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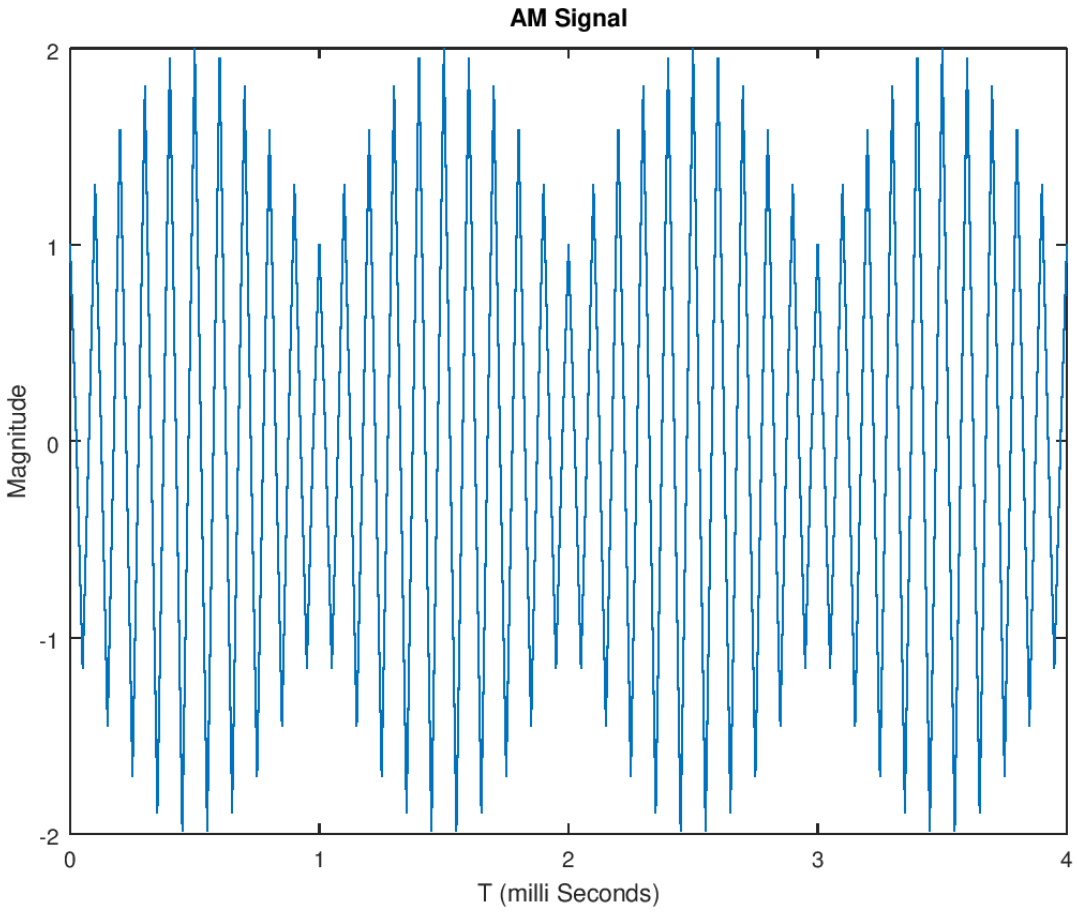
Generated AM signal:

**Code:**

```
%% getAM: Returns random AM signal
function [tAM, uAM] = getAM()
        ns = 4;

        T = 1; % In milli seconds
        m = 40; % Sample rate

        %discrete time representation of sine pulse
        time_p = 0:T/m:1; %sampling times over duration of pulse
        p = sin(pi*time_p); %samples of the pulse
        %symbols to be modulated
        % symbols = [-1;1;1;-1]

        % Random symbols
        symbols = randomArray(4);

        %UPSAMPLE BY m
        nsymbols = length(symbols);%length of original symbol sequence
        nsymbols_upsampled = 1+(nsymbols-1)*m;%length of upsampled symbol sequence
        symbols_upsampled = zeros(nsymbols_upsampled,1);%
        symbols_upsampled(1:m:nsymbols_upsampled) = symbols;%insert symbols with spacing
M

        %GENERATE MODULATED SIGNAL BY DISCRETE TIME CONVOLUTION
        u = conv(symbols_upsampled,p)';

        %PLOT MODULATED SIGNAL
        time_u = 0:T/m:(length(u)-1)/m; %unit of time = symbol time T


        % %%%%%%%%%%%%%
        % The AM signal

        Ac = 1;
        fc = 10/T;

        tAM = time_u;
        uAM = (u + Ac).*cos(2*pi*fc*tAM);

        size(tAM)
        size(uAM)
end
```

**Plot:**




AM signal has both positive and negative amplitudes

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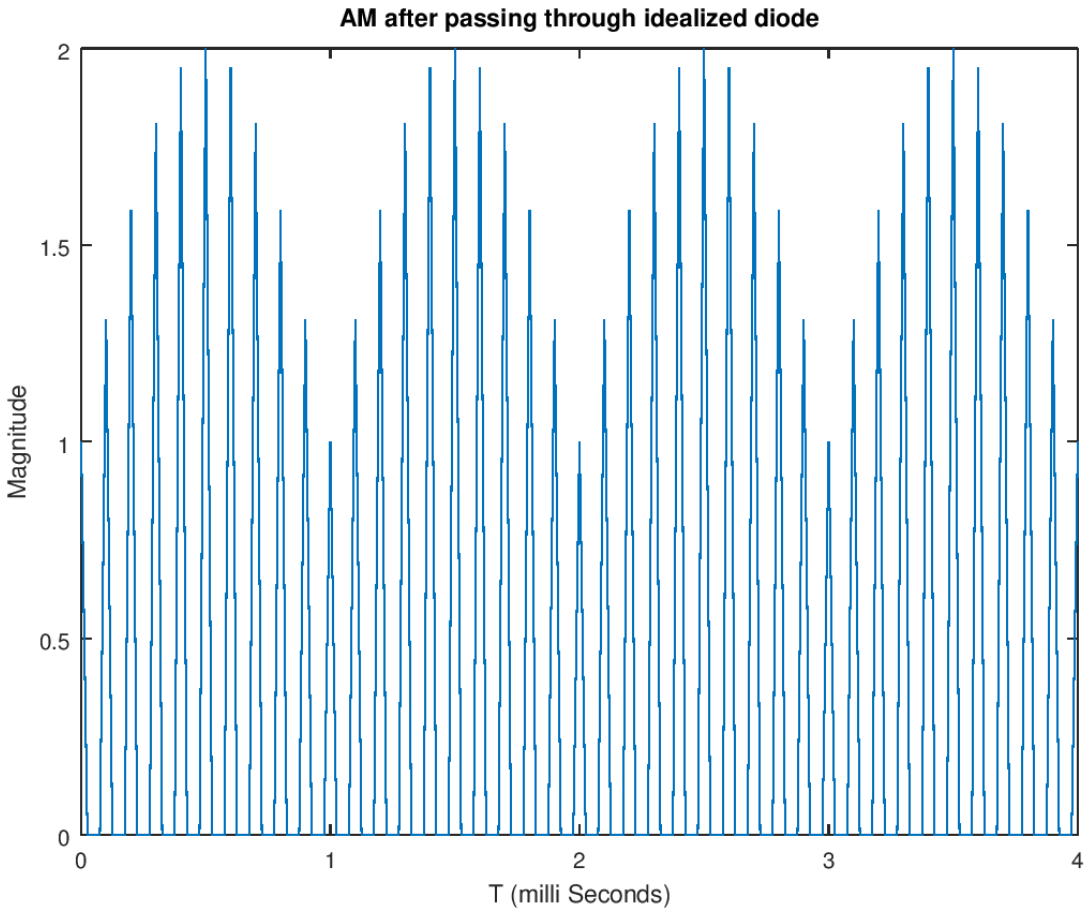
**Part 1**

**Objective:** Pass AM signal through idealised diode.

**Code:**

```
%% diodeFilter: makes all values less than zero 0
function [result] = diodeFilter(vector)
        vector(vector < 0) = 0;
        result = vector;
end
```




AM signal has only positive amplitudes now.

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Part 2

**Objective:** Pass signal resulting from last process through RC filter with impulse response: e^^(-t / RC)

**Calculating RC values from design rule of thumb**

1/fc << RC << 1/b

Where b is the bandwidth of message signal. We know from lab 3 that the message signal has a bandwidth of 1.5 KHz.

As we are in milli second time

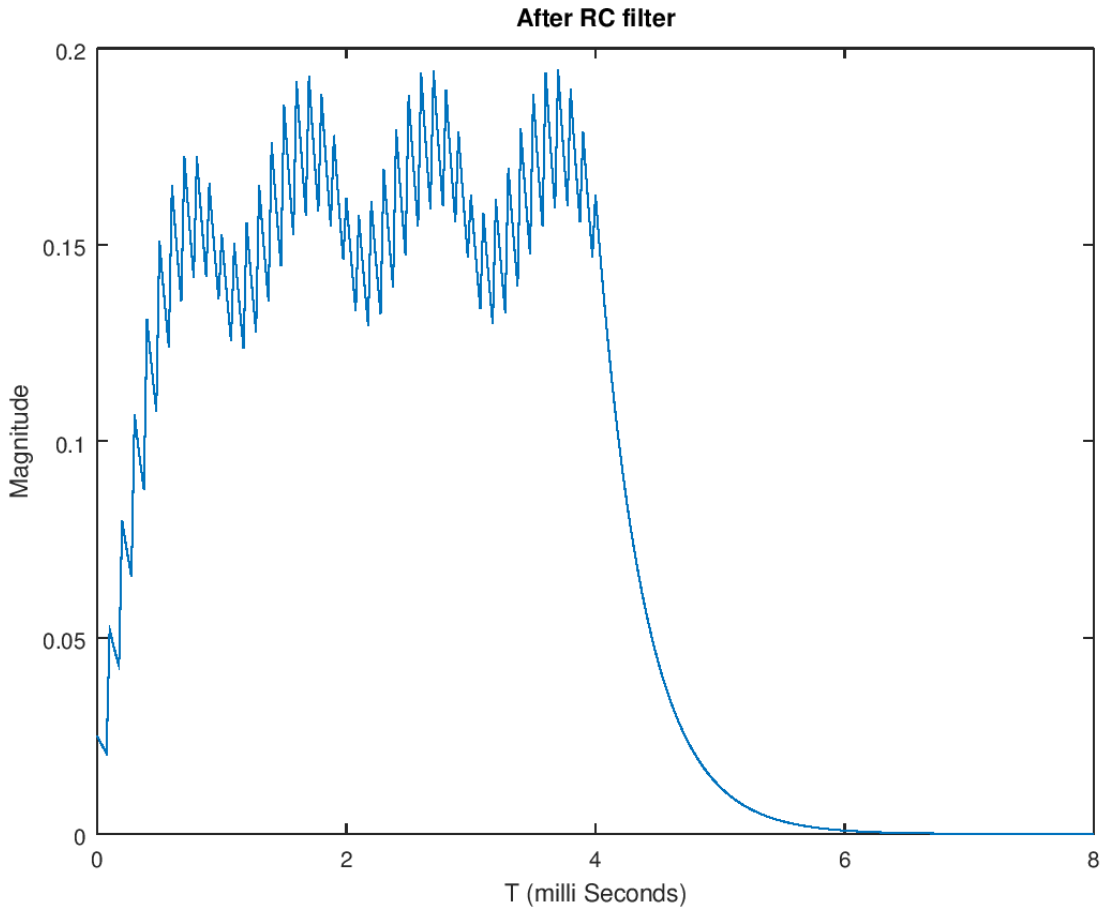
1/10 << RC << 1/1.5

Taking RC = 3.833/10

**Code:**

```
%% RCFilter
function [time_f, signal_f] = RCfilter(time, signal)
        % t_response = 0:ns/length(time):ns;
        t_response = time;

        dt = 1/40;

        u_response = ones(length(signal), 1);
        RC = 3.833 / 10;

        temp_t = t_response./RC;
        temp_t = temp_t.*-1;

        temp_t_exp = arrayfun( @(x) exp(x), temp_t);

        u_response = u_response.*temp_t_exp;

        u_response = u_response(1,:);

        size(t_response);
        size(u_response);

        [time_f, signal_f]  = contconv(signal, u_response, time(1), t_response(1), dt);
end
```

**Plot:**



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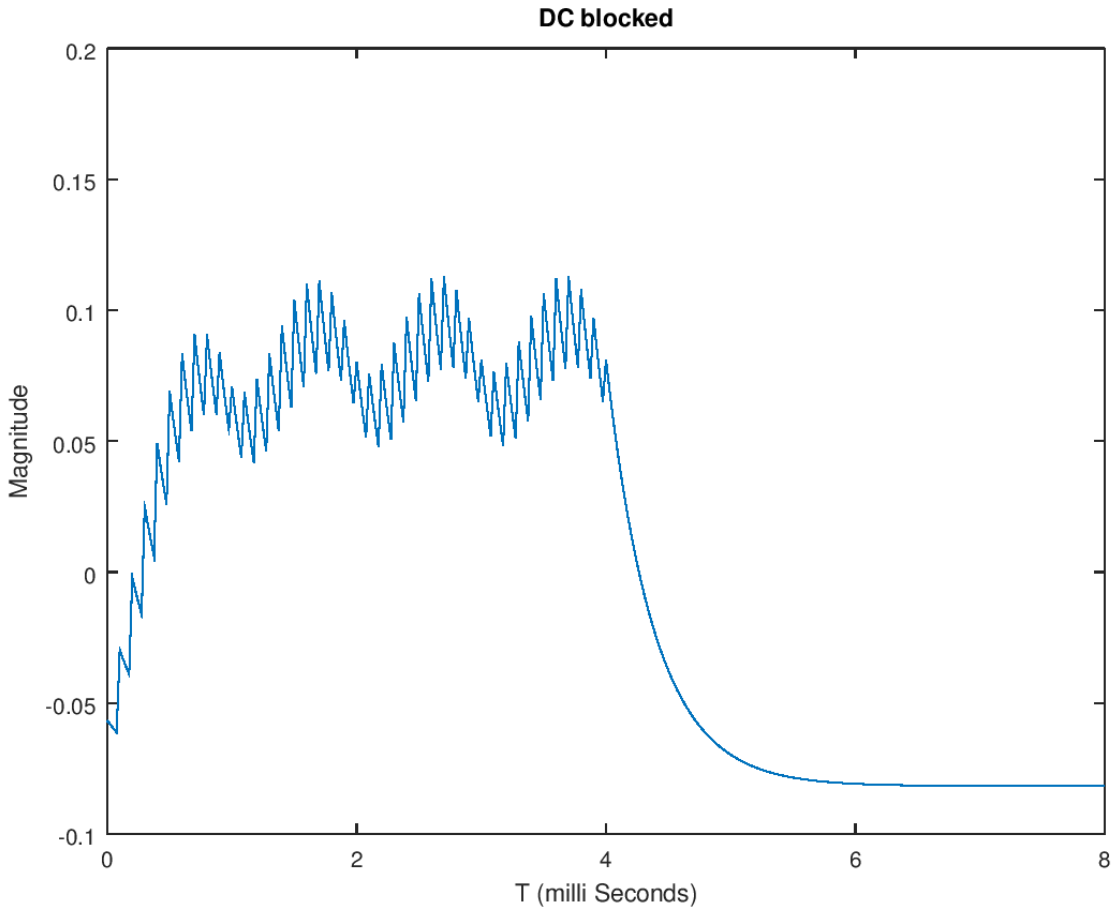
**Part 3**

**Objective:** Pass signal resulting from last process through a DC block circuit

**Code:**

```
%% DBblock: Removes DC component
function [time_dcblock, signal_dcblock] = DCblock(time, signal)

        meanSignal = mean(signal);

        time_dcblock = time;
        signal_dcblock = signal.-meanSignal;

end
```

**Plot:**




Observation: DC part of the message is removed.

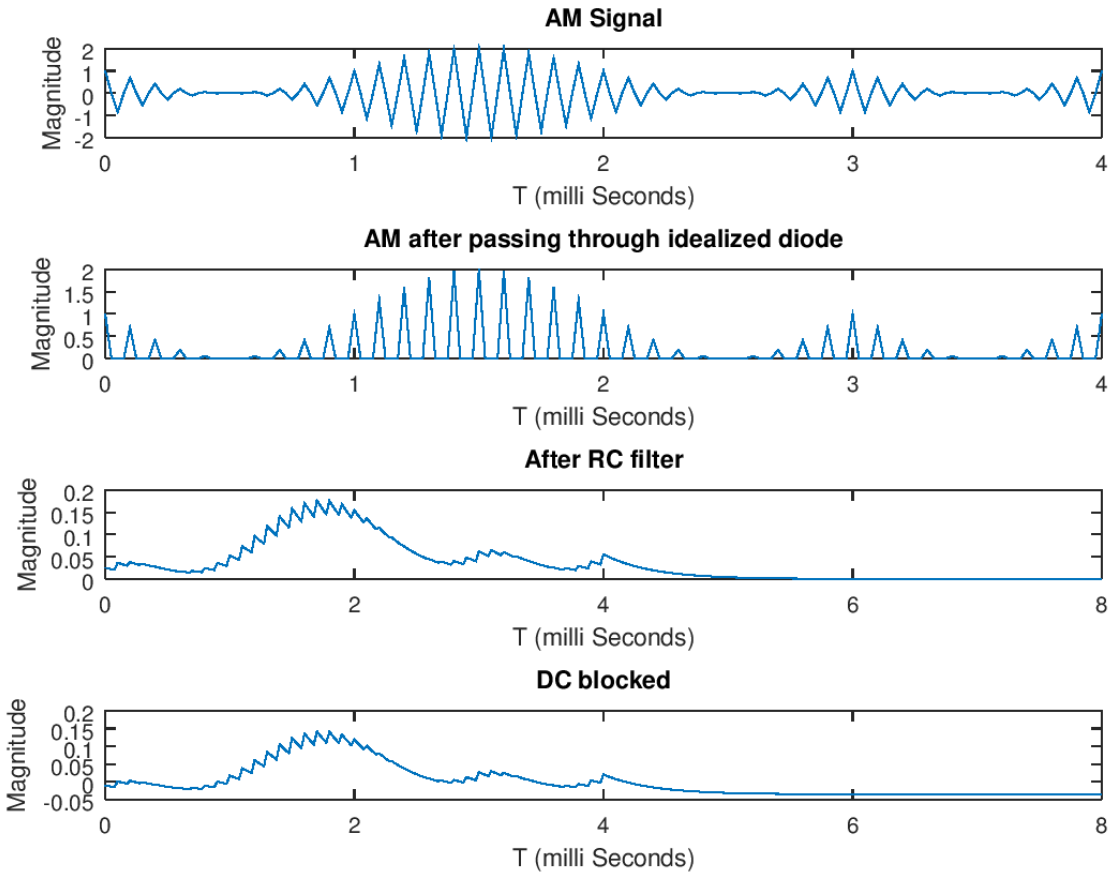
**Code to plot all the above plots:**

```
% Get AM Signal
[tAM, uAM] = getAM();

figure(1);

	plot(tAM, uAM);

	title("AM Signal");

	ylabel("Magnitude");
	xlabel("T (milli Seconds)");

print -dpng 6_a.png

% Pass through diode filter

filtered_t_AM = tAM;
filtered_u_AM = diodeFilter(uAM);

figure(2);

	plot(filtered_t_AM, filtered_u_AM);

	title("AM after passing through idealized diode");

	ylabel("Magnitude");
	xlabel("T (milli Seconds)");

print -dpng 6_b.png


[RCfilt_t_AM, RCfilt_u_AM] = RCfilter(filtered_t_AM, filtered_u_AM);

figure(3);

	plot(RCfilt_t_AM, RCfilt_u_AM);

	title("After RC filter");

	xlabel("T (milli Seconds)");
	ylabel("Magnitude");

print -dpng 6_c.png

[dcblock_t_AM, dcblock_u_AM] = DCblock(RCfilt_t_AM, RCfilt_u_AM);

figure(4);
	plot(dcblock_t_AM, dcblock_u_AM);

	title("DC blocked");

	xlabel("T (milli Seconds)");
	ylabel("Magnitude")

print -dpng 6_d.png
```

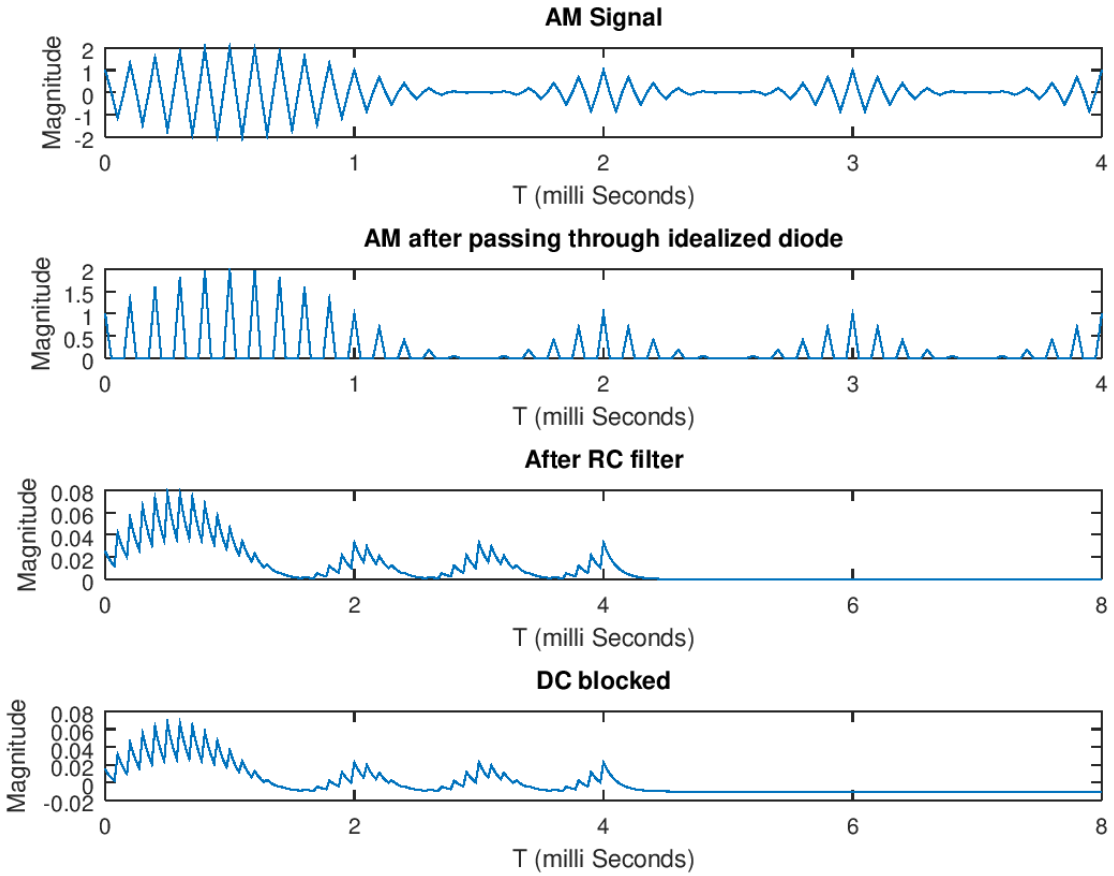
**Part 4**

**Objective:** Redo the same experiment for various values of RC

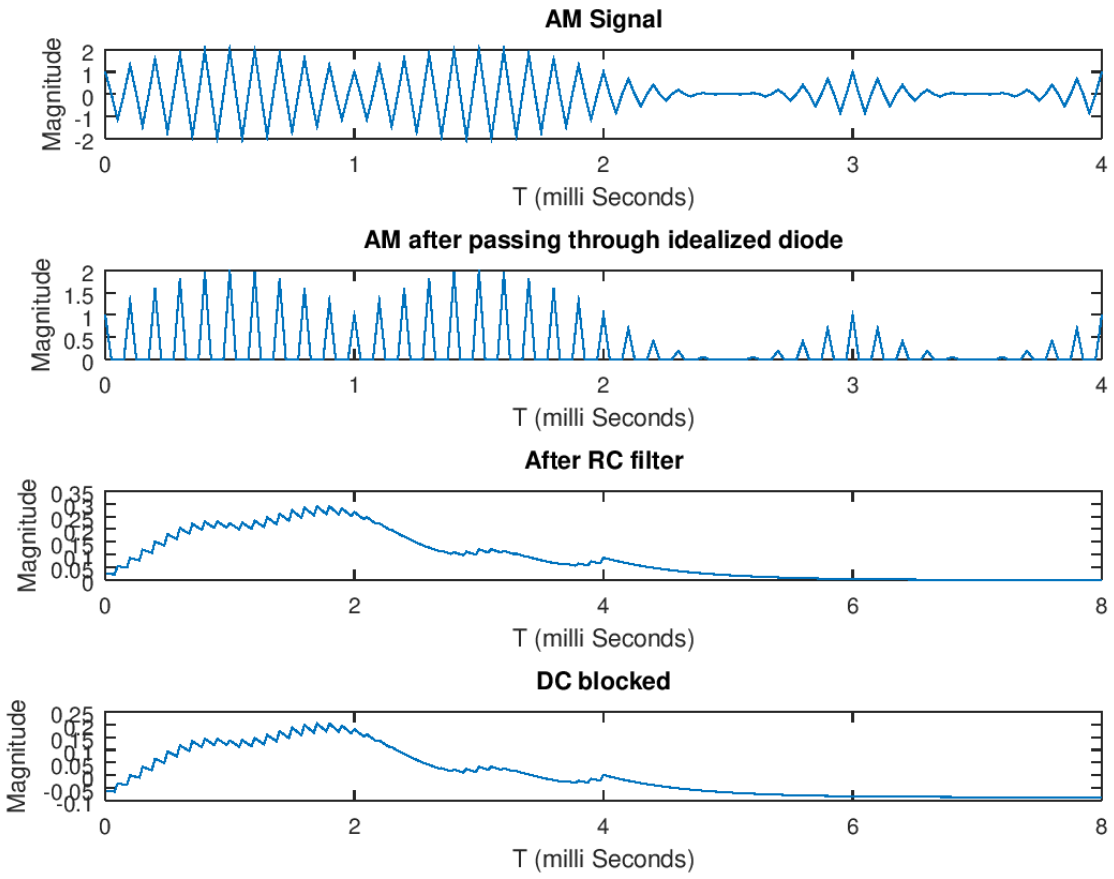
**1. For an ideal value of RC**



**For too low RC = 0.1**



**For too high value RC = 3**




**Obeservation:**

Magnitude reduced as RC decreased

Plot was smoother as RC increased
Amplitude variation decreased as RC increased