## Table of Contents

# Case study 3: Circuits as filters

**ESE 105**

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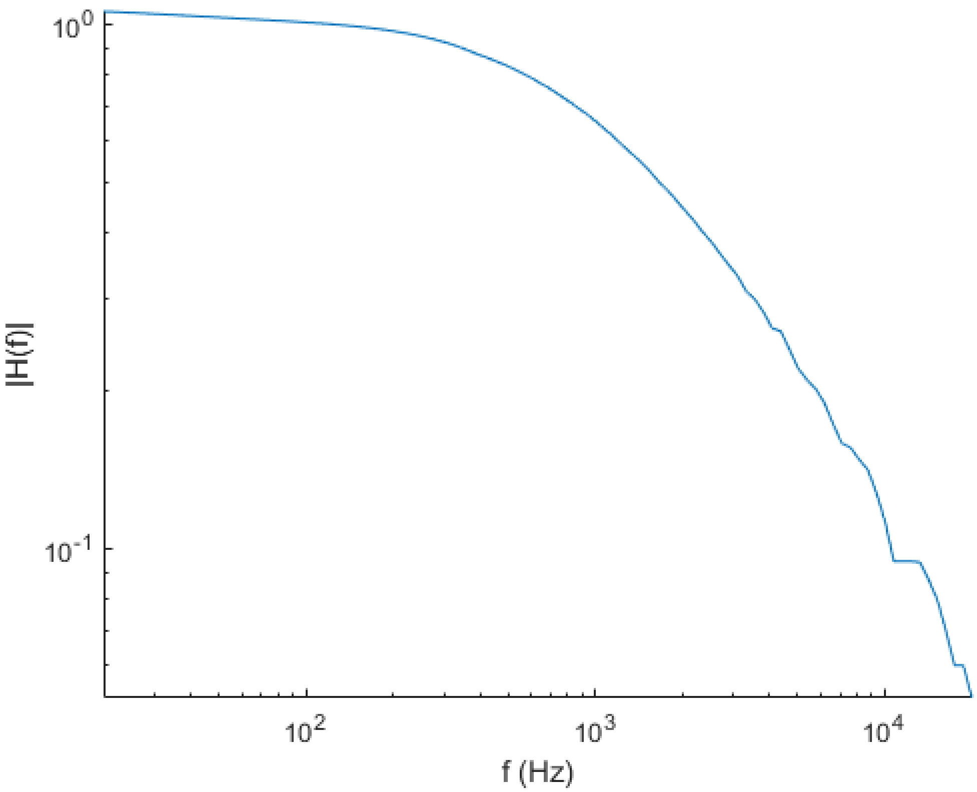
```
clear;
close all;
```

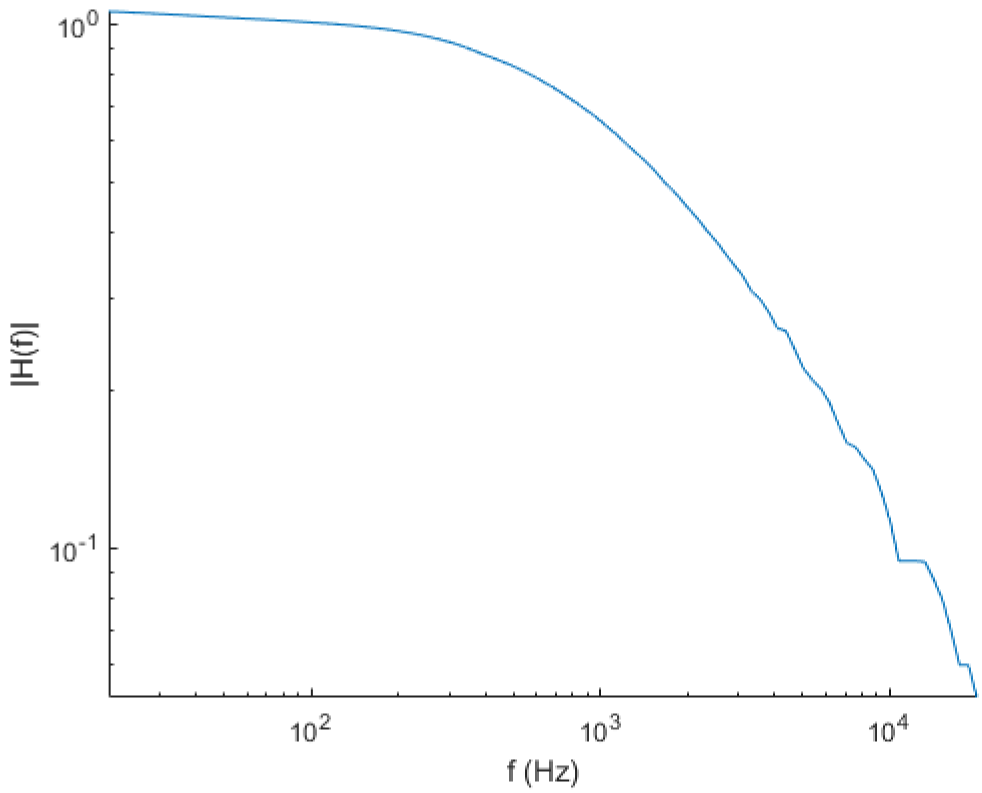
# Part 4: Transfer functions

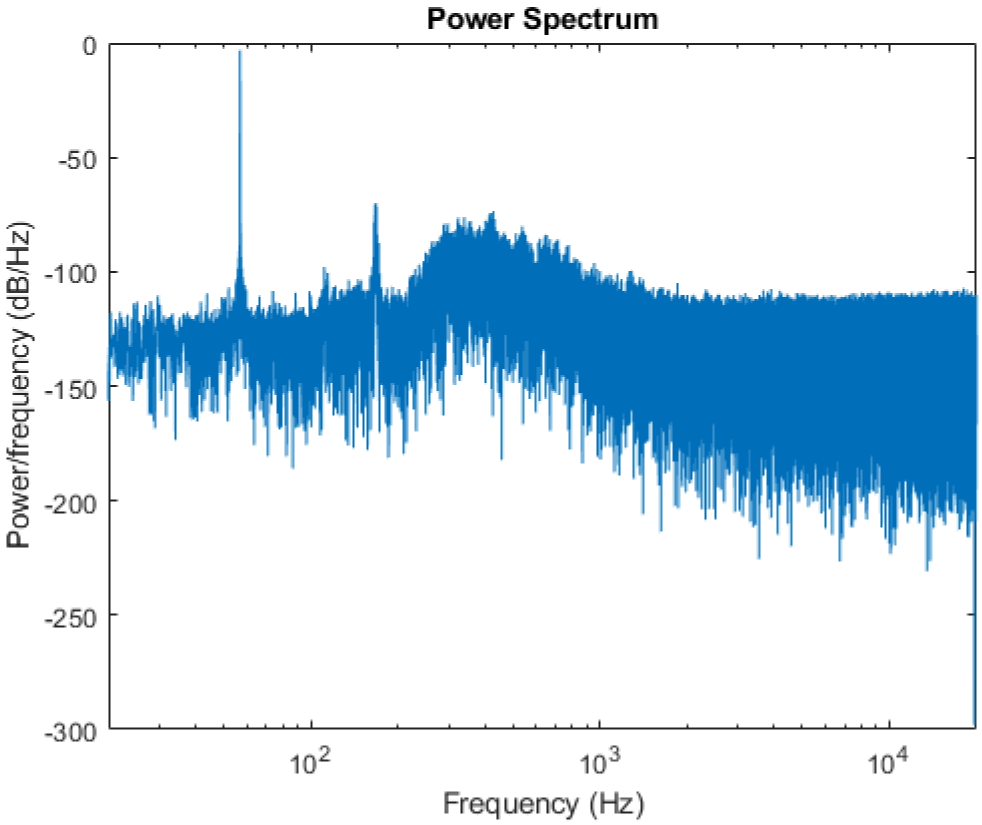
```
h = 1/44100;
f = logspace(log10(20),log10(20E3),101);
H_bandpass = zeros(size(f));

for a = 1:length(f)
    % generate inputs
    t = 0:h:2/f(a);
    V_in = 5 * sin(2*pi*f(a)*t);    % Volts

    % compute response
    V_bandpass = RCfilter(V_in,h);

    % compute transfer function at frequency f
 H_bandpass(a) = max(abs(V_bandpass))/max(abs(V_in));
end

figure;
loglog(f,H_bandpass); box off;
xlim([20 20E3]);    % limit plot to normal human hearing range
ylabel('|H(f)|');
xlabel('f (Hz)');
snapnow
```

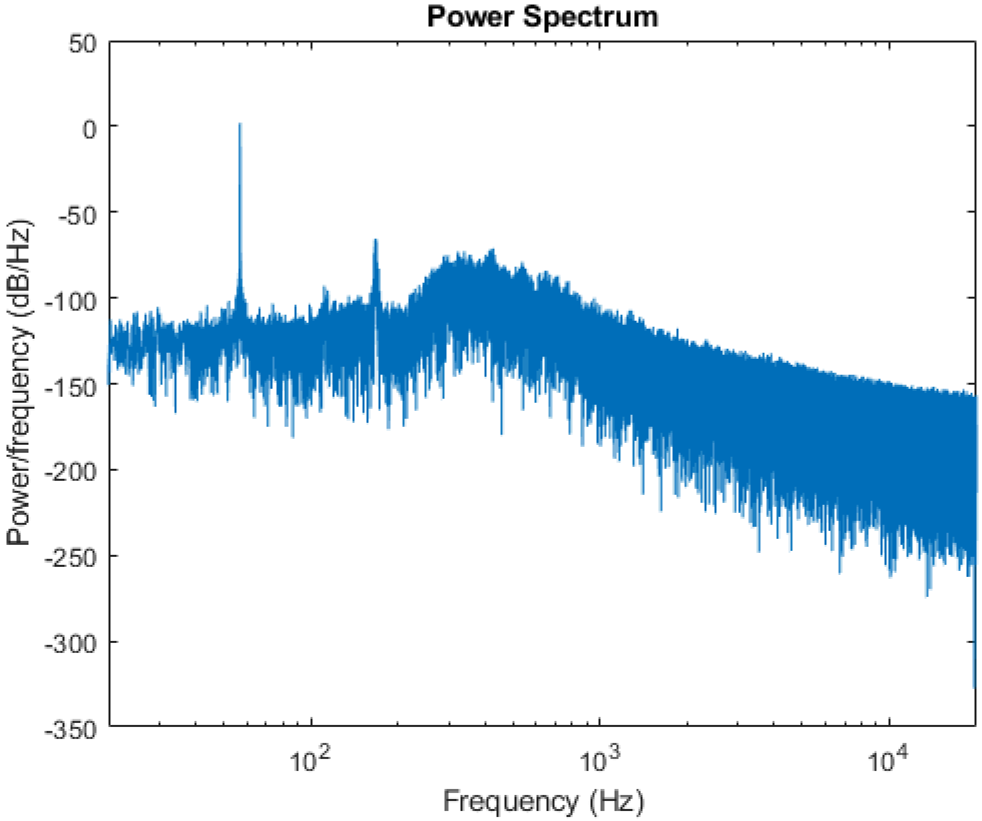


# Filter a noisy signal

```
% load('handel.mat');
% load('noisyhandel.mat');
% load('apollo11-main-landing.mat');
load('noisy-apollo11-main-landing.mat');

% set sampling interval to match sampling rate of the audio signal
h = 1/Fs;

% compute signal output from circuit
VsoundFiltered = RCfilter(Vsound,h);

% compare power spectra
plotPowerSpectrum(Vsound,Fs);
plotPowerSpectrum(VsoundFiltered,Fs);

% play original sound
playSound(Vsound,Fs);

% play sound after circuit filter
playSound(VsoundFiltered,Fs);
```


$10^0$
$10^{-1}$
|H(f)|
$10^2$
$10^3$
$10^4$
f (Hz)


Power Spectrum
0
-50
-100
-150
-200
-250
-300
Power/frequency (dB/Hz)
$10^2$
$10^3$
$10^4$
Frequency (Hz)



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