**A green tree on a black background

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BIRZEIT UNIVERSITY

Physics Department

## Physics 112

**Experiment No. 6**

**Capacitor & Inductors**

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* **Abstract :**

**Introduction :** In this experiment, it is expected to discover the time constant of three electrical circuits: RC-circuit, LR-circuit, and LC-circuit. To briefly explain, RC-circuit is an electrical circuit containing resistance, which is connected to a capacitor of capacitance. Secondly, LR-circuits would be where the capacitance of inductance, L, is joined in series with a capacitance of resistance, R. Lastly, the LC-circuit is formed when an inductor, L, and capacitor, C, are joined together. Therefore, to find the time constant of the three electrical circuits would be to use a DCO to measure the voltage of RC and RL circuits, as well as find the frequency of the LC current.

**The aim of the experiment :** is to find out the time constant in RC, RL ,

and LC-circuits.

**The method used :** is by using the DCO to measure the voltage in the

RC and LR circuits and to measure the frequency in the LC circuit.

**The main result :**

1. RC circuits :

**c  =** 104 µsec

**d  =** 104 µsec

**exp  =** 104 µsec

**theo  =** 100 µsec

1. LR circuit :

**c  =** 9 µsec

**d  =** 9 µsec

**exp  =** 9 µsec

**theo  =** 10 µsec

1. LC circuit :

fexp =4.63 KHz

ftheo = 5 KHz

exp = 29.1 rad/s

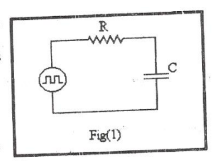
theo = 31.4 rad/s

* **Theory :**

**RC circuits :**

**Charging a capacitor :**

The voltage across the capacitor’s plates is defined by *VC =* , and

While Q(t) = C ( 1- ) (when we are talking about the positive half period of the square wave) , then Vc = ( 1- ) .

.The value of RC is usually called the time constant **(τ)** of the RC

circuit like the one shown in fig.1. **τ** is a measure of how fast the voltage across the capacitor rises. When t= τ , VC = 0.63

The current passing through the circuit is given by : I(t) = =

, while the voltage across the resistor is : VR = I(t) R = .

**Discharging a capacitor:**

Now, during the negative period of the square wave, the

capacitor, the capacitor discharges according to the following formula :

Q(t) = C , And so the voltage across the capacitor’s plates is:

VC = 0.37 *.*

In this case the voltage decays to 0.37 of its maximum value within

a time τ, which equals RC (the time constant).

The current passing through the circuit is:

I(t) = =

and so, the voltage is given by:

VR = I(t) R = -

**LR circuits:**

A diagram of a circuit

Description automatically generatedThe current passing through the LR circuit shown in

fig.3 rises with time according to the following equation:

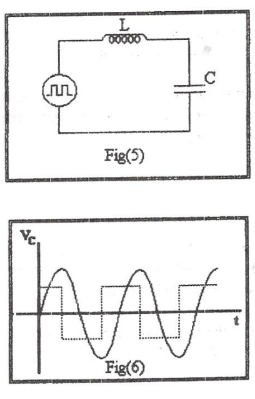
I = ( 1- )

The voltage across the resistor is : I = IR = ( 1- )

and across the inductor is : VL  = L =

In this case the time constant equals . When t = τ , and VL = 0.37 ,

and VR = 0.63 *.*

 **LC circuits :**

The following equation describes the voltage

across the capacitor’s plates of the one in the circuit

shown in fig.5,

VC = VCo cos (

Where VCo is the amplitude (constant ) and = .

Fig.6 shows the voltage across the capacitor as a

function of time .