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```
% Matlab m-file for ECE 214 Lab #3

addpath('D:\CppSim\CppSimShared\HspiceToolbox');
clear variables;
hspc_filename = 'ECE214_2018_Lab3.hspc';
```

Define variables, specify NGspice control statement, and run NGspice

put your resistor and capacitor values here

```
R1 = 2000;
R2 = 1000;
C1 = 100e-9;
C2 = 100e-9;
% label resistors as 'res1,' 'res2,' 'cap1,' and 'cap2' in your
 schematic
hspc_set_param('res1', R1, hspc_filename);
hspc_set_param('res2', R2, hspc_filename);
hspc_set_param('cap1', C1, hspc_filename);
hspc_set_param('cap2', C2, hspc_filename);

hspc_addline('.tran 10u 125m 25m', hspc_filename);
ngsim(hspc_filename); % run NGspice

-> Changing parameter 'res1' to value '2000' in file
 'ECE214_2018_Lab3.hspc'
-> Changing parameter 'res2' to value '1000' in file
 'ECE214_2018_Lab3.hspc'
-> Changing parameter 'cap1' to value '1e-07' in file
 'ECE214_2018_Lab3.hspc'
-> Changing parameter 'cap2' to value '1e-07' in file
 'ECE214_2018_Lab3.hspc'
-> Adding line '.tran 10u 125m 25m' in file 'ECE214_2018_Lab3.hspc'
Library: ECE214,  Cell: lab3,  Parameter file: ECE214_2018_Lab3.hspc
... netlisting ...
Spice netlisting of cell 'lab3' completed with no errors
... running hspc ...
```

```
... running NGspice ...

*************** NGspice run has completed ***************
```

load simulation results and extract time, Vout, and Vin

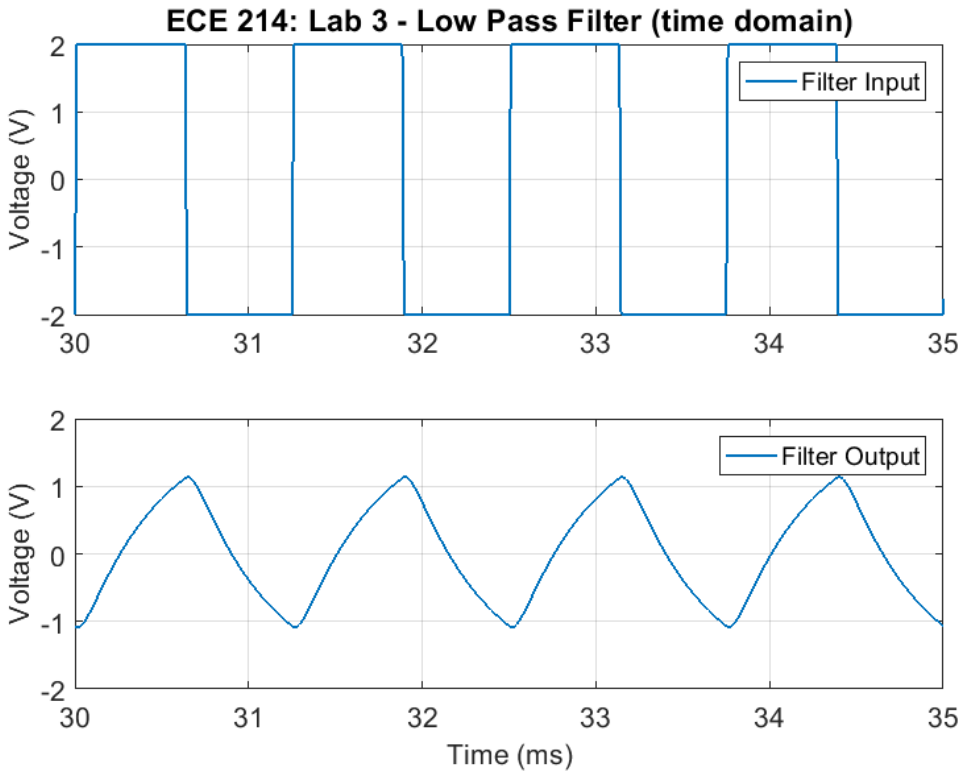
```
data = loadsig('simrun.raw');
time = evalsig(data, 'TIME');
Vout = evalsig(data,'vout');
Vin = evalsig(data, 'vin');
```

plot Vin and Vout as a function of time

```
fs = 16; % define font size
lw = 1.5; % define linewidth
Fig1 = figure('Position', [200, 75, 850, 600]); % figure size and
 location

subplot(2,1,1); % first subplot
plot(time.*1000,  Vin, 'linewidth',lw);
grid on; % add grid
set(gca, 'fontsize', fs); % set font size
ylabel('Voltage (V)', 'fontsize', fs); % label y-axis
title('ECE 214: Lab 3 - Low Pass Filter (time domain)'); % title
legend('Filter Input'); % add legend
axis([30 35 -2 2]); % set axis limits

subplot(2,1,2); % second subplot
plot(time.*1000, Vout, 'linewidth',lw);
grid on; % add grid
set(gca, 'fontsize', fs); % set font size
xlabel('Time (ms)', 'fontsize', fs); % label x-axis
ylabel('Voltage (V)', 'fontsize', fs); % label y-axis
legend('Filter Output'); % add legend
axis([30 35 -2 2]); %set axis limits
```

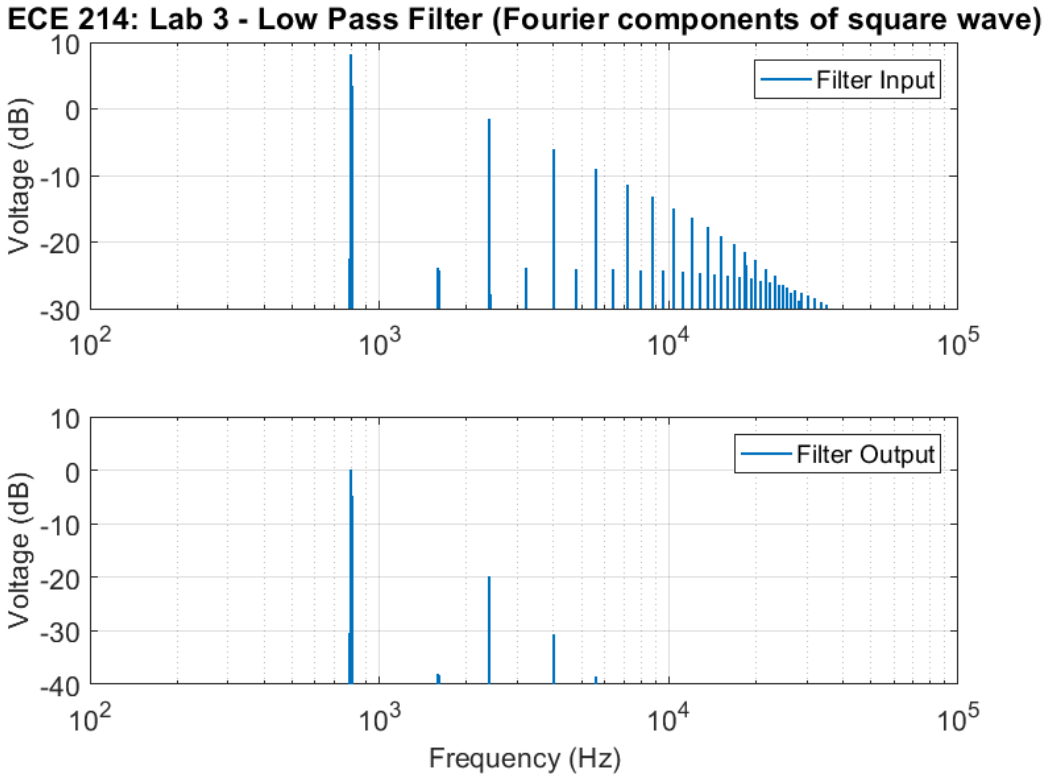


Plot the FFT (Approximate Fourier Series)

```
Fig2 = figure('Position', [150, 75, 850, 600]); % figure size and
 location

subplot(2,1,1);
[freq, mag_in] = vt_to_vf(time, Vin); % generate Fourier components
semilogx(freq, mag_in, 'linewidth', lw);
grid on;
set(gca, 'fontsize', fs);
axis([100,1e5,-30,10]); % set axis limits
legend('Filter Input'); % add legend
ylabel('Voltage (dB)', 'fontsize', fs); % label y-axis
title('ECE 214: Lab 3 - Low Pass Filter (Fourier components of square
 wave)')

subplot(2,1,2);
[freq, mag_out] = vt_to_vf(time, Vout); % generate Fourier components
semilogx(freq, mag_out, 'linewidth', lw);
grid on;
set(gca, 'fontsize', fs);
axis([100,1e5,-40,10]);
legend('Filter Output'); % add legend
ylabel('Voltage (dB)', 'fontsize', fs); % label y-axis
xlabel('Frequency (Hz)', 'fontsize', fs); % label x-axis
```



Post Lab - Frequency response of Low Pass Filter (ac analysis)

hspc_addline('.ac dec 200 100 1e5', hspc_filename); % change from transient to ac analysis ngsim(hspc_filename); % run NGspice

%% Load simulation results and extract Frequency and Vout data = loadsig('simrun.raw'); frequency = evalsig(data, 'FREQUENCY'); Vout = evalsig(data,'vout');

%% Plot amplitude and phase

Fig3 = figure('Position', [100, 75, 850, 600]);

subplot(2,1,1) semilogx(frequency, 20*log10(abs(Vout)), 'linewidth',lw); grid on; set(gca, 'fontsize', fs); ylabel('dB Voltage', 'fontsize', fs); title('ECE 214: Lab 3, Low Pass Filter (frequency response)'); legend('Filter Input'); % add legend

subplot(2,1,2) semilogx(frequency, phase(Vout)*180/pi, 'linewidth',lw); grid on; set(gca, 'fontsize', fs); xlabel('Frequency (Hz)', 'fontsize', fs); ylabel('Phase (degrees)', 'fontsize', fs); legend('Filter Output'); % add legend

end of M file

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