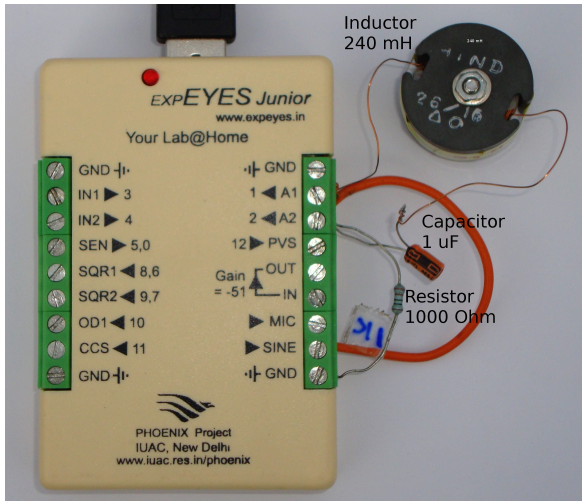
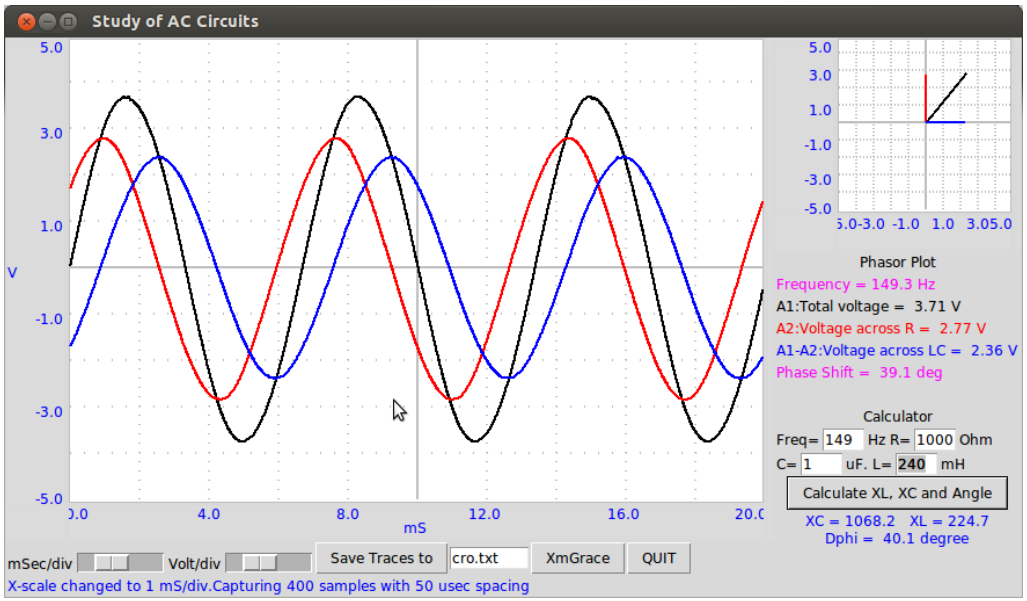
Example Usage: Alternating Current (Class XII NCERT book, ch. 7)



Even though the theory of AC circuits is included in the syllabus of class XII, schools do not have any equipment to perform such experiments. Experimental study requires measuring the voltages across circuit elements (L,C and R) several thousand times per second and plot them.

The figure above shows the circuit to study the effect of AC voltage on a series LCR circuit. The applied AC voltage from the SINE output, and voltage across R are captured by inputs A1 and A2. Voltage across LC is obtained by subtraction. All are plotted as a function of time. The Phasor diagram also is plotted in real time. A calculator is incorporated in to the GUI so that the measured phase shifts can be compared with theoretical values.



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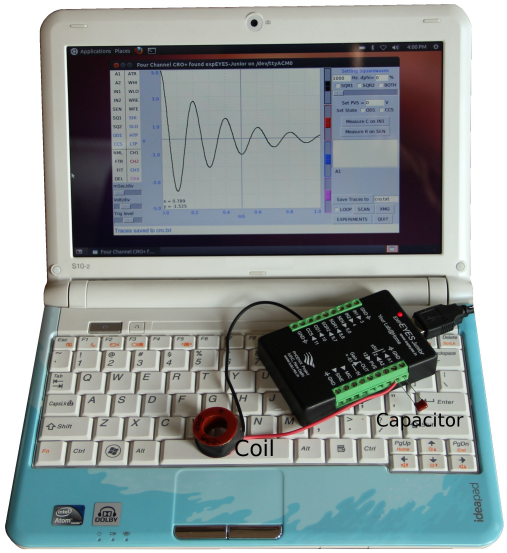

Transient response of LCR Circuit

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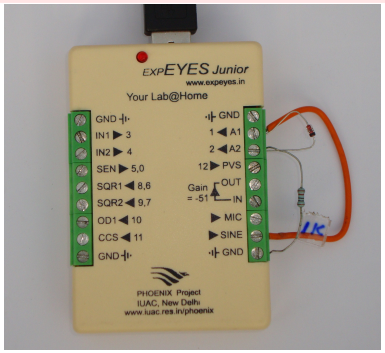
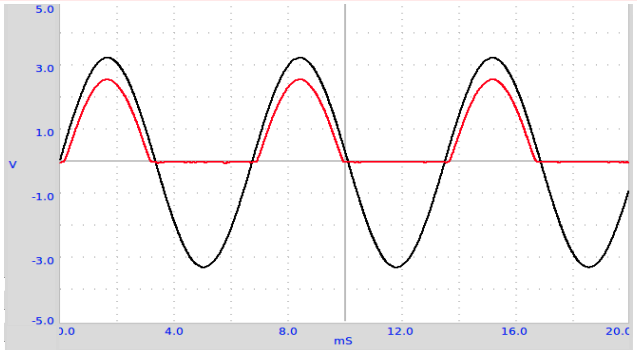
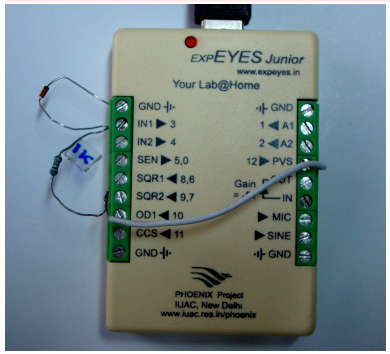
PN Junction Diode as Half wave Rectifier

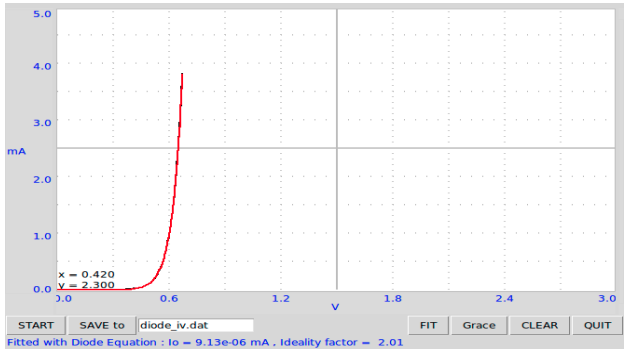




The black trace shows the input sine wave. The red trace shows the output after passing through a silicon PN junction. The 1k load resistor results in 3 to 4 mA of current flow. The voltage drop across the diode is clearly visible.

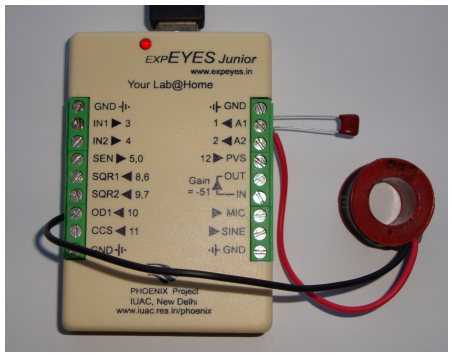
PN Junction Diode IV characteristic curve

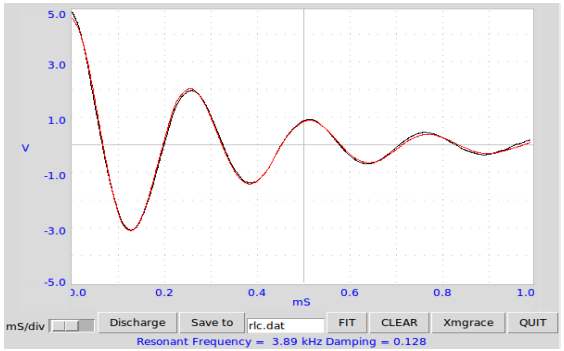




The Anode is connected to the programmable voltage source(PVS) through a 1kOhm resistor and the Cathode is connected to ground. PVS is changed in steps and the voltage across the diode is measured, to plot the IV curve.

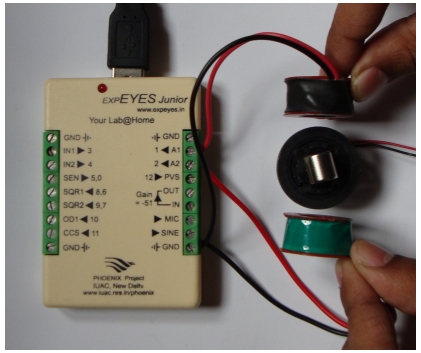
Transient response of LCR circuit

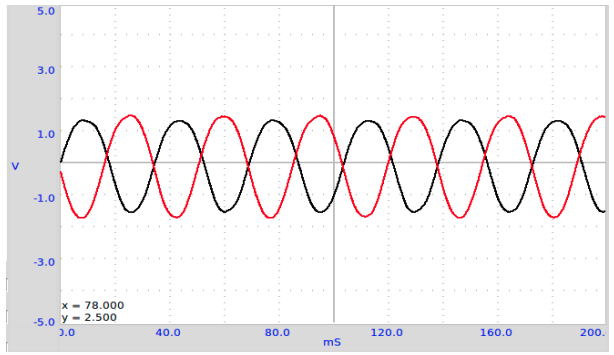




A 5 to 0 volts step is applied to an Inductor and Capacitor connected in series. The resulting voltage across the capacitor is shown in the figure. The values are: C=0.1uF, L=140mH (with 500 Ohm coil resistance). The circuit is under-damped.

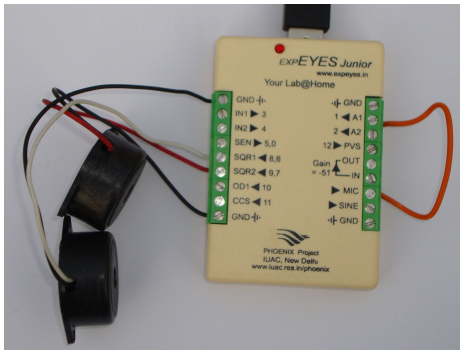
Two phase AC Generator using a rotating magnet and two coils

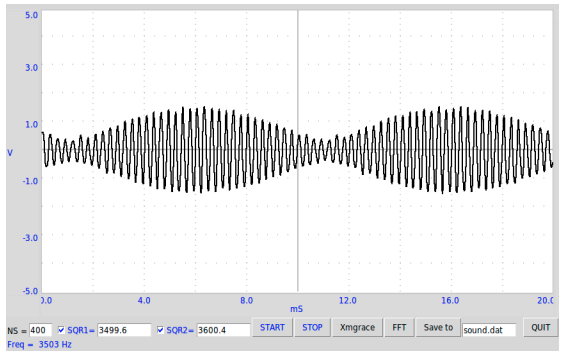




Voltage is induced on a coil by keeping it near a rotating magnet (mounted on a motor). The phase difference between the two waveforms depends on the angle between the axes of the two coils used.

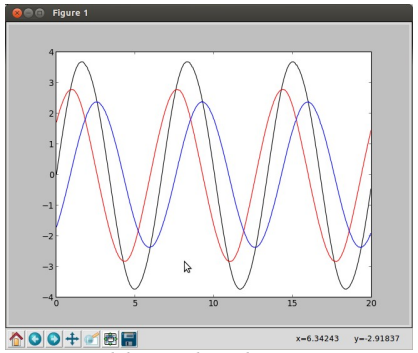
Interference of sound from two Piezo-electric buzzers





The square wave generators are set to two nearby frequencies and the outputs are connected to Piezo electric discs. The resultant sound is captured by a the built-in microphone, amplified and connected to one of the channels to show the beats.

New Experiments by Programming in Python




```
from pylab import *
import expeyes.eyesj
p = expeyes.eyesj.open()

t,v,tt,vv= p.capture2_hr(1,2,400,50)
plot(t,v,color='black')
plot(tt,vv,color='red')
vlc = array(v) -array(vv)
plot(t,vlc,color='blue')
show()
```

It is possible to develop new experiments by writing simple programs in Python. The code shown above captures the waveforms, from the series LCR circuit. The same is done using an included GUI program, as shown on the back cover.