```
%LP VCVS filter N=4
clc
close all
clear

wc=6800*pi; %speech signal filter fc=3400Hz
w=linspace(1,20000*2*pi,10000); % range from 0 to 20kHz


r11=7674; %stage I
r21=26242;
r31=45221;
r41=135664;

r12=5432; %stage II
r22=37065;
r32=56598;
r42=169795;

c=3.3e-9; % 3.3nF

k1=1+(r41/r31);
k2=1+(r42/r32);
K=k1*k2; % passband gain

%TF coefficients
b0 = 1/(r11*r21*c*c);
b1 = 1/(r11*c) + (2-k1)/(r21*c);

H1 = k1*b0./((1i*w).^2 + 1i*w*b1 + b0);

b0 = 1/(r12*r22*c*c);
b1 = 1/(r12*c) + (2-k1)/(r22*c);

H2 = k2*b0./((1i*w).^2 + 1i*w*b1 + b0);

H = H1.*H2;
```

```
mag_response = abs(H);

phase_response = rad2deg(unwrap(angle(H)));

figure(1)
plot(w/(2*pi),mag_response, 'linewidth', 2.5), grid on, zoom xon
xlabel('Freguency (Hz) - linear scale')
ylabel('Magnitude response - |Vo/Vi|')

figure(2)
semilogx(w/(2*pi),mag_response, 'linewidth', 2.5), grid on, zoom xon
xlabel('Freguency (Hz) - log scale')
ylabel('Magnitude response - |Vo/Vi|')

figure(3)
semilogx(w,mag_response, 'linewidth', 2.5), grid on, zoom xon
xlabel('Freguency (rad/s) - log scale')
ylabel('Magnitude response - |Vo/Vi|')

figure(4)
semilogx(w,mag_response.^2, 'linewidth', 2.5), grid on, zoom xon
xlabel('Freguency (rad/s) - log scale')
ylabel('Magnitude-squared response - |Vo/Vi|^2')

figure(5)
semilogx(w,10*log10(mag_response.^2), 'linewidth', 2.5), grid on, zoom xon
xlabel('Freguency (rad/s) - log scale')
ylabel('Magnitude-squared response (dB)')

figure(6)
semilogx(w,10*log10((mag_response/max(mag_response)).^2), 'linewidth',
2.5), grid on, zoom xon
xlabel('Freguency (rad/s) - log scale')
ylabel('Normalized Magnitude-squared response (dB)')



figure(7)
```

```
plot(w/(2*pi),phase_response, 'linewidth', 2.5), grid on, zoom xon
xlabel('Freguency (Hz) - linear scale')
ylabel('Phase response (degrees)')
```