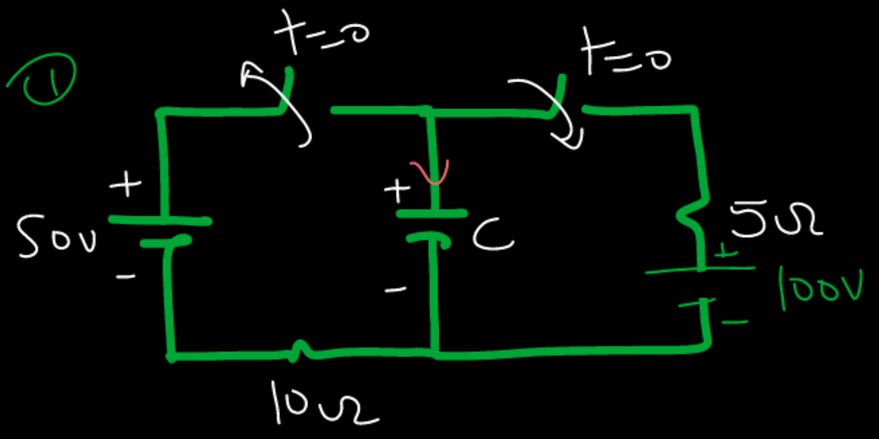


6 **CAPACITOR'S CURRENT DIRECTION CAN CHANGE SUDDENLY.**



7 **AN CAPACITOR CAN STORE ENERGY AND IT CAN DELIVER ACCORDING TO CIRCUIT NEED. SO CAPACITOR CAN BEHAVES AS A SOURCE OR LOAD DEPENDING UPON CIRCUIT CONDITION**

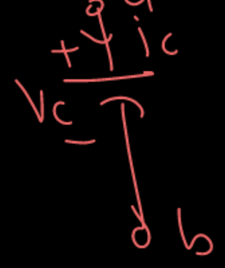
(i)



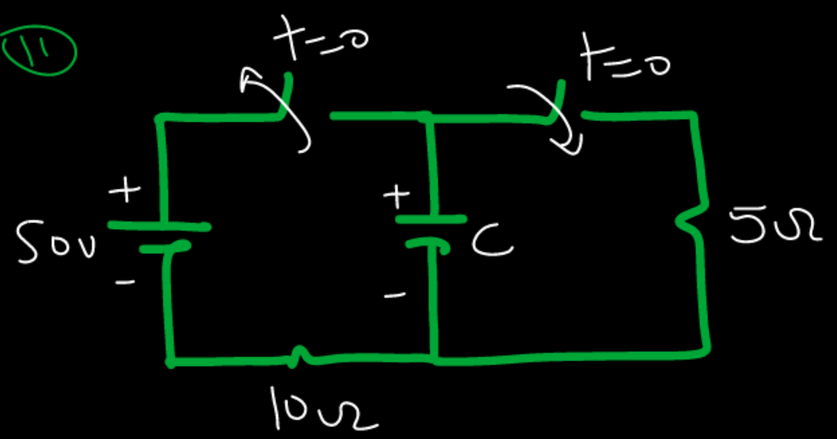
$t \geq 0$, cap. → load

$t \leq 0^-$

$t \geq 0$



(ii)

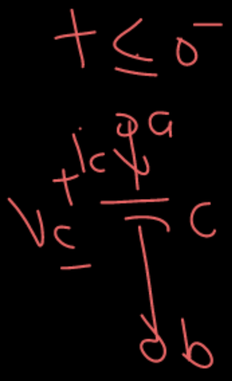


$V_{C0^-} = 50V$

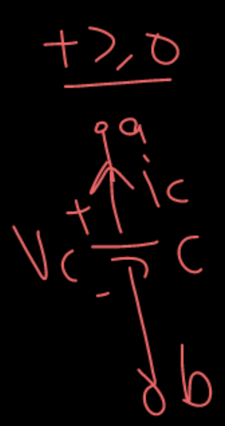
$t \geq 0$

cap → Source

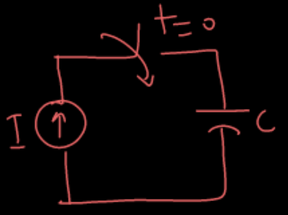
$t \leq 0^-$

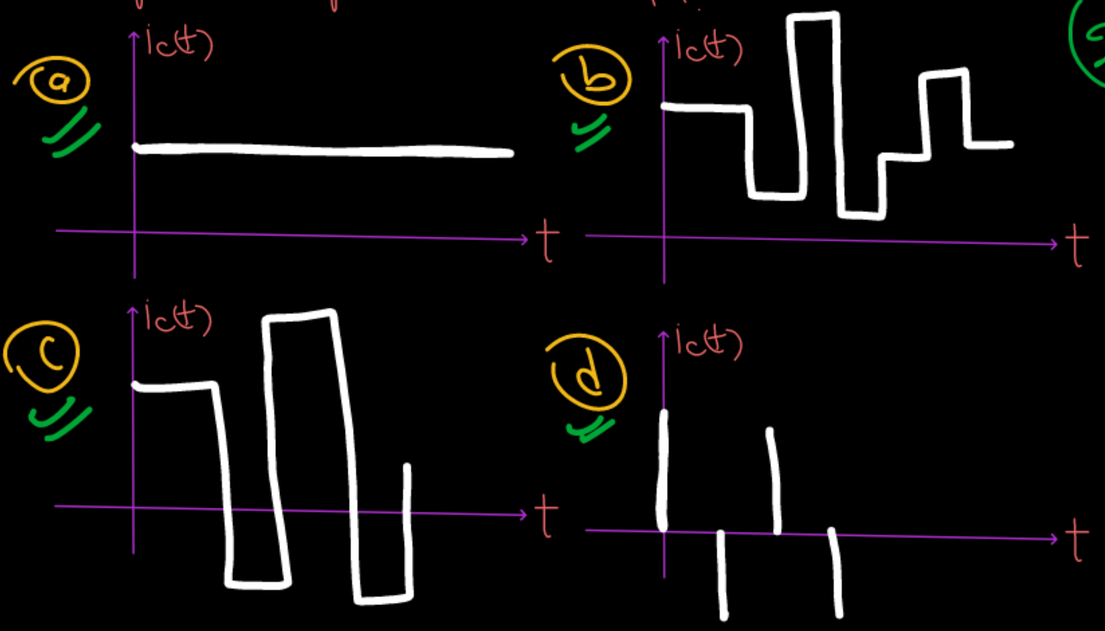


$t \geq 0$



ex- which of the following current respose, can represent capacitor's current ?

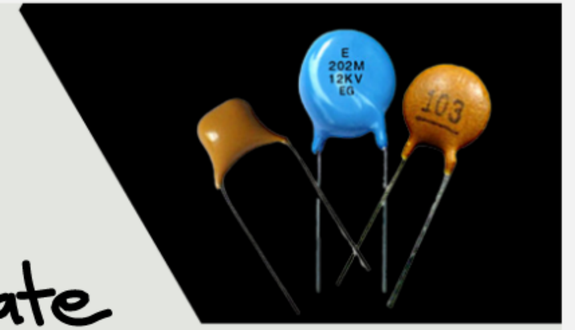




(2 mints)

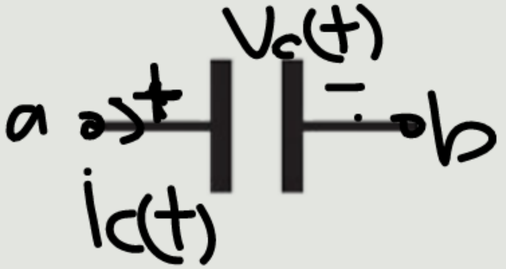
"After just switching, generally capacitor's Vol. magnitude and polarity will not change but The magnitude of capacitor's current and direction of capacitor's current can change."

PROPERTIES OF CAPACITOR



8 CAPACITOR'S POWER

we want to calculate ⇒ S.S. energy or instantaneous energy.

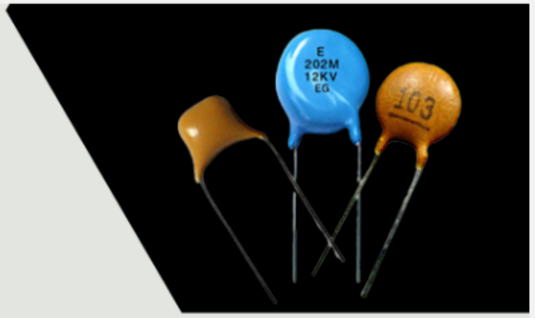


$$P_a = V_c(t) \times i_c(t)\ W$$

$$P_d = V_c(t) \times i_c(t) \cdot W$$

9 WHEN CHARGED CAPACITOR BEHAVES AS A SOURCE , GURANTEED IT WILL CHANGE ITS OWN DIRECTION OF CURRENT

PROPERTIES OF CAPACITOR



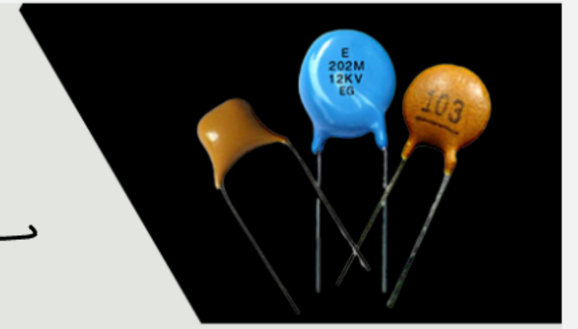
10 A FULLY CHARGED CAPACITOR BEHAVES AS A OPEN CIRCUIT IN DC CIRCUIT

11 AN UNCHARGED capacitor BEHAVES AS AN SHORT CIRCUIT

12 IN DC CIRCUIT CAPACITORS ARE NOT RESPONSIBLE FOR REACTIVE POWER , THEY ARE RESPOSIBLE FOR REAL POWER

13 IN AC CIRCUIT CAPACITORS ARE RESPONSIBLE FOR REACTIVE POWER , THEY ARE NOT RESPOSIBLE FOR REAL POWER

PROPERTIES OF CAPACITOR



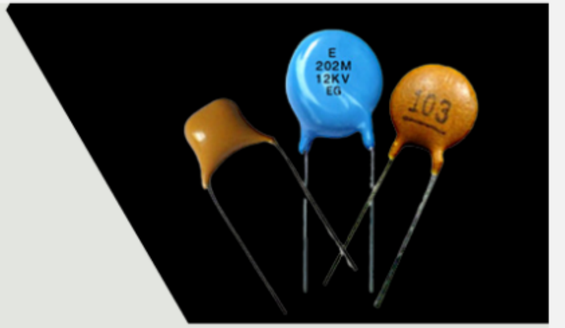
14 CAPACITOR CAN ALSO MAINTAIN ALMOST CONSTANT VOLTAGE FOR VARIABLE CURRENT .

15 CAPACITOR'S CURRENT MAY/MAYNOT BE ZERO FOR CONSTANT VOLTAGE .

16 IT IS GURANTEED THAT CAPACITOR WILL BEHAVE AS AN SHORT CIRCUIT AT

$$(t = -\infty)$$

PROPERTIES OF CAPACITOR

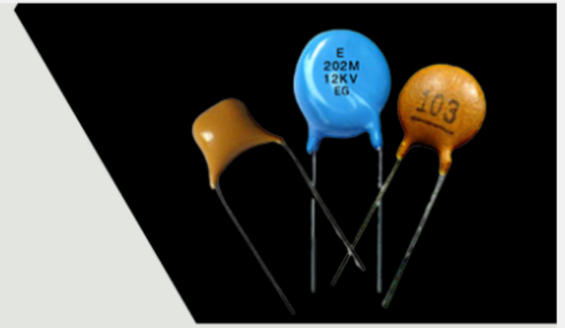


17 AN CAPACITOR MAY BE SHORT CIRCUIT OR OPEN CIRCUIT IN STEADY STATE IN DC CICUIT .

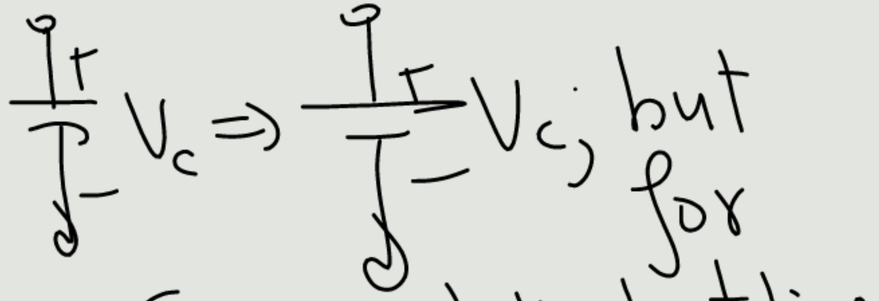
18 IN AC CIRCUIT CAPACITOR'S WILL NOT BE SHORT OR OPEN CIRCUIT .

19 TIME CONSTANT τ PALYS VERY IMPORTANT ROLE TO DEFINE TRANSIENT TIME

PROPERTIES OF CAPACITOR



20 **A FULLY CHARGED CAPACITOR IN DC CIRCUIT , CAN BEHAVE AS A CONSTANT DC VOLTAGE SOURCE.**

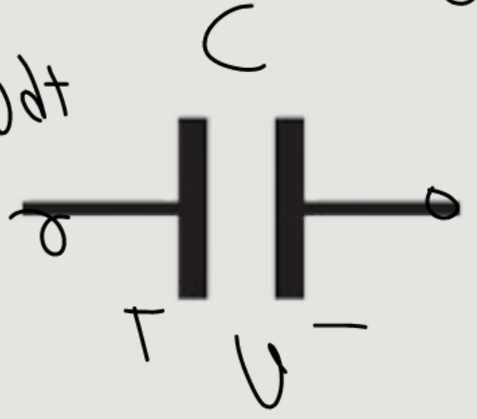


21 **ENERGY STORED BY CAPACITOR**

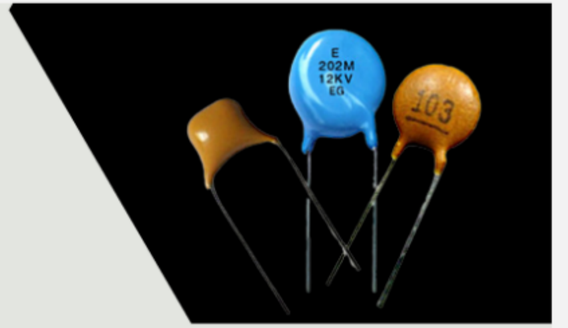
$$W = \int_t P(t)\,dt = \int_t V_c(t)\cdot i_c(t)\,dt$$

$$= \frac{1}{2} C V^2$$

$(W \propto V^2)$



PROPERTIES OF CAPACITOR

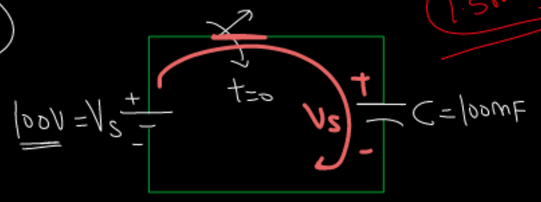


23

CAPACITOR'S VOLTAGE CAN CHANGE SUDDENLY IF AN IMPULSE CURRENT PASSES THROUGH THE CAPACITOR.

ex: The capacitor's voltage at $t = 0^+$ will be, for given circuit ? (1.5 mint)

if $V_{(0^-)} = 0$ Volts



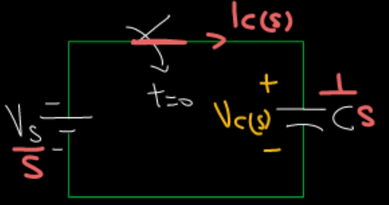
Solⁿ ⇒ $V_{(0^+)} = ?$

(a) 0V (b) 10V (c) 1000V (d) 100V

By ohm's law.

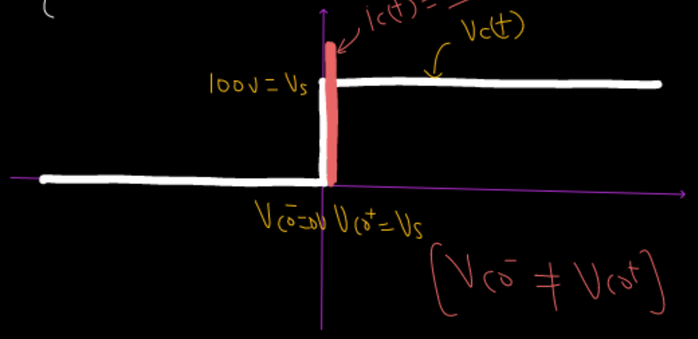
$V_{c(s)} = \frac{1}{Cs} \times I_{c(s)}$

$\frac{V_s}{s} = \frac{1}{Cs} I_{c(s)}$



$\therefore I_{c(s)} = C V_s$, take inv. lap. trafⁿ.

$\{i_c(t) = (CV_s)\delta(t)\}$



$[V_{(0^-)} \neq V_{(0^+)}]$