LABORATORIO DI FISICA SPERIMENTALE

Ingegneria meccanica

A.A. 2020-2021

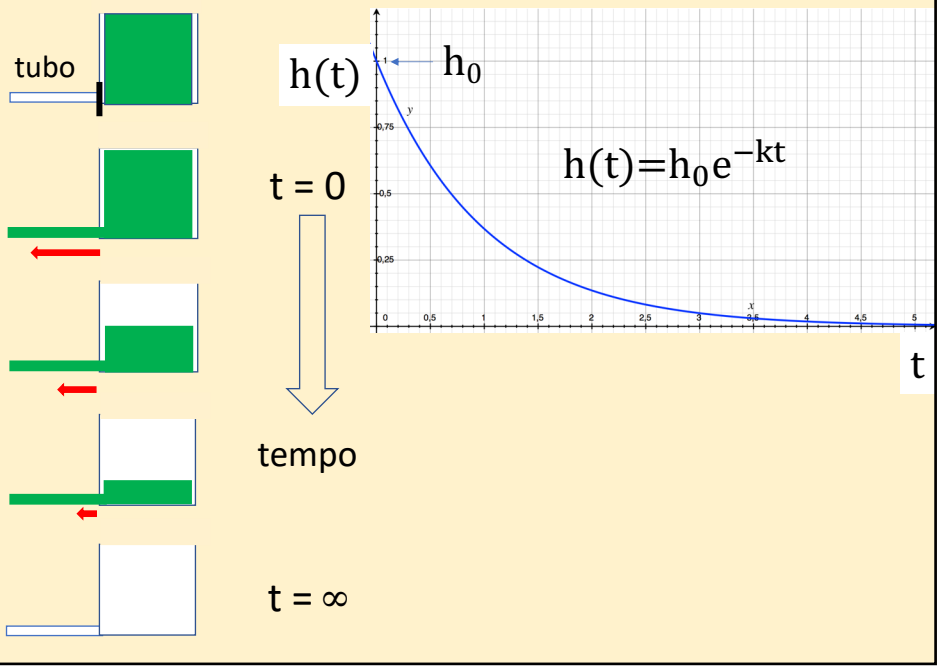
Nona esperienza:

andamenti esponenziali

LaDiFi laboratoriodidatticodiFisica

1

ANDAMENTI ESPONENZIALI



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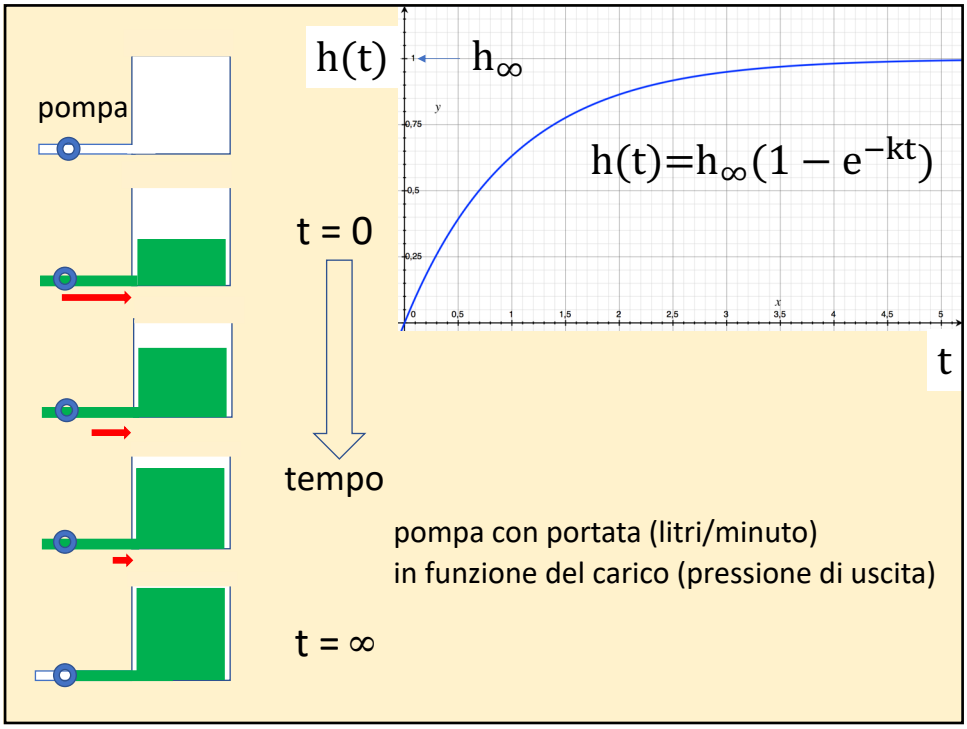
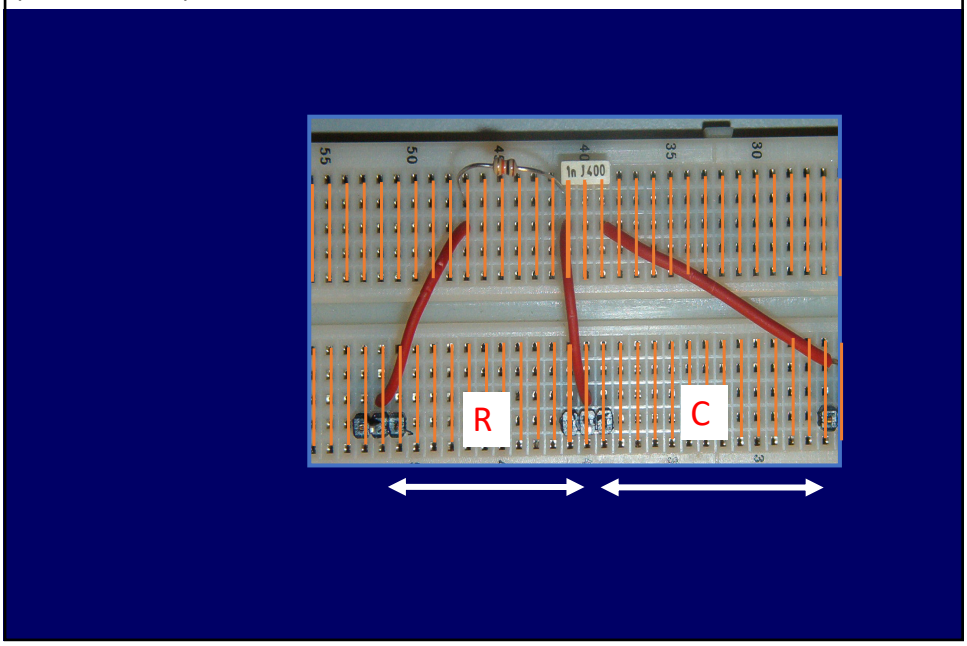


3

IL SISTEMA DA STUDIARE: circuito elettrico realizzato su una basetta (bread board)



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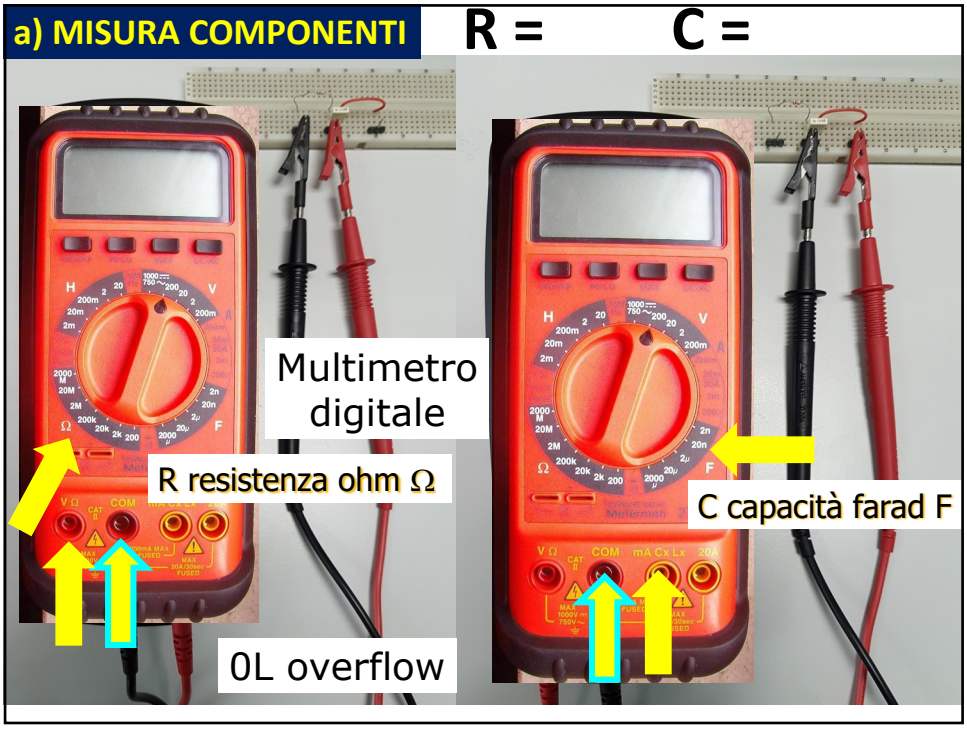
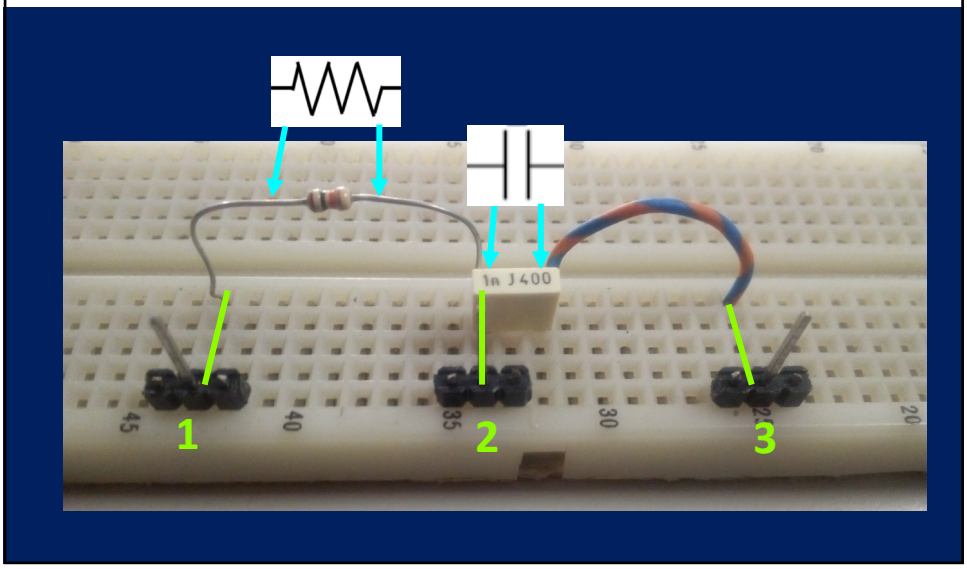


5

IL SISTEMA DA STUDIARE: circuito elettrico costituito da
1-2 resistenza R $V_R = R\,I$ (legge di Ohm)
2-3 capacità C $V_C = Q/C$
connessi tramite conduttori [e attraversati dalla corrente $I = dQ/dt$]



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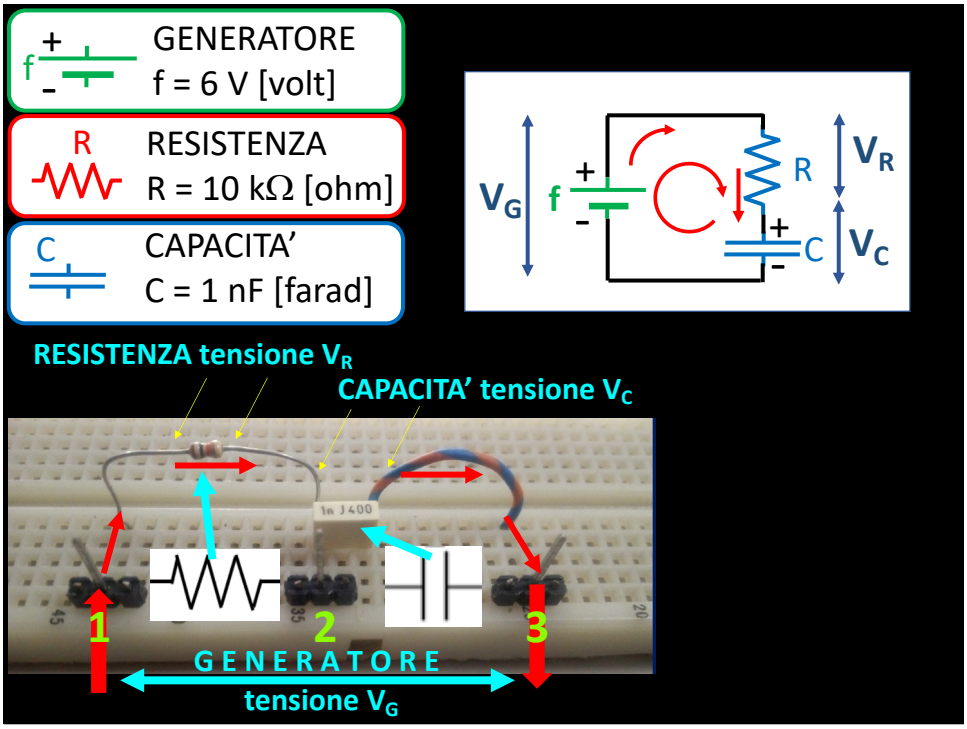


7

1-2 resistenza	R	$V_R = R\,I$ (legge di Ohm)
2-3 capacità	C	$V_C = Q/C \rightarrow Q = C\,V_C$
corrente	I	$I = dQ/dt = C\,dV_C/dt$

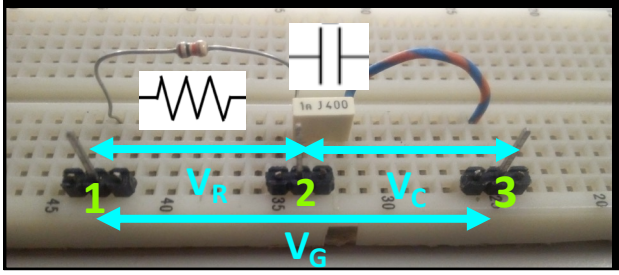
In questo circuito (serie):

1) gli elementi sono **attraversati dalla stessa corrente I(t)** = dQ/dt
(Q è la carica elettrica che scorre da 1 a 3)

2) le **differenze di potenziale** presenti i capi dei componenti **si sommano**: $V_{1\text{-}3} = \mathbf{V_G = V_R + V_C} = R\,I + V_C$

Sostituendo $I = dQ/dt = C\,dVc/dt$ si ha $\mathbf{V_G = RC\,dV_C/dt + V_C}$

riordinando... $RC\,dV_C/dt + V_C = V_G$



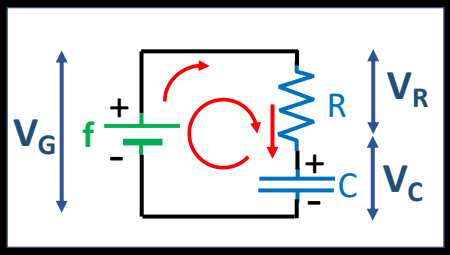
8

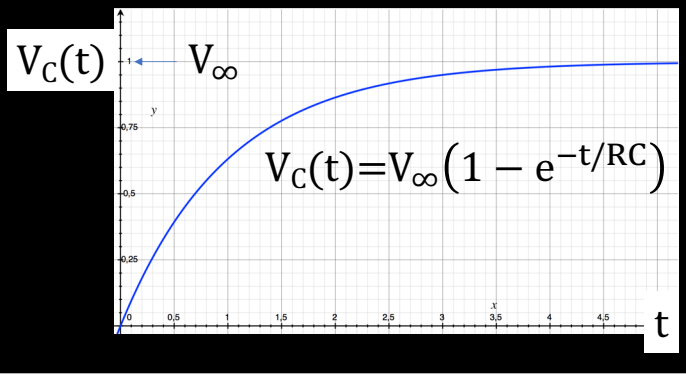
RC $dV_C/dt+V_C(t) = V_G$ dove: $V_G = f$ — carica del condensatore

$$V_C(t) = f + V_0\, e^{-\frac{t}{RC}}$$

$$V_C(t) = f(1 - e^{-\frac{t}{RC}})$$

$$V_C(\infty) = V_\infty = f$$





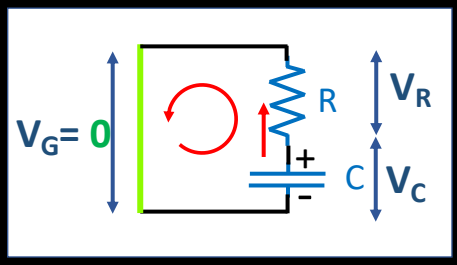
9

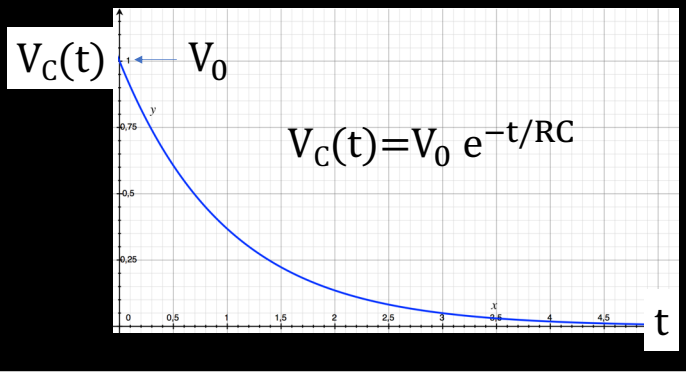
RC $dV_C/dt+V_C(t) = V_G$ dove: $V_G = 0$ — scarica del condensatore

$$V_C(t) = V_0\, e^{-\frac{t}{RC}}$$

$$V_C(t) = f\, e^{-\frac{t}{RC}}$$

$$V_C(\infty) = 0$$





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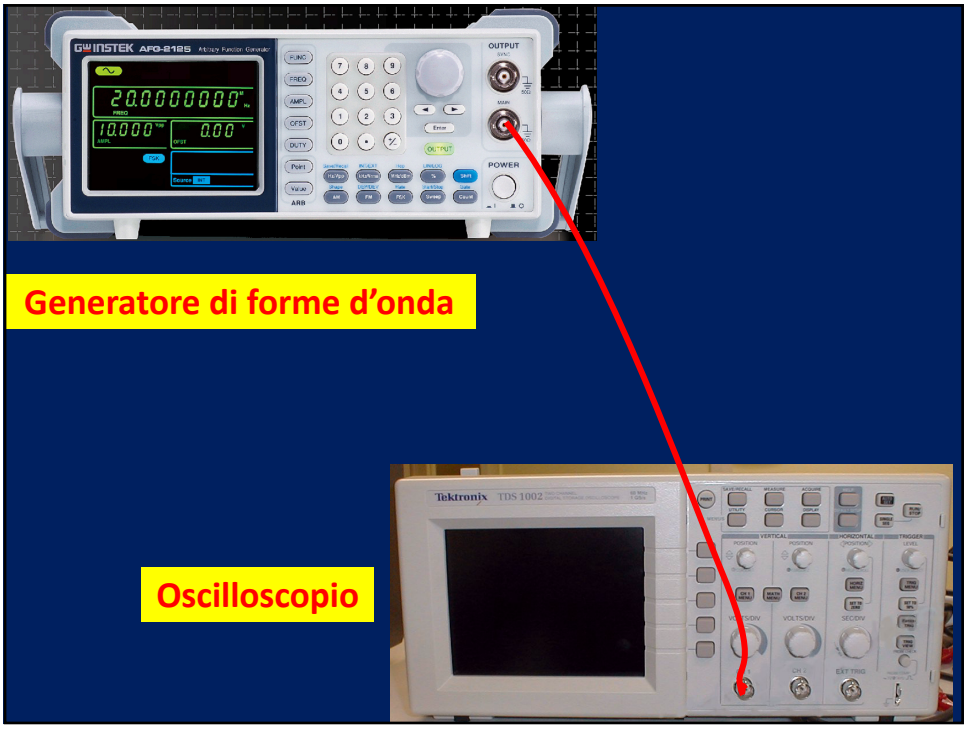
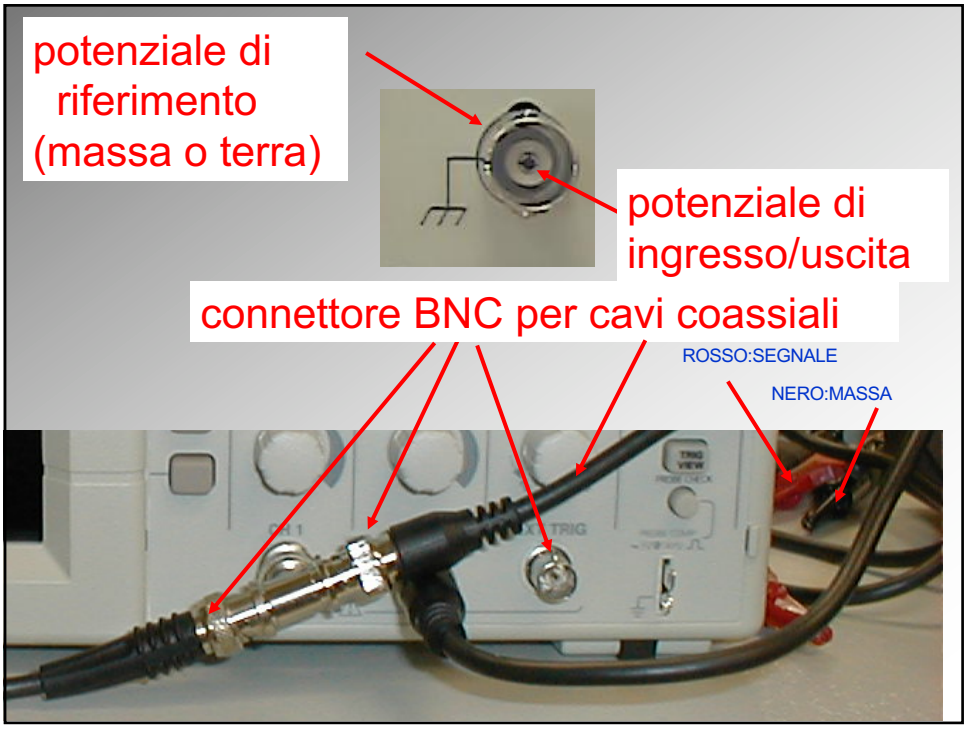

Generatore di forme d'onda
Oscilloscopio

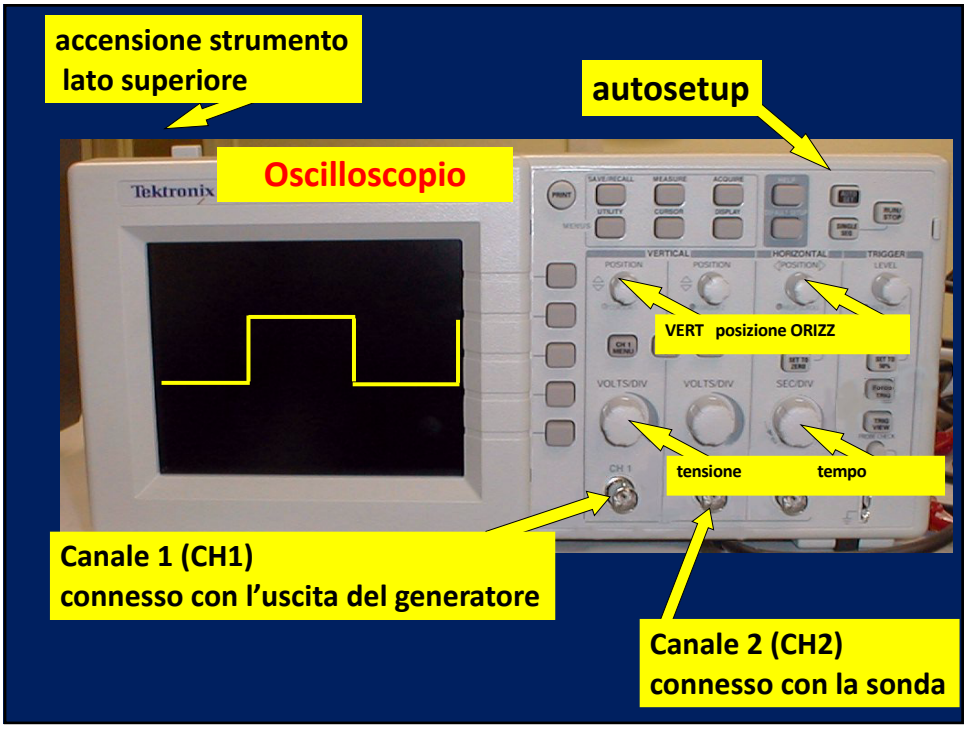
11


potenziale di riferimento (massa o terra)
potenziale di ingresso/uscita
connettore BNC per cavi coassiali
ROSSO:SEGNALE
NERO:MASSA

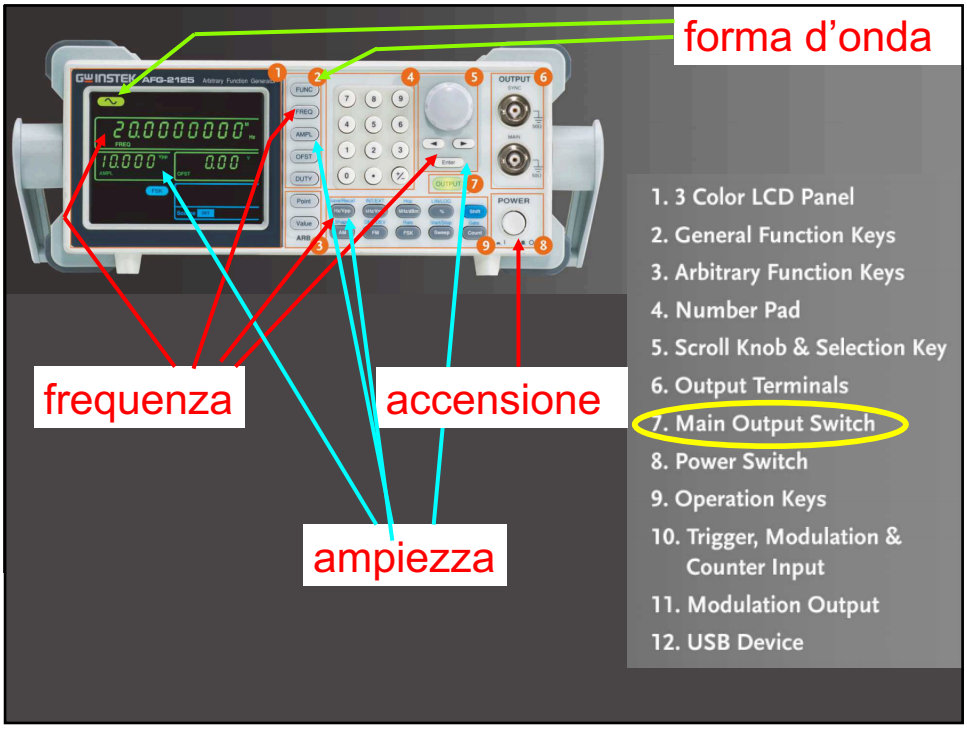
12


sonda
CH1
Accopp.
DC
Limite Banda
OFF
60MHz
Volt/Div.
Coarse
Attenuazione
Sonda
1X
Inversione
OFF
-40.0mV
330kHz

13


accensione strumento
lato superiore
autosetup
Oscilloscopio
Tektronix
VERT posizione ORIZZ
tensione
tempo
Canale 1 (CH1)
connesso con l'uscita del generatore
Canale 2 (CH2)
connesso con la sonda

14


forma d'onda
frequenza
accensione
ampiezza
1. 3 Color LCD Panel
2. General Function Keys
3. Arbitrary Function Keys
4. Number Pad
5. Scroll Knob & Selection Key
6. Output Terminals
7. Main Output Switch
8. Power Switch
9. Operation Keys
10. Trigger, Modulation & Counter Input
11. Modulation Output
12. USB Device

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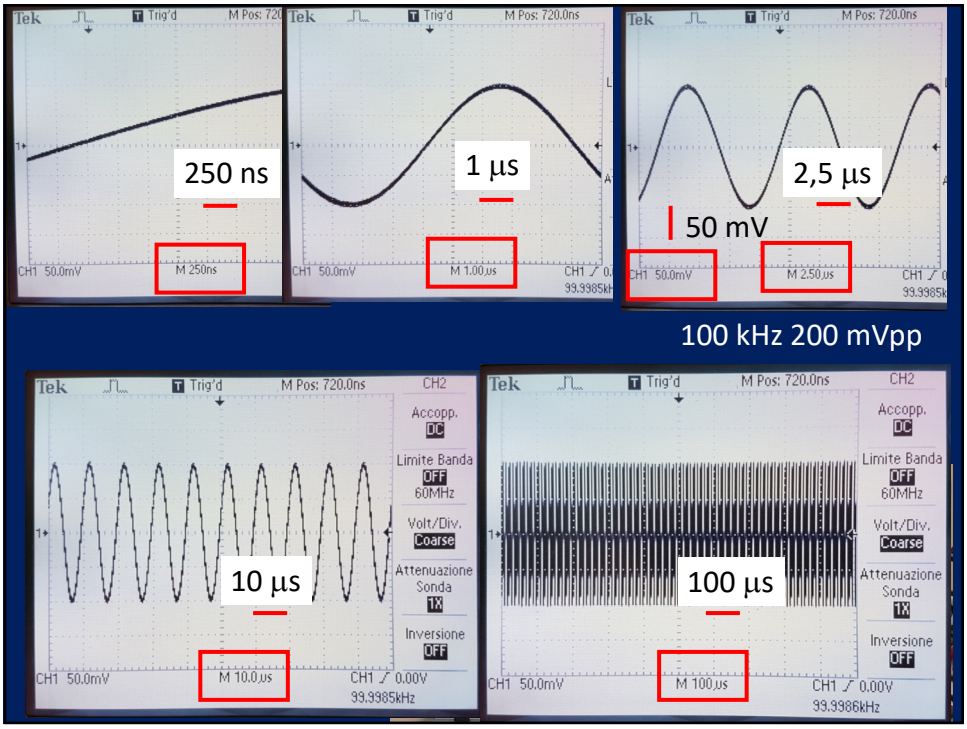
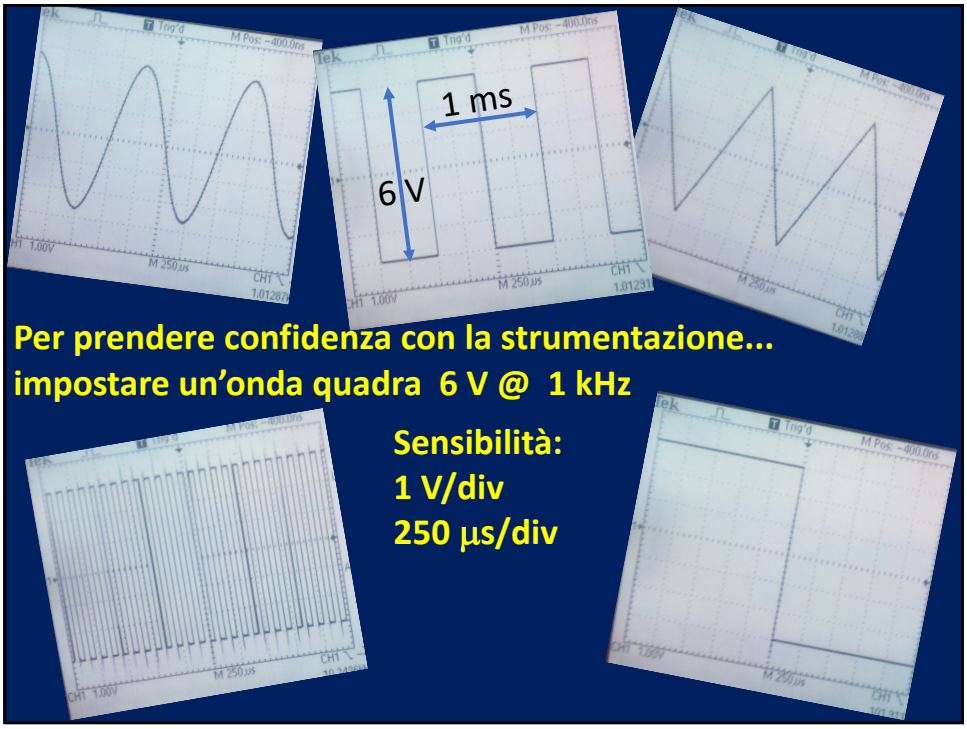
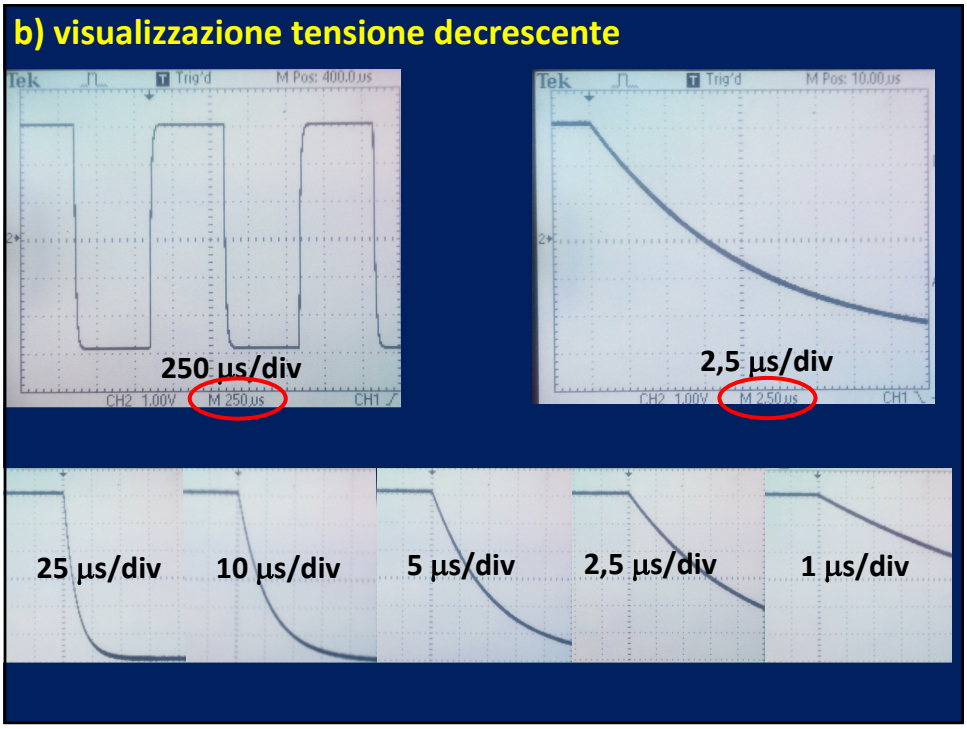

250 ns
1 µs
2,5 µs
50 mV
100 kHz 200 mVpp
10 µs
100 µs

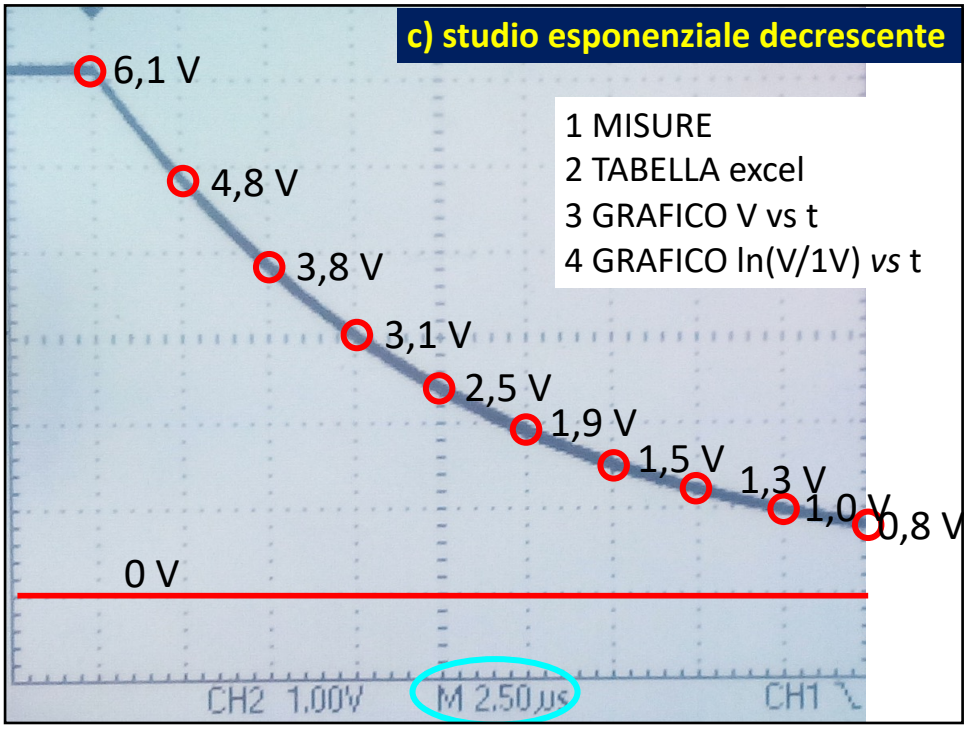
16


1 ms
6 V
Per prendere confidenza con la strumentazione...
impostare un'onda quadra 6 V @ 1 kHz
Sensibilità:
1 V/div
250 µs/div

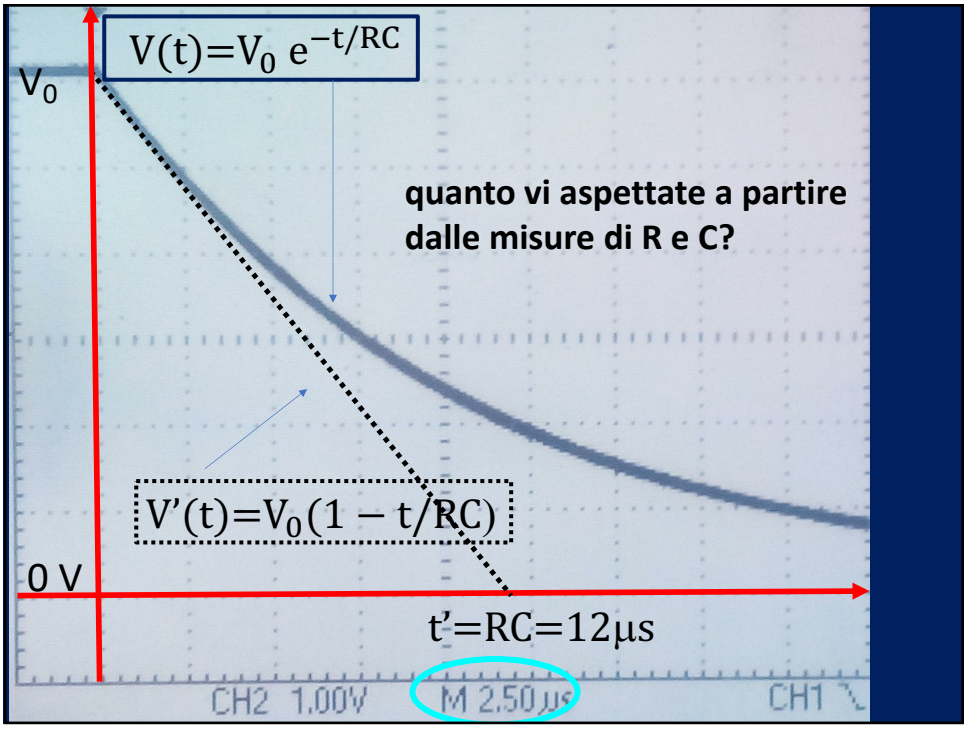
17


b) visualizzazione tensione decrescente
250 µs/div
2,5 µs/div
25 µs/div
10 µs/div
5 µs/div
2,5 µs/div
1 µs/div

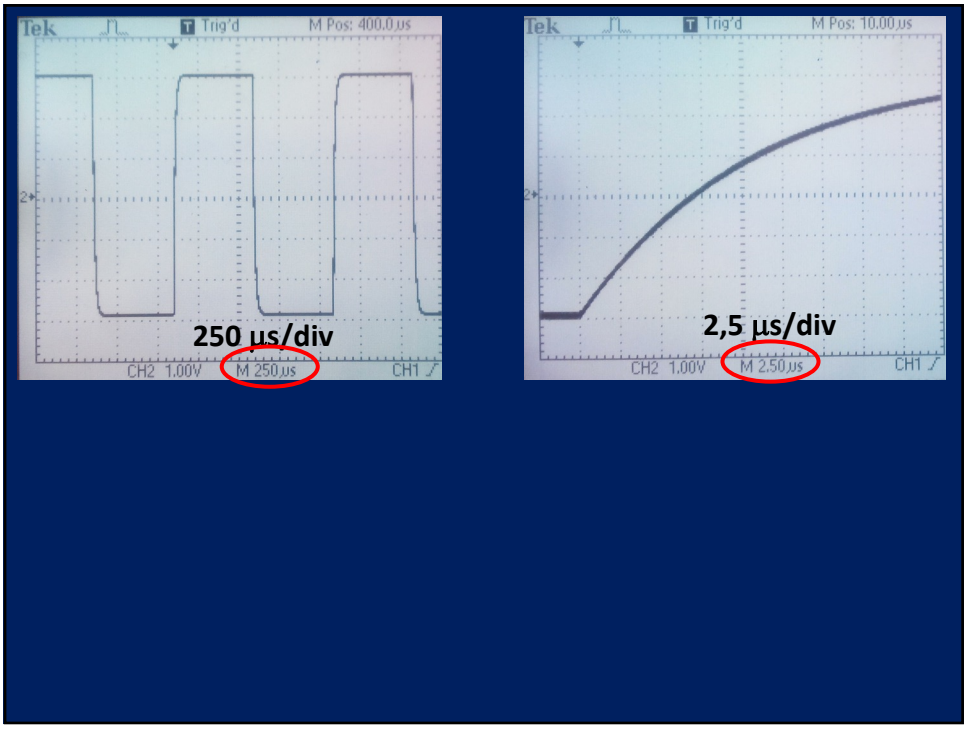
18


c) studio esponenziale decrescente
1 MISURE
2 TABELLA excel
3 GRAFICO V vs t
4 GRAFICO ln(V/1V) *vs* t
6,1 V
4,8 V
3,8 V
3,1 V
2,5 V
1,9 V
1,5 V
1,3 V
1,0 V
0,8 V
0 V
CH2 1.00V
M 2.50µs
CH1

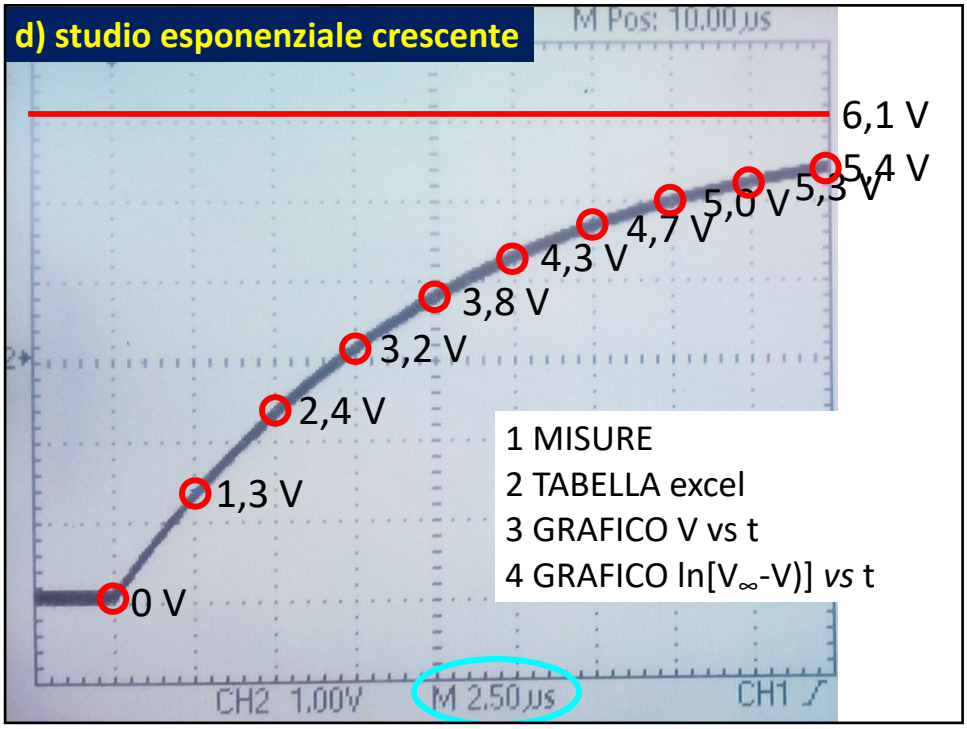
19


$V(t)=V_0\ e^{-t/RC}$
V_0
quanto vi aspettate a partire dalle misure di R e C?
$V'(t)=V_0(1-t/RC)$
0 V
$t'=RC=12\mu s$
CH2 1.00V
M 2.50µs
CH1

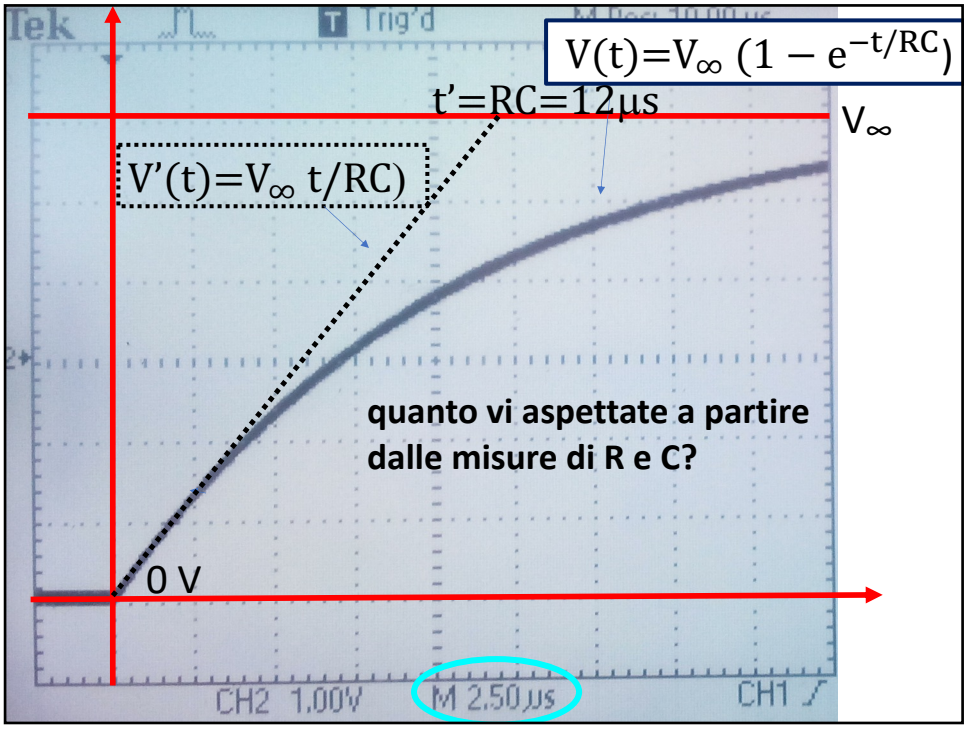
20


Tek
Trig'd
M Pos: 400.0µs
250 µs/div
CH2 1.00V
M 250µs
CH1
Tek
Trig'd
M Pos: 10.00µs
2,5 µs/div
CH2 1.00V
M 2.50µs
CH1

21


d) studio esponenziale crescente
M Pos: 10.00µs
6,1 V
5,4 V
5,3 V
5,0 V
4,7 V
4,3 V
3,8 V
3,2 V
2,4 V
1,3 V
0 V
1 MISURE
2 TABELLA excel
3 GRAFICO V vs t
4 GRAFICO ln[V∞-V)] vs t
CH2 1.00V
M 2.50µs
CH1

22


Tek
Trig'd
$V(t)=V_\infty\,(1-e^{-t/RC})$
t'=RC=12μs
V_∞
$V'(t)=V_\infty\,t/RC)$
quanto vi aspettate a partire
dalle misure di R e C?
0 V
CH2 1.00V
M 2.50μs
CH1

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a giovedì 27 MAGGIO
LaDiFi
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