

## ✓ Actividad 1 del Módulo 1

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Link a repositorio GitHub: [https://github.com/allaltune/HCSPD\\_2024/tree/main/Semana%201](https://github.com/allaltune/HCSPD_2024/tree/main/Semana%201)

## ✓ Actividad 1 - a.

Se asignan los valores: R = 1Q, L = 1H y C = 1F

Queda el espacio de estados:

$$A = \begin{bmatrix} -1 & -1 \\ 1 & 0 \end{bmatrix}$$
$$B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$
$$C^T = \begin{bmatrix} 1 & 0 \end{bmatrix}$$

Se instala Octave

lapt install octave

```
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  aglfn default-jre-headless epstool fonts-droid-fallback fonts-freefont-otf fonts-noto-mono
  fonts-urw-base35 ghostscript gnuplot-data gnuplot-qt gsfonts imagemagick-6-common info
  install-info libamd2 libauthen-sasl-perl libbtf1 libcamd2 libcolamd2 libcholmod3 libclone-perl
  libcolamd2 libcomblas1.16.0 libcxspase3 libdata-dump-perl libemf1 libencode-locale-perl
  libevdev2 libfftw3-double3 libfftw3-long3 libfftw3-mpi3 libfftw3-single3 libfile-listing-perl
  libfltk-g11.3 libfltk1.3 libfont-afm-perl libglpk40 libglu1-mesa libgraphicsmagick++-q16-12
  libgraphicsmagick-q16-3 libgs9 libgs9-common libgudev-1.0-0 libhdf5-openmpi-103-1
  libhtml-form-perl libhtml-format-perl libhtml-parser-perl libhtml-tagset-perl libhtml-tree-perl
  libhttp-cookies-perl libhttp-daemon-perl libhttp-date-perl libhttp-message-perl
  libhttp-negotiate-perl libhypre-2.22.1 libidn12 libijs-0.35 libinput-bin libinput10
  libio-html-perl libio-socket-ssl-perl libjbig2dec0 libklu1 liblqr-1-0 liblua5.4-0
  liblwp-mediatypes-perl liblwp-protocol-https-perl libmagick++-6.q16-8 libmagickcore-6.q16-6
  libmagickwand-6.q16-6 libmailtools-perl libmd4c0 libmetis5 libmtdev1 libmumps-5.4
  libnet-http-perl libnet-smtp-ssl-perl libnet-ssleay-perl libnotify4 libpetsc-real3.15 libplot2c2
  libportaudio2 libpstoedit0c2a libptscotch-6.1 libqrpdate1 libqscintilla2-qt5-15
  libqscintilla2-qt5-110n libqt5core5a libqt5dbus5 libqt5gui5 libqt5shell5 libqt5network5
  libqt5sprintsupport5 libqt5sql5 libqt5sql5-sqlite libqt5svg5 libqt5widgets5 libqt5xml5
  libscalapack-openmpi2.1 libscotch-6.1 libsuitesparseconfig5 libsundials-ida4
  libsundials-nvecparallel-petsc4 libsundials-nvecserial4 libsundials-sunlinsol2
  libsundials-summatrix2 libsuperlu-dist7 libtext-unidecode-perl libtrilinos-amesos-13.2
  libtrilinos-aztec-13.2 libtrilinos-epetra-13.2 libtrilinos-epetraext-13.2
  libtrilinos-galeri-13.2 libtrilinos-ifpack-13.2 libtrilinos-kokkos-13.2 libtrilinos-ml-13.2
  libtrilinos-teuchos-13.2 libtrilinos-trilinos-13.2 libtrilinos-triutils-13.2
  libtrilinos-zoltan-13.2 libtry-tiny-perl libumfpack5 liburi-perl libwacom-bin libwacom-common
  libwacom9 libwww-flite-0.2-7 libwww-perl libwww-robotrules-perl libwxbase3.0-0v5
  libwxgtk3.0-gtk3-0v5 libxcb-icc4 libxcb-image0 libxcb-keysyms1 libxcb-render-util0 libxcb-util1
  libxcb-xinerama0 libxcb-xinput0 libxcb-xxkb1 libxkbcommon-x11-0 libxml-libxml-perl
  libxml-namespacesupport-perl libxml-parser-perl libxml-sax-base-perl libxml-sax-expat-perl
  libxml-sax-perl libzip4 netbase octave octave-common octave-doc perl-openssl-defaults poppler-data
  pstoedit qt5-gtk-platformtheme qttranslations5-l10n tex-common texinfo
Suggested packages:
  default-jre fonts-noto fonts-texgyre ghostscript-x gnuplot-doc libdigest-hmac-perl libgssapi-perl
  libfftw3-bin libfftw3-dev libfftw3-mpi-dev libiodbc2-dev graphicsmagick-dbg libcrypt-ssleay-perl
  libmagickcore-6.q16-6-extra gnome-shell | notification-daemon libqscintilla2-doc
  qt5-image-formats-plugins qtwayland5 scalapack-doc libsub-name-perl libbusiness-isbn-perl
  libauthen-ntlm-perl libxml-sax-expatxs-perl octave-dev www-browser | pdf-viewer poppler-utils
  fonts-japanese-mincho | fonts-ipafont-mincho fonts-japanese-gothic | fonts-ipafont-gothic
  fonts-arphic-ukai fonts-arphic-uming fonts-nanum xfig | ivttools-bin | tgif | transfig debhelper
  texlive-base texlive-latex-base texlive-plain-generic texlive-fonts-recommended
The following NEW packages will be installed:
  aglfn default-jre-headless epstool fonts-droid-fallback fonts-freefont-otf fonts-noto-mono
  fonts-urw-base35 ghostscript gnuplot-data gnuplot-qt gsfonts imagemagick-6-common info
  install-info libamd2 libauthen-sasl-perl libbtf1 libcamd2 libcolamd2 libcholmod3 libclone-perl
  libcolamd2 libcomblas1.16.0 libcxspase3 libdata-dump-perl libemf1 libencode-locale-perl
  libevdev2 libfftw3-double3 libfftw3-long3 libfftw3-mpi3 libfftw3-single3 libfile-listing-perl
  libfltk-g11.3 libfltk1.3 libfont-afm-perl libglpk40 libglu1-mesa libgraphicsmagick++-q16-12
  libgraphicsmagick-q16-3 libgs9 libgs9-common libgudev-1.0-0 libhdf5-openmpi-103-1
  libhtml-form-perl libhtml-format-perl libhtml-parser-perl libhtml-tagset-perl libhtml-tree-perl
  libhttp-cookies-perl libhttp-daemon-perl libhttp-date-perl libhttp-message-perl
  libhttp-negotiate-perl libhypre-2.22.1 libidn12 libijs-0.35 libinput-bin libinput10
  libio-html-perl libio-socket-ssl-perl libjbig2dec0 libklu1 liblqr-1-0 liblua5.4-0
  liblwp-mediatypes-perl liblwp-protocol-https-perl libmagick++-6.q16-8 libmagickcore-6.q16-6
  libmagickwand-6.q16-6 libmailtools-perl libmd4c0 libmetis5 libmtdev1 libmumps-5.4
  libnet-http-perl libnet-smtp-ssl-perl libnet-ssleay-perl libnotify4 libpetsc-real3.15 libplot2c2
  libportaudio2 libpstoedit0c2a libptscotch-6.1 libqrpdate1 libqscintilla2-qt5-15
  libqscintilla2-qt5-110n libqt5core5a libqt5dbus5 libqt5gui5 libqt5shell5 libqt5network5
  libqt5sprintsupport5 libqt5sql5 libqt5sql5-sqlite libqt5svg5 libqt5widgets5 libqt5xml5
  libscalapack-openmpi2.1 libscotch-6.1 libsuitesparseconfig5 libsundials-ida4
  libsundials-nvecparallel-petsc4 libsundials-nvecserial4 libsundials-sunlinsol2
  libsundials-summatrix2 libsuperlu-dist7 libtext-unidecode-perl libtrilinos-amesos-13.2
  libtrilinos-aztec-13.2 libtrilinos-epetra-13.2 libtrilinos-epetraext-13.2
  libtrilinos-galeri-13.2 libtrilinos-ifpack-13.2 libtrilinos-kokkos-13.2 libtrilinos-ml-13.2
  libtrilinos-teuchos-13.2 libtrilinos-trilinos-13.2 libtrilinos-triutils-13.2
  libtrilinos-zoltan-13.2 libtry-tiny-perl libumfpack5 liburi-perl libwacom-bin libwacom-common
  libwacom9 libwww-flite-0.2-7 libwww-perl libwww-robotrules-perl libwxbase3.0-0v5
  libwxgtk3.0-gtk3-0v5 libxcb-icc4 libxcb-image0 libxcb-keysyms1 libxcb-render-util0 libxcb-util1
  libxcb-xinerama0 libxcb-xinput0 libxcb-xxkb1 libxkbcommon-x11-0 libxml-libxml-perl
  libxml-namespacesupport-perl libxml-parser-perl libxml-sax-base-perl libxml-sax-expat-perl
  libxml-sax-perl libzip4 netbase octave octave-common octave-doc perl-openssl-defaults poppler-data
  pstoedit qt5-gtk-platformtheme qttranslations5-l10n tex-common texinfo
lapt-get install -y liboctave-dev

Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libegl-dev libfftw3-bin libfftw3-dev libfftw3-quad3 libgl-dev libgl1-mesa-dev libgles-dev
  libgles1 libglvnd-core-dev libglvnd-dev libglx-dev libopengl-dev octave-dev
Suggested packages:
  libfftw3-doc
The following NEW packages will be installed:
  libegl-dev libfftw3-bin libfftw3-dev libfftw3-quad3 libgl-dev libgl1-mesa-dev libgles-dev
  libgles1 libglvnd-core-dev libglvnd-dev libglx-dev liboctave-dev libopengl-dev octave-dev
0 upgraded, 14 newly installed, 0 to remove and 45 not upgraded.
Need to get 3,450 kB of archives.
After this operation, 26.4 MB of additional disk space will be used.
Get:1 http://archive.ubuntu.com/ubuntu jammy/main amd64 libglx-dev amd64 1.4.0-1 [14.1 kB]
Get:2 http://archive.ubuntu.com/ubuntu jammy/main amd64 libgl-dev amd64 1.4.0-1 [101 kB]
Get:3 http://archive.ubuntu.com/ubuntu jammy/main amd64 libegl-dev amd64 1.4.0-1 [18.0 kB]
```

```

Get:4 http://archive.ubuntu.com/ubuntu jammy/main amd64 libfftw3-quad3 amd64 3.3.8-2ubuntu8 [614 kB]
Get:5 http://archive.ubuntu.com/ubuntu jammy/main amd64 libfftw3-bin amd64 3.3.8-2ubuntu8 [35.5 kB]
Get:6 http://archive.ubuntu.com/ubuntu jammy/main amd64 libfftw3-dev amd64 3.3.8-2ubuntu8 [2,101 kB]
Get:7 http://archive.ubuntu.com/ubuntu jammy/main amd64 libgles1 amd64 1.4.0-1 [11.5 kB]
Get:8 http://archive.ubuntu.com/ubuntu jammy/main amd64 libgles-dev amd64 1.4.0-1 [49.4 kB]
Get:9 http://archive.ubuntu.com/ubuntu jammy/main amd64 libopengl-dev amd64 1.4.0-1 [3,400 B]
Get:10 http://archive.ubuntu.com/ubuntu jammy/main amd64 libglvnd-core-dev amd64 1.4.0-1 [12.7 kB]
Get:11 http://archive.ubuntu.com/ubuntu jammy/main amd64 libglvnd-dev amd64 1.4.0-1 [3,162 B]
Get:12 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libgl1-mesa-dev amd64 23.2.1-1ubuntu3.1~22.04.2 [6,842 B]
Get:13 http://archive.ubuntu.com/ubuntu jammy/universe amd64 octave-dev amd64 6.4.0-2 [473 kB]
Get:14 http://archive.ubuntu.com/ubuntu jammy/universe amd64 liboctave-dev all 6.4.0-2 [6,648 B]
Fetched 3,450 kB in 0s (7,061 kB/s)
Selecting previously unselected package libglx-dev:amd64.
(Reading database ... 131795 files and directories currently installed.)
Preparing to unpack .../00-libglx-dev_1.4.0-1_amd64.deb ...
Unpacking libglx-dev:amd64 (1.4.0-1) ...
Selecting previously unselected package libgl-dev:amd64.
Preparing to unpack .../01-libgl-dev_1.4.0-1_amd64.deb ...
Unpacking libgl-dev:amd64 (1.4.0-1) ...
Selecting previously unselected package libegl-dev:amd64.
Preparing to unpack .../02-libegl-dev_1.4.0-1_amd64.deb ...
Unpacking libegl-dev:amd64 (1.4.0-1) ...
Selecting previously unselected package libfftw3-quad3:amd64.
Preparing to unpack .../03-libfftw3-quad3_3.3.8-2ubuntu8_amd64.deb ...
Unpacking libfftw3-quad3:amd64 (3.3.8-2ubuntu8) ...
Selecting previously unselected package libfftw3-bin.
Preparing to unpack .../04-libfftw3-bin_3.3.8-2ubuntu8_amd64.deb ...
Unpacking libfftw3-bin (3.3.8-2ubuntu8) ...
Selecting previously unselected package libfftw3-dev:amd64.
Preparing to unpack .../05-libfftw3-dev_3.3.8-2ubuntu8_amd64.deb ...
Unpacking libfftw3-dev:amd64 (3.3.8-2ubuntu8) ...
Selecting previously unselected package libgles1:amd64.
Preparing to unpack .../06-libgles1_1.4.0-1_amd64.deb ...
Unpacking libgles1:amd64 (1.4.0-1) ...
Selecting previously unselected package libgles-dev:amd64.
Preparing to unpack .../07-libgles-dev_1.4.0-1_amd64.deb ...
Unpacking libgles-dev:amd64 (1.4.0-1) ...
Selecting previously unselected package libopengl-dev:amd64.
Preparing to unpack .../08-libopengl-dev_1.4.0-1_amd64.deb ...
Unpacking libopengl-dev:amd64 (1.4.0-1) ...
Selecting previously unselected package libglvnd-core-dev:amd64

```

```

%%writefile instalacion_pkg.m
pkg install -forge control

```

```

Writing instalacion_pkg.m

```

```

%%writefile inst_pkg_signal.m
pkg install -forge signal

```

```

Writing inst_pkg_signal.m

```

```

loctave -W instalacion_pkg.m

```

```

slicot/src/TB01ZD.f:272:72: warning: type of 'mb01pd' does not match original declaration [-Wlto-type-mismatch]
272 | CALL MB01PD( 'S', 'G', N, N, 0, 0, ANORM, 0, NBLK, A, LDA, INFO )
    | ^
slicot/src/MB01PD.f:1:23: note: 'mb01pd' was previously declared here
1 | SUBROUTINE MB01PD( SCUN, TYPE, M, N, KL, KU, ANRM, NBL, NROWS, A,
  | ^
slicot/src/MB01PD.f:1:23: note: code may be misoptimized unless '-fno-strict-aliasing' is used
sl_sb10ad.cc:36:9: warning: type of 'sb10ad_' does not match original declaration [-Wlto-type-mismatch]
36 | int F77_FUNC (sb10ad, SB10AD)
    | ^
slicot/src/SB10AD.f:1:23: note: return value type mismatch
1 | SUBROUTINE SB10AD( JOB, N, M, NP, NCON, NMEAS, GAMMA, A, LDA,
  | ^
slicot/src/SB10AD.f:1:23: note: type 'void' should match type 'int'
slicot/src/SB10AD.f:1:23: note: 'sb10ad' was previously declared here
slicot/src/SB10AD.f:1:23: note: code may be misoptimized unless '-fno-strict-aliasing' is used
sl_tg01fd.cc:35:9: warning: type of 'tg01fd_' does not match original declaration [-Wlto-type-mismatch]
35 | int F77_FUNC (tg01fd, TG01FD)
    | ^
slicot/src/TG01FD.f:1:23: note: return value type mismatch
1 | SUBROUTINE TG01FD( COMPQ, COMPZ, JOBA, L, N, M, P, A, LDA, E, LDE,
  | ^
slicot/src/TG01FD.f:1:23: note: type 'void' should match type 'int'
slicot/src/TG01FD.f:1:23: note: 'tg01fd' was previously declared here
sl_ib01ad.cc:36:9: warning: type of 'ib01ad_' does not match original declaration [-Wlto-type-mismatch]
36 | int F77_FUNC (ib01ad, IB01AD)
    | ^
slicot/src/IB01AD.f:1:23: note: return value type mismatch
1 | SUBROUTINE IB01AD( METH, ALG, JOBD, BATCH, CONCT, CTRL, NOBR, M,
  | ^
slicot/src/IB01AD.f:1:23: note: type 'void' should match type 'int'
slicot/src/IB01AD.f:1:23: note: 'ib01ad' was previously declared here
sl_ident.cc:51:9: warning: type of 'ib01bd_' does not match original declaration [-Wlto-type-mismatch]
51 | int F77_FUNC (ib01bd, IB01BD)
    | ^
slicot/src/IB01BD.f:1:23: note: return value type mismatch
1 | SUBROUTINE IB01BD( METH, JOB, JOBCK, NOBR, N, M, L, NSMPL, R,
  | ^
slicot/src/IB01BD.f:1:23: note: type 'void' should match type 'int'
slicot/src/IB01BD.f:1:23: note: 'ib01bd' was previously declared here
slicot/src/IB01BD.f:1:23: note: code may be misoptimized unless '-fno-strict-aliasing' is used
sl_ib01cd.cc:36:9: warning: type of 'ib01cd_' does not match original declaration [-Wlto-type-mismatch]
36 | int F77_FUNC (ib01cd, IB01CD)
    | ^
slicot/src/IB01CD.f:1:23: note: return value type mismatch
1 | SUBROUTINE IB01CD( JOBX0, COMUSE, JOB, N, M, L, NSMP, A, LDA, B,
  | ^
slicot/src/IB01CD.f:1:23: note: type 'void' should match type 'int'
slicot/src/IB01CD.f:1:23: note: 'ib01cd' was previously declared here
sl_sb10yd.cc:36:9: warning: type of 'sb10yd_' does not match original declaration [-Wlto-type-mismatch]
36 | int F77_FUNC (sb10yd, SB10YD)
    | ^
slicot/src/SB10YD.f:1:23: note: return value type mismatch
1 | SUBROUTINE SB10YD( DISCFL, FLAG, LENDAT, RFRDAT, IFRDAT, OMEGA, N,
  | ^

```

```
slicot/src/SB10YD.f:1:23: note: type 'void' should match type 'int'
slicot/src/SB10YD.f:1:23: note: 'sb10yd' was previously declared here
```

```
!octave -W inst_pkg_signal.m
```

For information about changes from previous versions of the signal package, run 'news signal'.

Se resuelve en forma analítica mediante Octave:

```
%%writefile Calculo_RLC_Analitico.m
clear all; clc;
pkg load control
pkg load signal
warning('off','all');

#Defino el espacio de estados
A= [-1, -1; 1, 0];
B= [1; 0];
C= [1;0];
C2= [0;1];
C_transp= C';
C2_transp=C2';
#Planteo el sistema
sys=ss(A,B,C_transp);
[num,den]=ss2tf(sys);

sys2=ss(A,B,C2_transp);
[num2,den2]=ss2tf(sys2);

G=tf(num,den);
G2=tf(num2,den2);

t=0:0.1:3;
u = zeros (length(t) ,1);
i=1;
for t=0:0.1:3
    i=i+1;
    u(i,1)=12;
endfor
#Grafico y guardo el png
hfig1 = figure(1); set(hfig1, 'Visible', 'off');

subplot(2,1,1); hold on;
lsim(sys,u,t);title('x_1 corriente'); hold on;

subplot(2,1,2); hold on;
lsim(sys2,u,t);title('x_2 Vc_t'); hold on;

print(hfig1,'Vars_temporal','-r300','-dpng');
save('Calculo_RLC_Analitico.mat','-v7');

Writing Calculo_RLC_Analitico.m

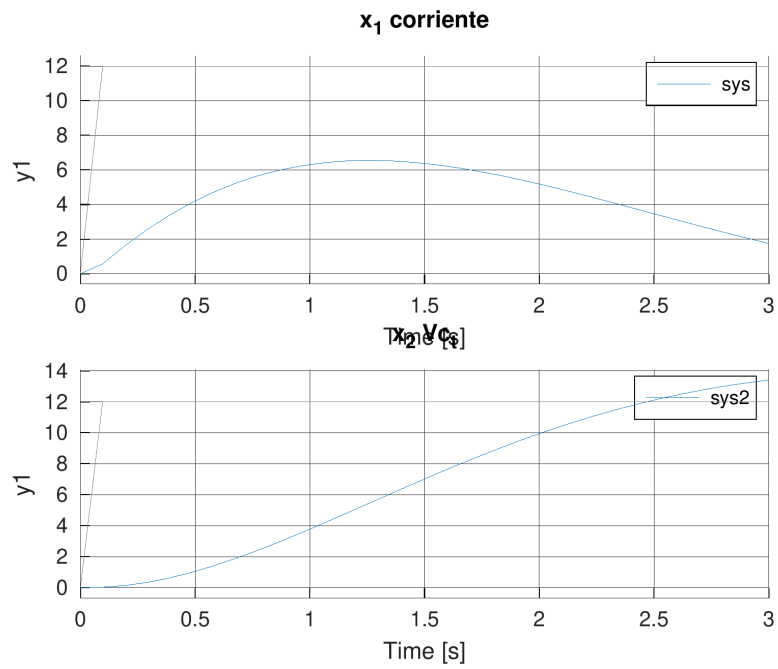
!octave -W Calculo_RLC_Analitico.m

ans = -8.2778
ans = -23.804

!octave -W Calculo_RLC_Analitico.m
import scipy.io
mat = scipy.io.loadmat('/content/Calculo_RLC_Analitico.mat')

ans = -8.2778
ans = -23.804

from PIL import Image
imt = Image.open("/content/Vars_temporal.png")
imt
```



#### ✎ Actividad 1 - b.

Planteando la solución mediante Euler:

```

%%writefile Verificacion_Num.m
clc;
clear all;
warning('off','all');

% Defino el espacio de estados
R=1; L=1; C=1;
A=[-R/L, -1/L; 1/C,0];
B=[1/L;0];
C_out=[R 0];

%condicion inicial
X=[0; 0];

%tiempo de etapa
t_etapa=3e-4;

%Tiempo de fin de simulación
tF=3;

u=12;

ii = 0;
for t=0:t_etapa:tF
    ii=ii+1;
    x1(ii)=X(1); % corriente
    x2(ii)=X(2); % tensión en el capacitor
    x=X;
    xp=A*x+B*u;
    x=x+xp*t_etapa;
    X=x;
end

t=0:t_etapa:tF;
hfig1 = figure(1); set(hfig1, 'Visible', 'off');

% Plotting
subplot(2,1,1);hold on;
plot(t, x1, 'r');
title('x_1 corriente');

subplot(2,1,2);hold on;
plot(t, x2, 'r');
title('x_2 Vc_t');

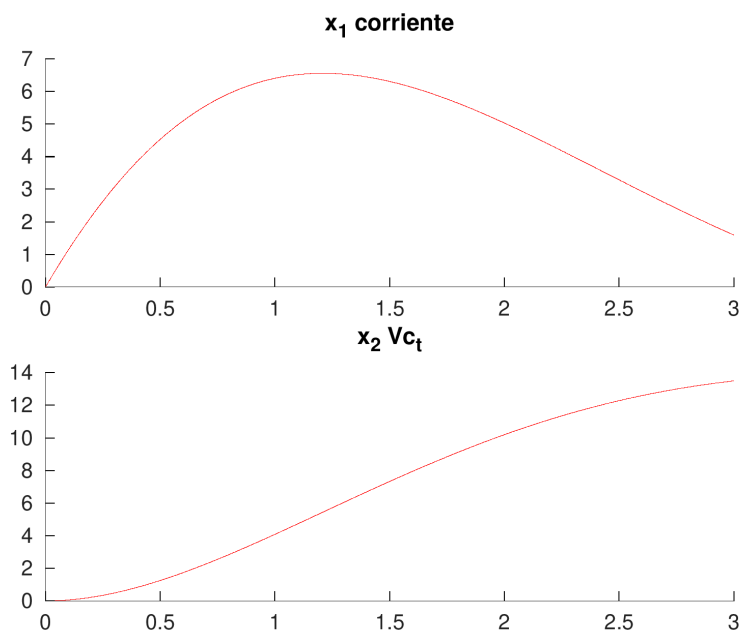
print(hfig1,'Vars_temporal','-r300','-dpng');
save('Verificacion_Num_1.mat','-v7');

    Overwriting Verificacion_Num.m

# -W : no window system
!octave -W Verificacion_Num.m
import scipy.io
mat = scipy.io.loadmat('/content/Verificacion_Num_1.mat')

from PIL import Image
imt = Image.open("/content/Vars_temporal.png")
imt

```



## ✓ Actividad 2

Se asignan los valores:  $R = 2.2k\Omega$ ,  $L = 10\mu H$  y  $C = 100nF$ . Planteando la solución mediante Euler:

```

%%writefile Verificacion_Num.m
clc;
clear all;
warning('off','all');

% Defino el espacio de estados
R=2200; L=10e-6; C=100e-9;
A=[-R/L, -1/L; 1/C,0];
B=[1/L;0];
C_out=[R 0];

%condicion inicial
X=[0; 0];

%tiempo de etapa
t_etapa=0.01E-9;

%Tiempo de fin de simulación
tF=2E-6;

u=12;

ii = 0;
for t=t_etapa:tF
    ii=ii+1;
    x1(ii)=X(1); % corriente
    x2(ii)=X(2); % tensión en el capacitor
    x=X;
    xp=A*x+B*u;
    x=x+xp*t_etapa;
    X=x;
end

t=0:t_etapa:tF;
hfig1 = figure(1); set(hfig1, 'Visible', 'off');
% Plotting
subplot(2,1,1);hold on;
plot(t, x1, 'r');
title('x_1 corriente');

subplot(2,1,2);hold on;
plot(t, x2, 'r');
title('x_2 Vc_t');

print(hfig1,'Vars_temporal','-r300','-dpng');
save('Verificacion_Num_1.mat','-v7');

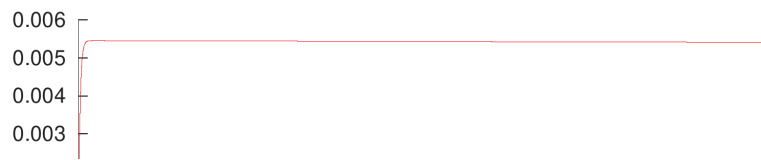
    Overwriting Verificacion_Num.m

# -W : no window system
!octave -W Verificacion_Num.m
import scipy.io
mat = scipy.io.loadmat('/content/Verificacion_Num_1.mat')

from PIL import Image
imt = Image.open("/content/Vars_temporal.png")
imt

```

**$x_1$  corriente**



### ▼ Actividad 3

Considerando que la entrada cambia de signo cada 1ms

**$v = V_a$**

```
%%writefile Verificacion_Num.m  
clc;  
clear all;
```