

# Exp 6: Capacitors and inductors

Three circuits :-

1- first circuit :- RC-Circuit

$V_c$  :-

$$\mathcal{E} - RI - \frac{q}{C} = 0$$

$$q(t) = C\mathcal{E}(1 - e^{-t/RC})$$

$$V_c(t) = \mathcal{E}(1 - e^{-t/RC})$$

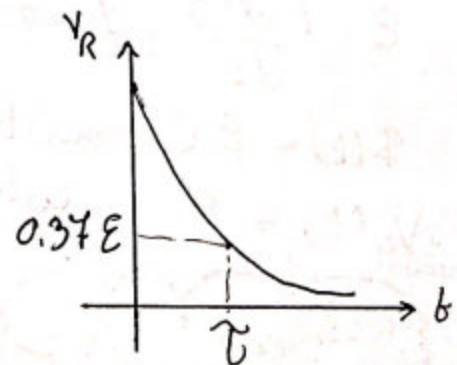
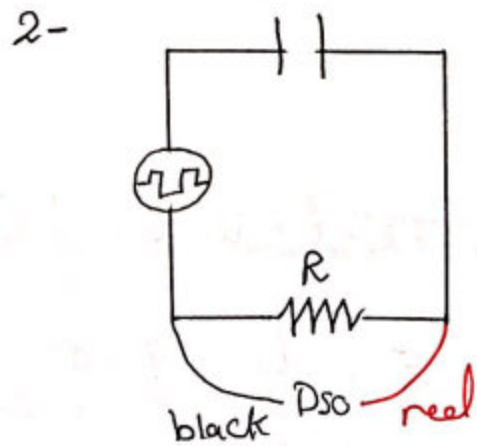
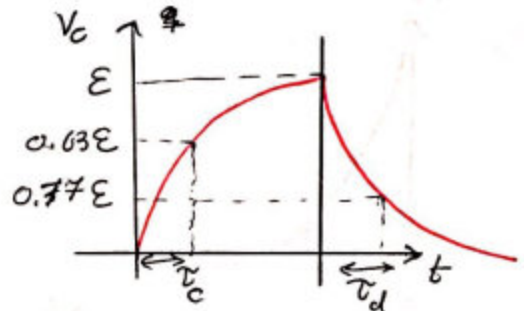
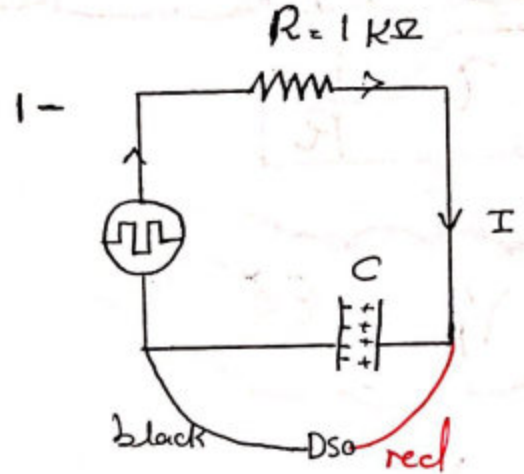
→  $V_c = 0.63 \mathcal{E}$

$$\tau_c = RC$$

$V_c(t) = 0.37 \mathcal{E}$   
disch

$$V_R(t) = IR$$

$$V_R(t) = \mathcal{E} e^{-t/RC}$$



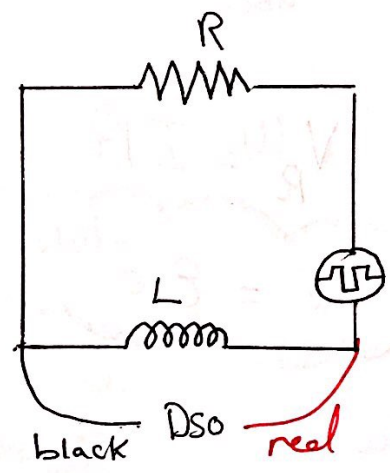
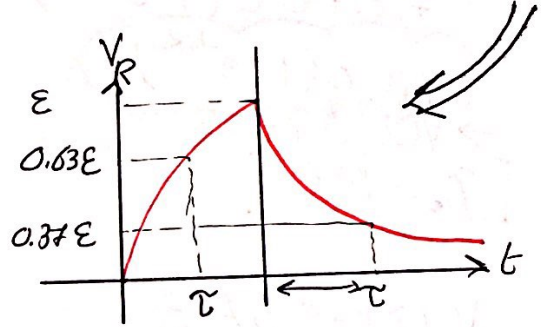
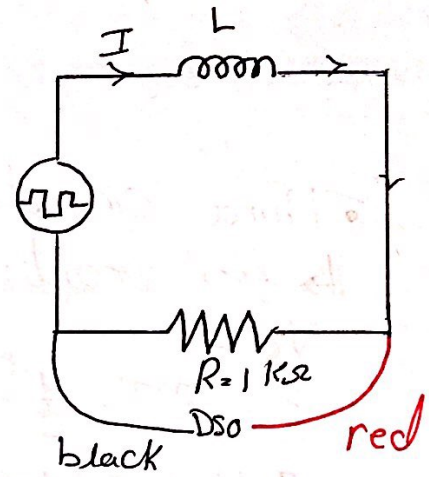
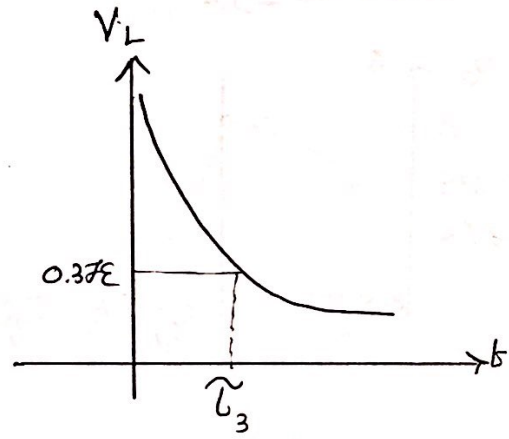
Second circuit: RL - Circuit

$$\mathcal{E} - L \frac{dI}{dt} - IR = 0$$

$$V(t) = \mathcal{E} (1 - e^{-Rt/L})$$

$$\tau = \frac{L}{R}$$

$$V_L = -\mathcal{E} e^{-t/\tau}$$



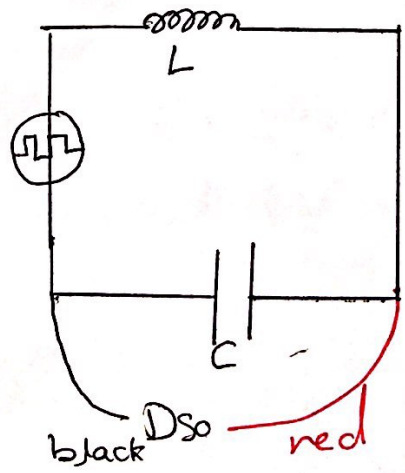
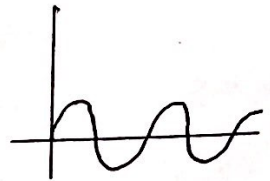
Third circuit: LC - Circuit

$$\mathcal{E} - L \frac{dI}{dt} - \frac{q}{C} = 0$$

$$\mathcal{E} - L \frac{d^2q}{dt^2} - \frac{q}{C} = 0$$

$$q(t) = EC \sin \omega t$$

$$V_C(t) = \mathcal{E} \sin \omega t$$



$$\omega_{Theory} = \frac{1}{\sqrt{LC}}$$

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$



لبنيا ٢ دوائر :-

1- RC Circuits

- What we use :-
- A Resistance
- A Capacitor
- An inductor
- signal Generator
- oscilloscope

• قم بوصول المواع مع جهاز Dso  
 • قم بوصول مولد الموجات مع المقادير

• نظركم رسمه charging & discharging على الشاشة (Vc)  
 • قم بحساب الثابت الزمني  $\tau$  ( $\tau_c$  و  $\tau_d$ )

• قم بحساب  $\tau_c$  و  $\tau_d$  مع R و C حيث تضع R موصوله مع Dso و قم بحساب  $\tau$  من رسمه VR

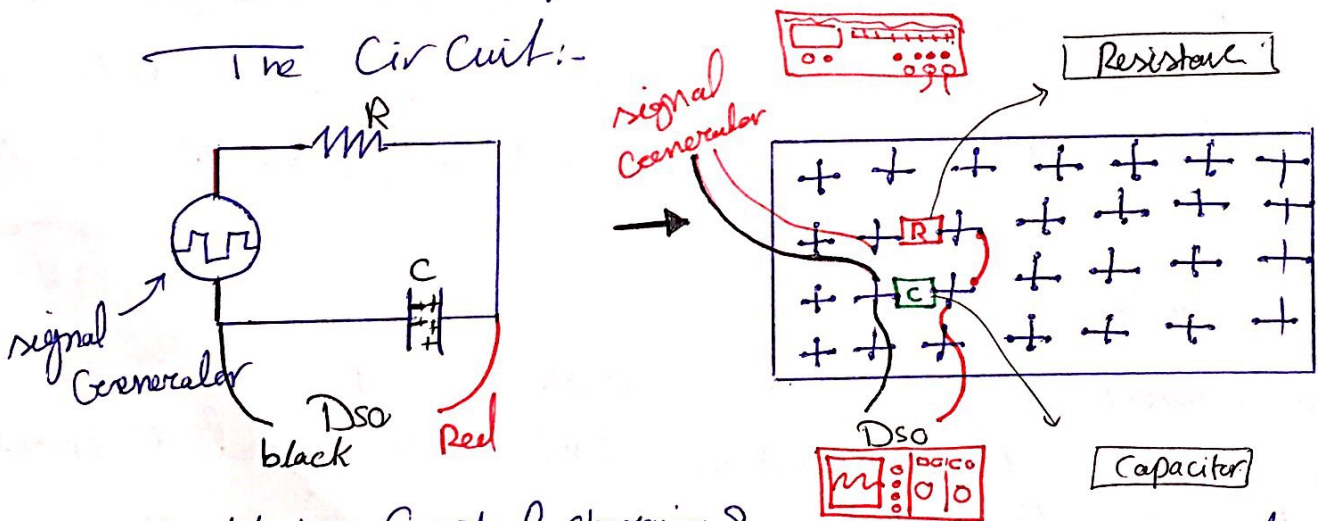
• Procedure :-

- We have three circuits to make :-

A-1- R-C circuit :-

- You connect the capacitor with the Dso (oscilloscope)
- You connect a signal Generator and a Resistance with the the capacitor

The Circuit :-

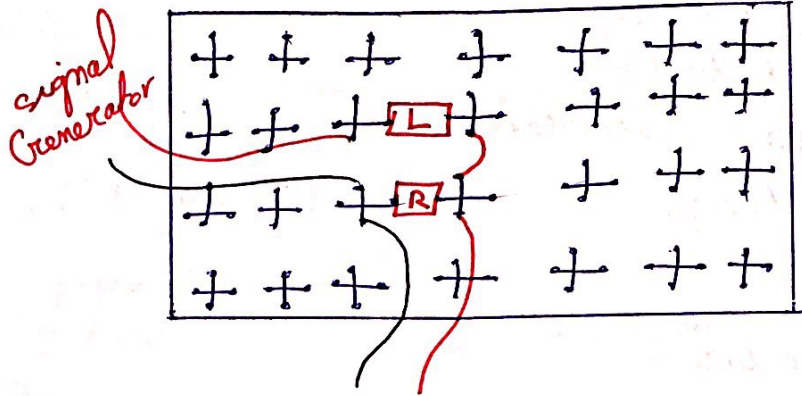
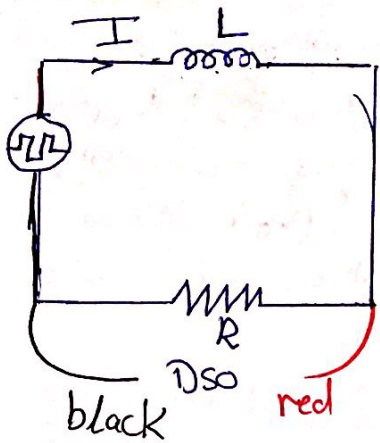


- You obtain a Graph of charging & discharging / you find  $\tau_{1,2}^{exp}$  As I explained in Page 1
- 2- You connect R with the Dso and C with the signal Generator to obtain  $\tau_3$

B-1- L-R circuit :-

- You connect R with the Dso
- You connect L with signal Generator & R

The Circuit :-



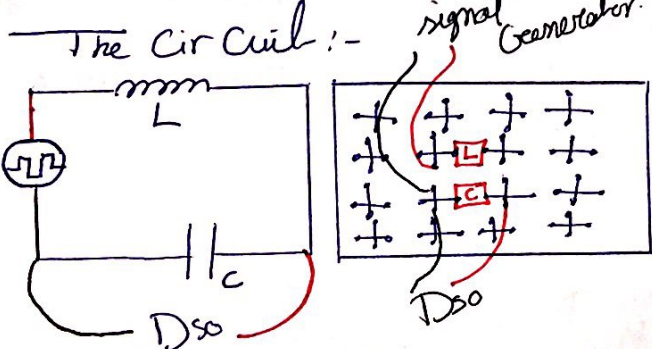
- You obtain the Graph of  $V_R$  <sup>DSO</sup>. Calculate  $V_c$  and  $V_d$
- Replace R with L and obtain  $V_L$  to get  $V_3$

**L-R circuit.**

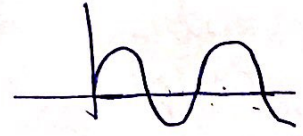
- 1- قم بوصول المقاومة مع جهاز DSO
- 2- قم بوصول كابل مع مولد الاوجات مع المقاومة كما هو موضح في الشكل
- 3- قس على  $V_R$  على  $V_L$  الى DSO وعليك ان تبين  $V_c$  و  $V_d$  ولها
- 4- تبديل R و L و احصل على  $V_L$  و  $V_3 = V_L$

**L-C Circuit:-**

- You connect the Capacitor with the DSO
- You connect the Resistance with the signal Generator and with the Capacitor.



قم بوصول الدارة كما هو موضح . عليك ان تحصل على  $f$  من الجهاز نفسه



- obtain  $f$  exp from the DSO
  - By increasing  $f$  until Amplitude is maximized
- قم بزيادة  $f$  حتى تصل الى الحد الأقصى . لكي اعد قوتها لها عند التردد  $f$  القصوى