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Workshop on

“Physics Lab experiential learning using Scilab-XCOS”
For Physics cycle students

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Outline

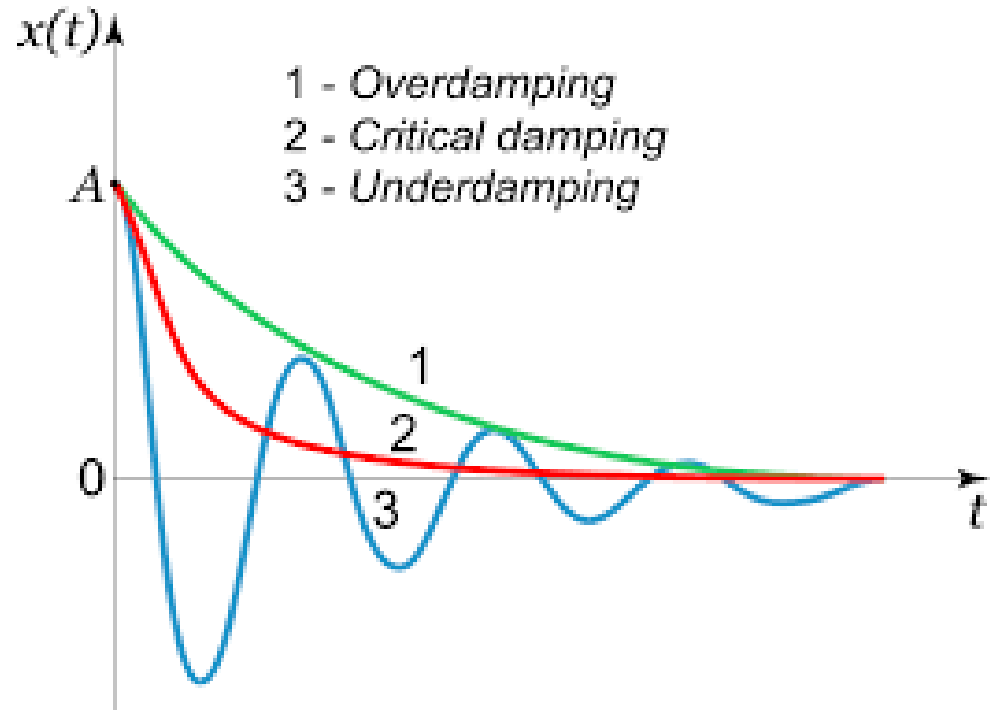
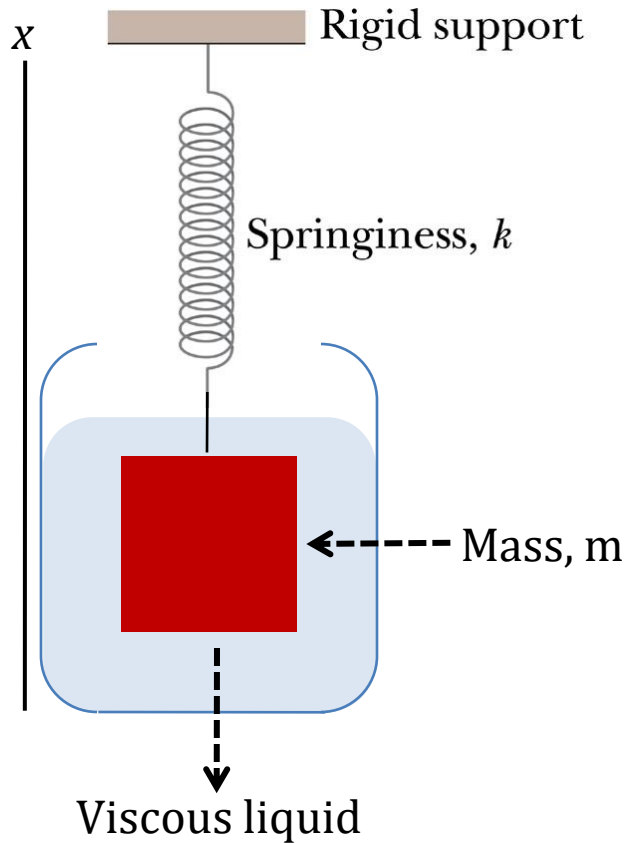
- Damped Harmonic Oscillation
- About Scilab-Xcos
- Simulation using Xcos
- Inference

Damped harmonic motion

$$F_{damping} = -r \frac{dy}{dt}$$

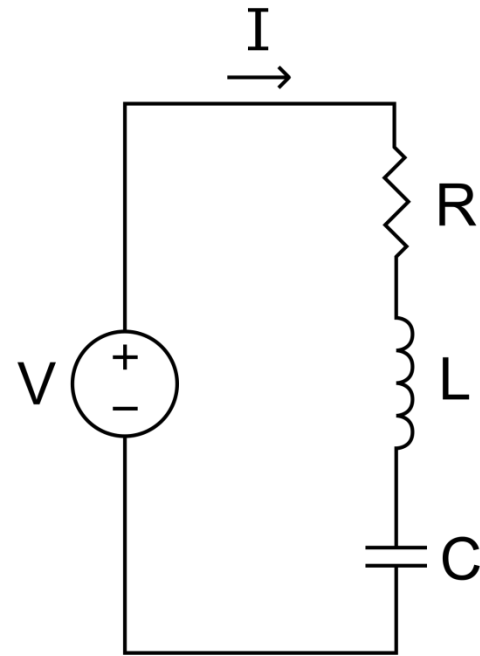
Damping force

Damping constant



Electrical Damped harmonic oscillation

The circuit can be modeled by using second order linear differential equation for the electrical damped harmonic oscillator:



$$\frac{d^2V}{dt^2} + \left(\frac{R}{L}\right) \frac{dV}{dt} + \left(\frac{1}{LC}\right) V = 0$$

The characteristic equation using the quadratic formula is

$$\alpha = \frac{-R \pm \sqrt{R^2 - 4L/C}}{2L}$$

By substituting the variables for b and ω , α can be written as

$$\alpha = -b \pm \sqrt{b^2 - \omega^2}$$

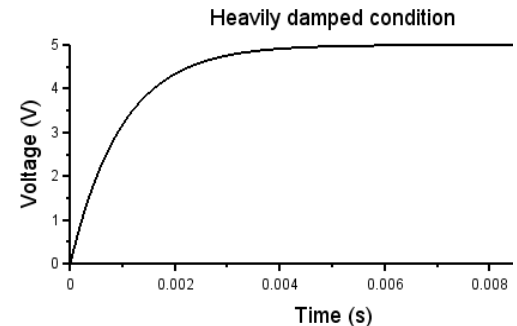
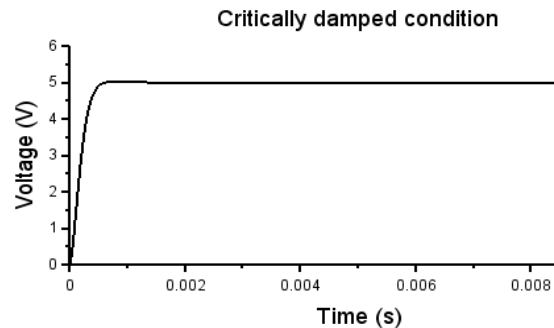
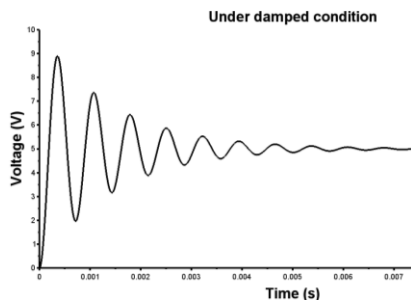
$$\text{Where } b = \frac{R}{2L} \text{ and } \omega^2 = \frac{1}{\sqrt{LC}}$$

The voltage across the capacitor is studied by varying R and keeping L and C is constant

The natural frequency of a series RLC circuit is given by $\omega = \frac{1}{\sqrt{LC}}$

and damping factor $b = \frac{R}{2L}$

Depending upon the value of b and ω the response could be under-damped, critically-damped or over-damped



6/3/2022
 $b < \omega$

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 $b \approx \omega$

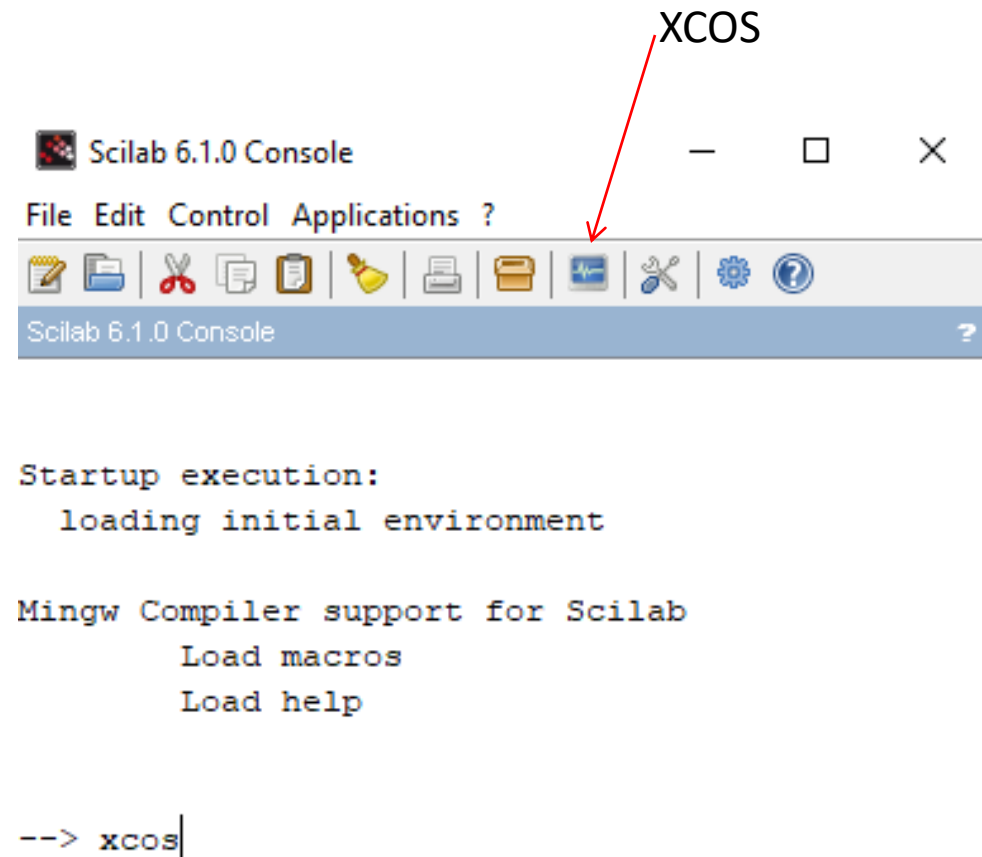
$b > \omega$

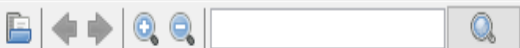
Scilab

- Numerical computations, data analysis and plotting, system modeling and simulation, graphical user interface.
- Scilab is in use in every strategic domain of science, industry, and services including space, aeronautics, automobile etc.,
- **XCOS** is a tool in Scilab that is used to model and simulate dynamic systems.
- XCOS allows us to represent models in the form of blocks and block diagrams.

- Scilab includes hundreds of mathematical functions.
 - **Maths & Simulation**
 - **2-D & 3-D Visualization**
 - **Statistics**
 - **Signal Processing**
 - **Xcos - Dynamic systems modelling**

- Xcos is a graphical editor to design hybrid dynamical systems models.
- Standard Palettes & Blocks
- Model building & edition
- Simulation





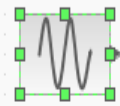
- Palettes
 - Recently Used Blocks
 - Continuous time systems
 - Discontinuities
 - Discrete time systems
 - Lookup Tables
 - Event handling
 - Mathematical Operations
 - Matrix
 - Electrical
 - Integer
 - Port & Subsystem
 - Zero crossing detection
 - Signal Routing
 - Signal Processing
 - Implicit
 - Annotations
 - Sinks
 - Sources
 - Thermo-Hydraulics
 - Demonstrations Blocks
 - User-Defined Functions
- C:\Users\BMR\Documents\VVCE\DHM XCOS.zcos

Constant Voltage	CVS	STEP_FUNCTION
VVsourceAC	TKSCALE	SUMMATION
Capacitor	MUX	CMSCOPE
VsourceAC	Ground	VoltageSensor
Inductor	GENSQR_f	GENSIN_f



Start simulation





Scilab Multiple Values Request

Set CLOCK_c block parameters

Event clock generator

Do not start if 'Initialisation Time' is negative

Period:

Initialisation Time:

*Untitled - Xcos

File Edit View Simulation Format To

Setup

Execution trace an

Set Context

Compile

Modelica initialize

Start

Stop

Set Parameters

Final integration time:

Real time scaling:

Integrator absolute tolerance:

Integrator relative tolerance:

Tolerance on time:

Max integration time interval:

Solver kind:

Maximum step size (0 means no limit):

Scilab Multiple Values Request

Set GENSIN_f block parameters

Sine wave generator

Amplitude:

Frequency (rad/s):

Phase (rad):

Scilab Multiple Values Request

Set CSCOPE block parameters

Curve style: Color>0 | mark<0:

Output window number (-1 for automatic):

Output window position:

Output window sizes:

Ymin:

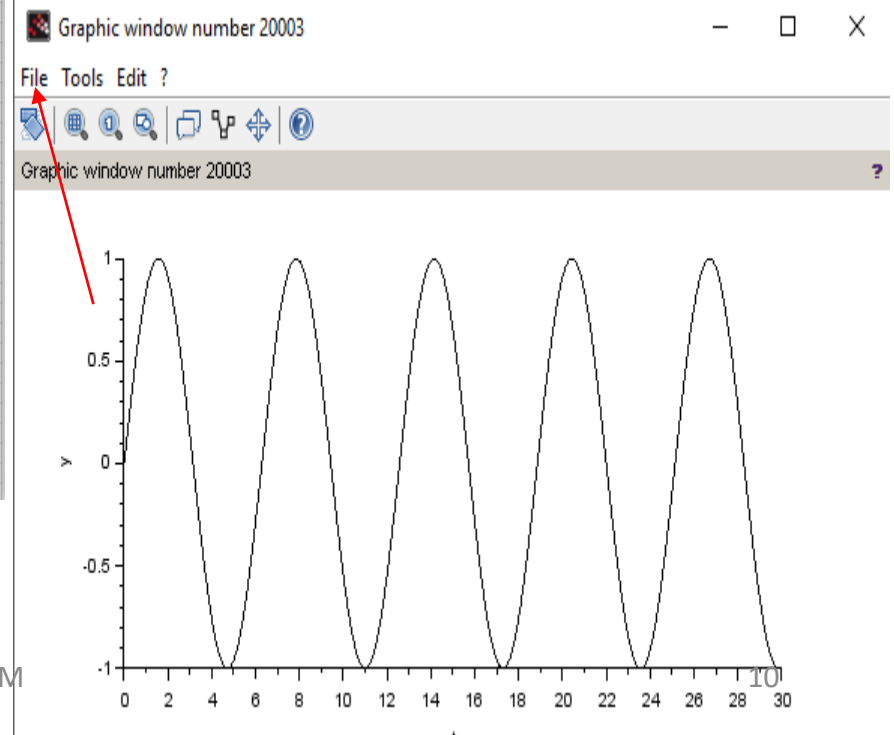
Ymax:

Refresh period:

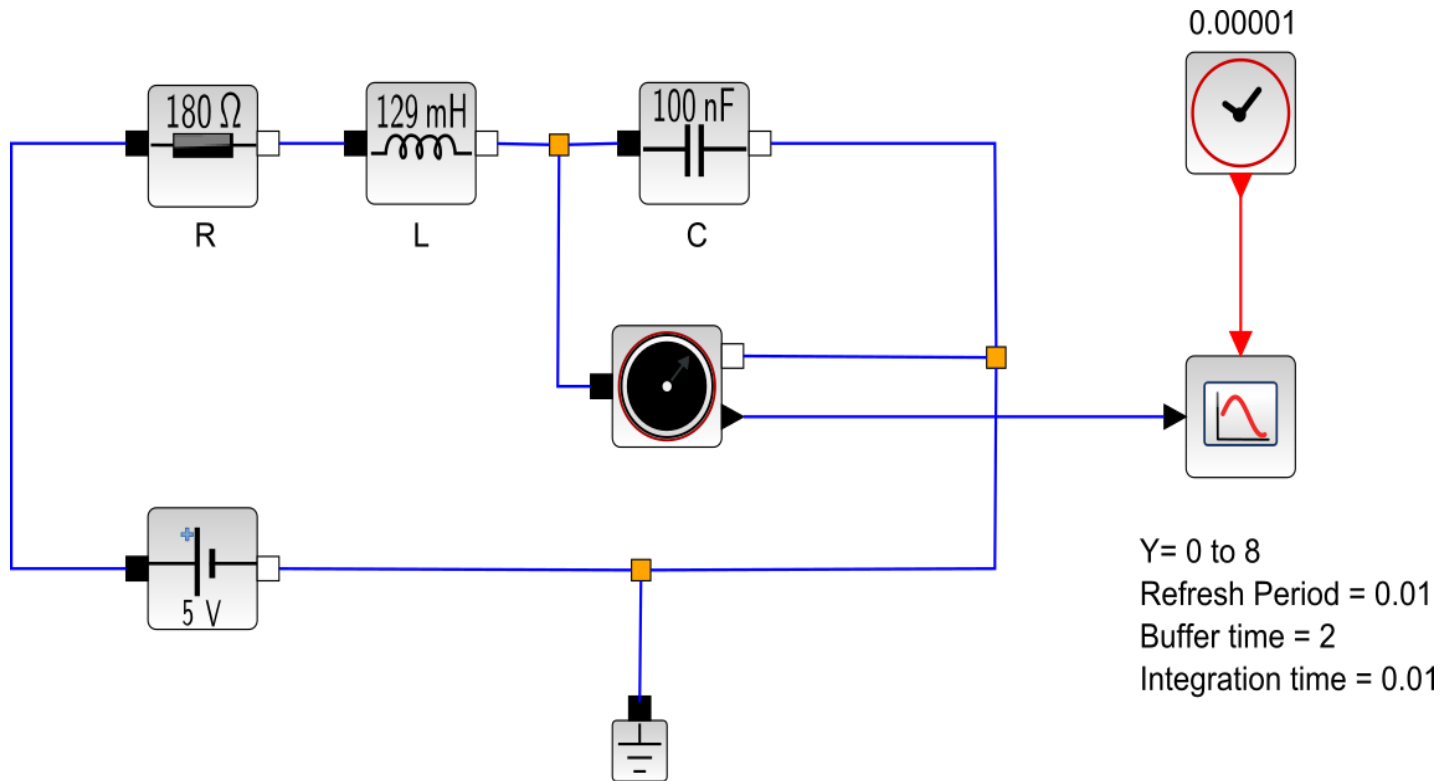
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RLC circuit using XCOS



Inference

- Understanding of damped harmonic oscillations concept
- Identification of different cases of damped harmonic oscillations based on RLC value
 - Under damped
 - Critically damped
 - Heavy damped

Report writing

- Aim/Objective of the experiment
- Theory of electrical damped oscillation
- Circuit diagram using XCOS
- Tabular column for three different cases of Damped harmonic oscillation
- Output graph
- Analysis of the graph

THANK YOU