EE115 Lab 1

1) In this task, we will examine the average power of a random signal that has its minimum value larger than or equal to -1, and its impact n the power efficiency of the conventional AM signals.

a) Use the Gaussian random generator to generate a random sequence $m[0], m[1], \ldots, m[N]$ where N could be 200 or some other large integer

```
clear variables
% closes all figures
close all
% Random seed, allows how to set a random seed for a random sequence. This
% means that we're always using the random seed of 0. This means that if I
% run the code multiple times I will get the same results. If you want
% different sequences comment this out
rng(0);
% Generates a sample (random sequence) from Gaussian distribution
m = randn(1,200)
```

```
m = 1×200
    0.5377    1.8339   -2.2588    0.8622    0.3188   -1.3077   -0.4336    0.3426 ···
```

b) Determine the minimum value of the sequence and denoote it by $-M_0$.

```
M_o = -min(m)
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```
M_o = 2.9443
```

c)Compute the normalized sequence $m_n[k] = \frac{1}{M_0} m[k]$ whose minimum value should be now -1

```
m_n_k = (1/M_o)*m;
norm_min_val = min(m_n_k)
```

```
norm_min_val = -1
```

d) Compute the average power of $m_n[k]$ by $P_m = \frac{1}{N} \sum_{k=1}^{N} m_n^2[k]$

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p = sum(m_n_k.^2);
p_m = (1/200)*p
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```
p_m = 0.1360
```

*e) If we apply the conventional AM to $m_n(t) = m_n[k]\text{rect}(t - \text{kT})$ when rect(t) is a rectangular pulse of width equal to T, the transmitted signal is:

$$u_{\mathrm{AM}}(t) = A_c(a_{\mathrm{mod}}m_n(t) + 1)\cos(2\pi f_c t)$$

and then its power efficiency is

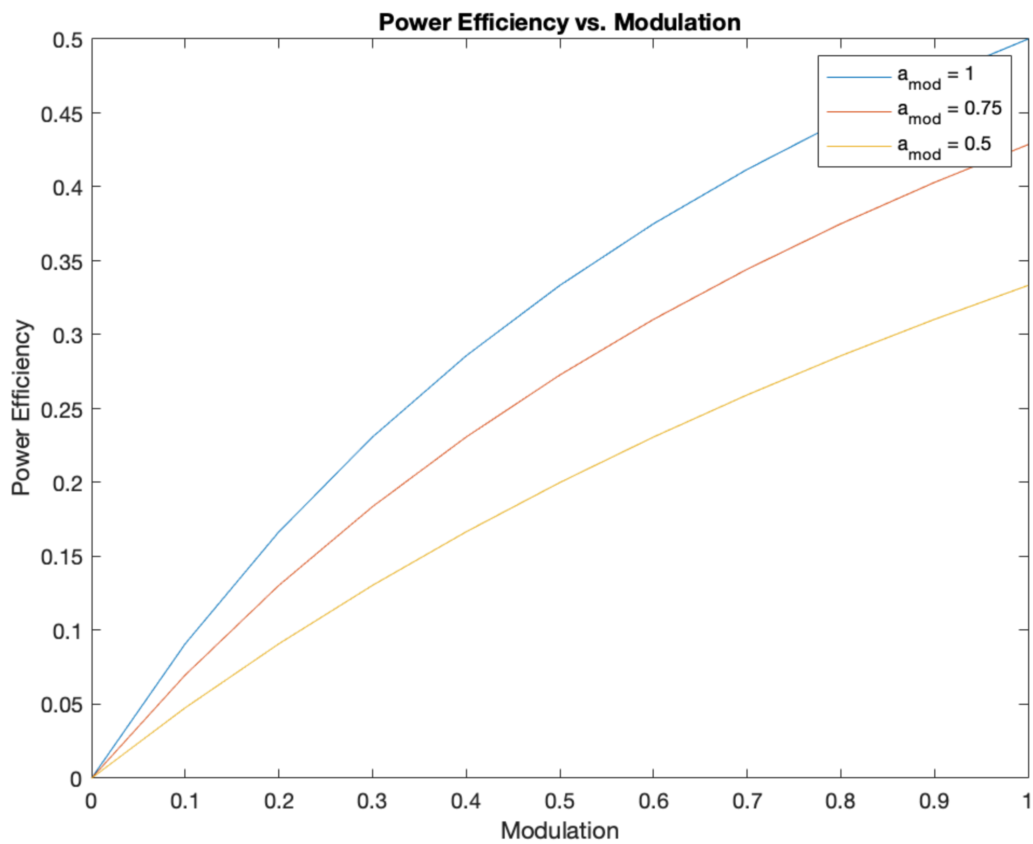
$$\eta_{\mathrm{AM}} = \frac{a_{\mathrm{mod}}P_m}{1 + a_{\mathrm{mod}}P_m}$$

Plot η_{AM} versus $0 < P_m < 1$ for each of $a_{\mathrm{mod}} = 1, 0, 75, 0.5$

```
% Use the dot operator
% Since p_m is a variable use the range
pm = 0:0.1:1;
a_1 = 1;
plot_1 = (a_1*pm)./(1 + a_1*pm);
figure (1)
plot(pm,plot_1)
xlabel('Modulation')
ylabel('Power Efficiency')
title('Power Efficiency vs. Modulation')
hold all

a_2 = 0.75;
plot_2 = (a_2*pm)./(1 + a_2*pm);
plot(pm,plot_2)

a_3 = 0.5;
plot_3 = (a_3*pm)./(1 + a_3*pm);
plot(pm,plot_3)
legend('a_m_o_d = 1', 'a_m_o_d = 0.75', 'a_m_o_d = 0.5')
```



2) In this task, we will examine the quality of a simple DC blocker which consists of a capacitor C and a resistor R (in serial connection). We know that the frequency response $H(f)$ of the DC blocker is:

$$H(f) = \frac{\mathrm{j}2\pi f}{\mathrm{j}2\pi f + \frac{1}{\mathrm{RC}}}$$

a) Plot $|H(f)|$ versus $-50 < f < 50$ in Hz for each of $\mathrm{RC} = 0.01, 0.1, 1, 10$

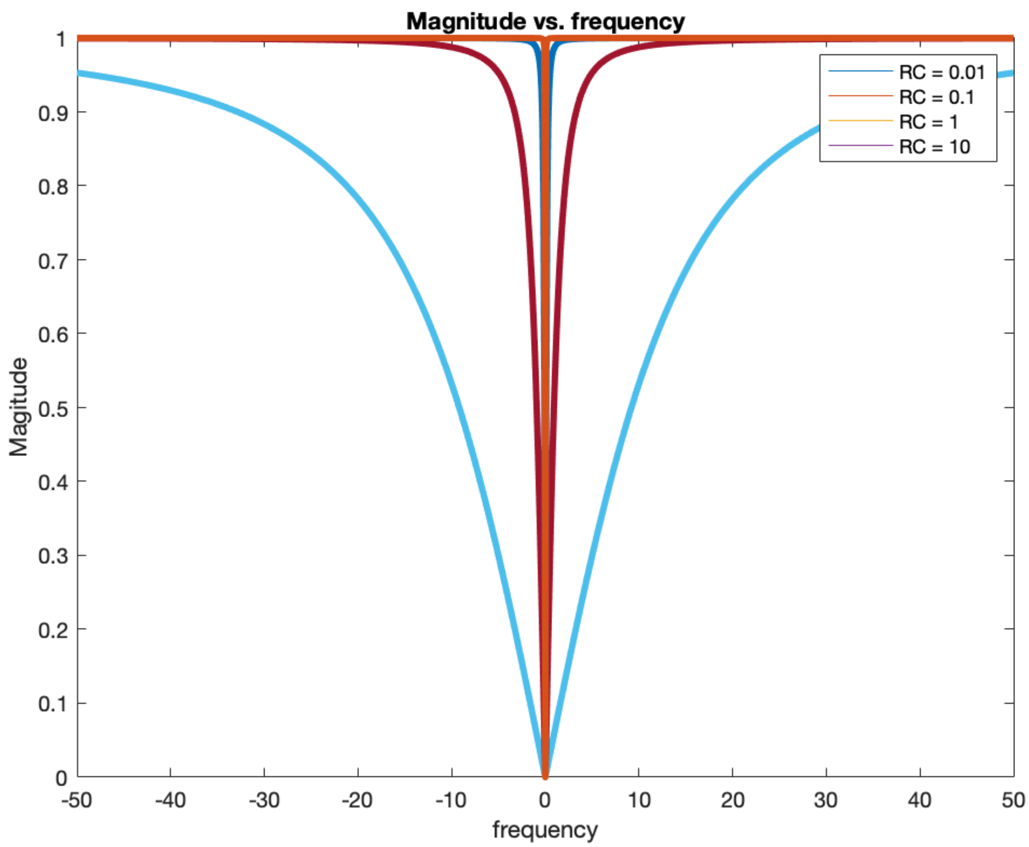
```
% to compute the magnitude us the abs function
frequency = -50:0.1:50;
RC_1 = 0.01;
H_F_1 = abs((1i*2*pi*frequency)./(1i*2*pi*frequency + (1/RC_1)));
figure (2)
plot(frequency, H_F_1, 'linewidth',3);
xlabel('frequency')
ylabel('Magnitude of |H(f)|')
title('Magnitude vs. frequency')
hold all

RC_2 = 0.1;
H_F_2 = abs((1i*2*pi*frequency)./(1i*2*pi*frequency + (1/RC_2)));
plot(frequency, H_F_2, 'linewidth',3);
```

```
RC_3 = 1;
H_F_3 = abs((1i*2*pi*frequency)./(1i*2*pi*frequency + (1/RC_3)));
plot(frequency, H_F_3, 'linewidth',3);

RC_4 = 10;
H_F_4 = abs((1i*2*pi*frequency)./(1i*2*pi*frequency + (1/RC_4)));
plot(frequency, H_F_4, 'linewidth',3);

legend('RC = 0.01', 'RC = 0.1', 'RC = 1', 'RC = 10')
```



b) If we want too remove the DC component from *Enter your equation.* where the spectrum of occupies the band from 20Hz to 5kHz, what shuld be an acceptable range of the RC values? (Provide a proper minimum value of RC.)

Because we want the DC component to not attenuate our signal at a frequency less than 20Hz, we need to use an inequality statement to determine what value of RC is acceptable:

$$\frac{1}{\mathrm{RC}} < 20\mathrm{Hz} \Rightarrow \mathrm{RC} > \frac{1}{20\mathrm{Hz}} \Rightarrow \mathrm{RC} = 0.05.$$