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```
clc;
clear;
close all;

format long;
```

Question 2

```
fc = 10;
kf = 3;

freqs = [ 15 10 20 ];
amps = [ 2 10 2 ];

freq_dev = kf * amps;
bandwidth = 2 * freq_dev + 2*freqs;
beta = freq_dev ./ freqs;
universal = [9 4 12] .* freq_dev;

narrowband = beta < 1;
```

Question 3

```
ka = 2;
fc = 10;
ac = 2;

amps = [ .4; .45; .6 ];

fs = 100;
t = 0:1/fs:2000/fs-1/fs;

m = amps .* sin(2*pi*2*t);
x = ac * (ones(size(m)) + ka*m) .* cos(2*pi*fc*t);

mod_index = ka*amps'*100;
over_mod = mod_index > 100;

for i = 1:3
    fprintf("Amp = %f V\n", amps(i));
```

```

fprintf("  Modulation Index: %d\n", mod_index(i));
fprintf("  Overmodulated? : %d\n\n", over_mod(i));

figure;
plot(t, x(i, :));
title("Signal Modulated with Amplitude " + amps(i));
xlabel("time (s)");
ylabel("amplitude (V)");
end

```

```

Amp = 0.400000 V
  Modulation Index: 80
  Overmodulated? : 0

```

```

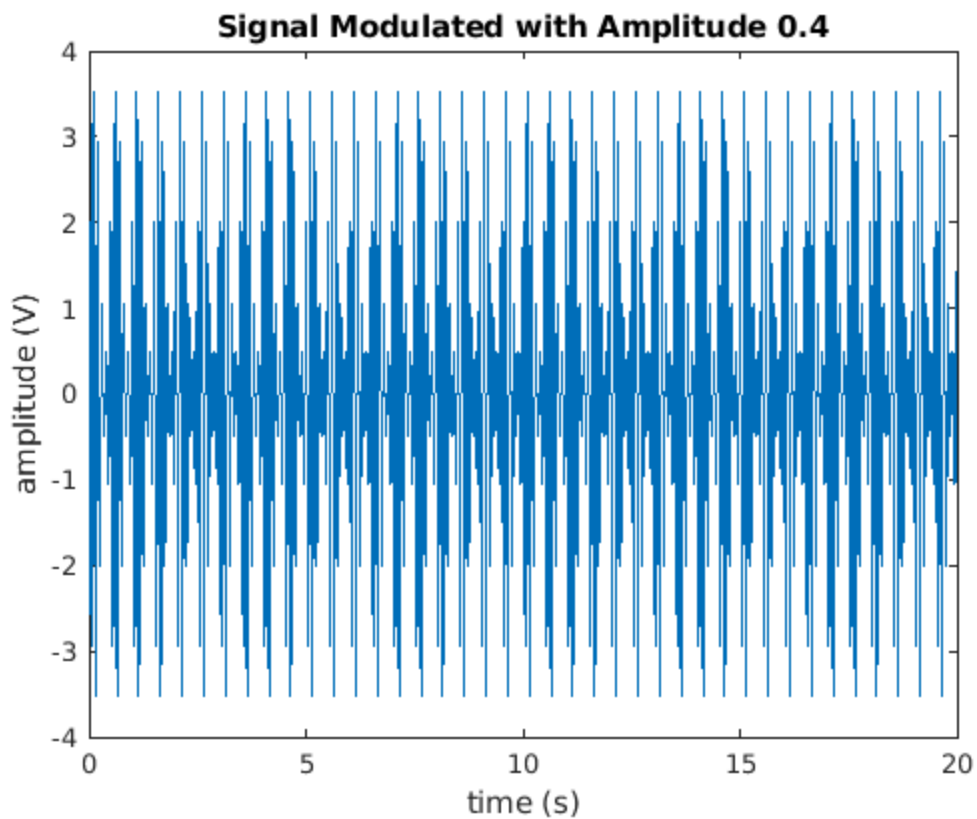
Amp = 0.450000 V
  Modulation Index: 90
  Overmodulated? : 0

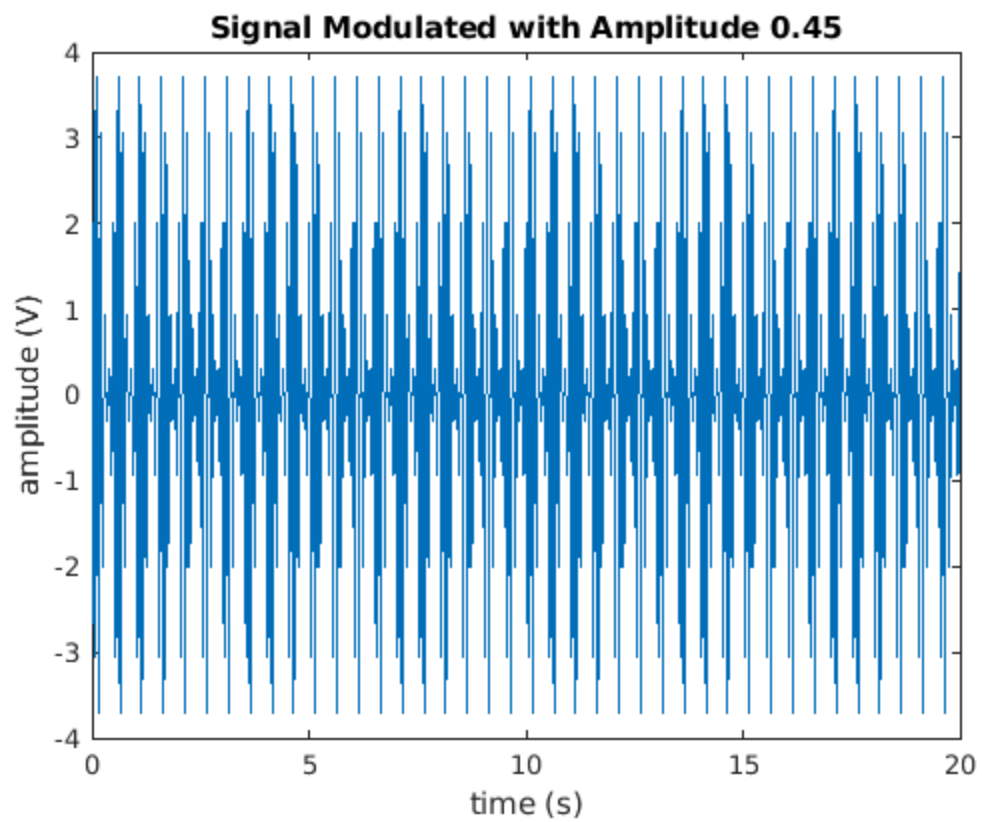
```

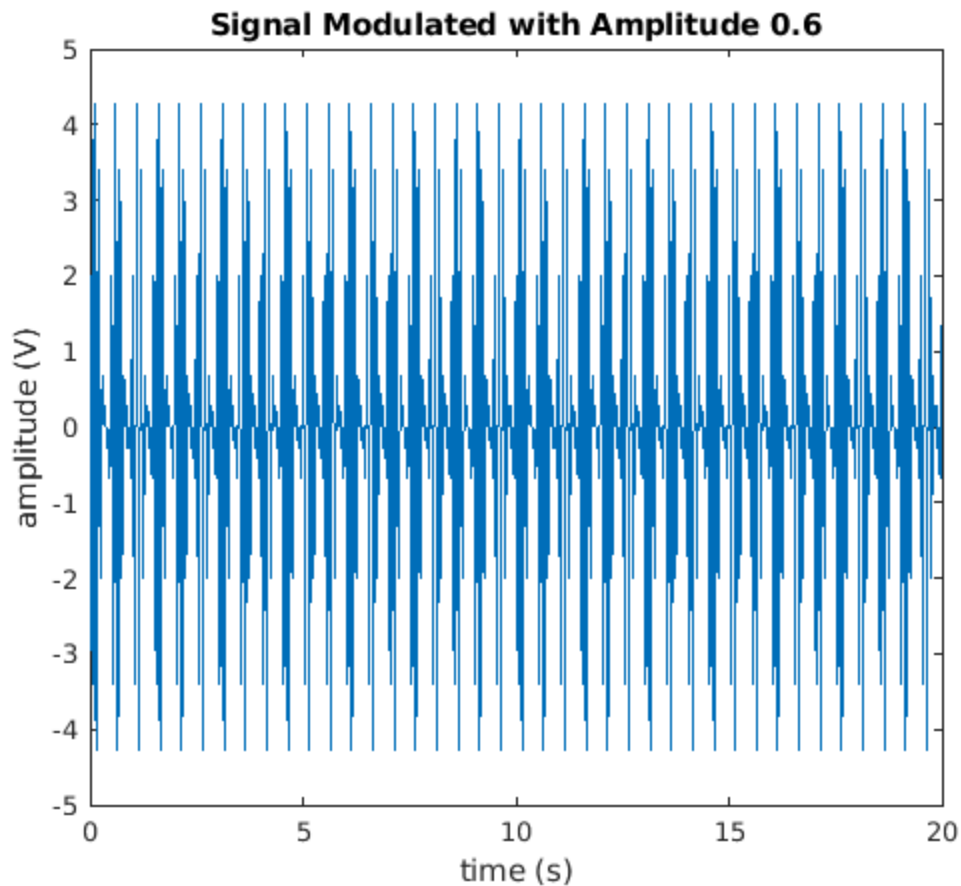
```

Amp = 0.600000 V
  Modulation Index: 120
  Overmodulated? : 1

```







Question 4

```
syms r

eq1 = 10e-4 == exp(-r^2/2);

sol = solve([eq1], [r]);

threshold = double(sol(1));
n = 1e7;
sigma = [10; 10; 10] .* [0; -1/10; 1/10];
p = exp(-threshold^2*ones(size(sigma))/2./sigma);
R = sqrt(sigma) .* abs(randn(3,n) + 1j*randn(3,n));

percent = sum(R > threshold, 2)/length(R);

for i = 1:3
    figure;
    plot(R(i, :));
    yline(threshold, "-r", "Threshold", 'LineWidth', 3);
    title("R with sigma^2 = " + sigma(i));
```

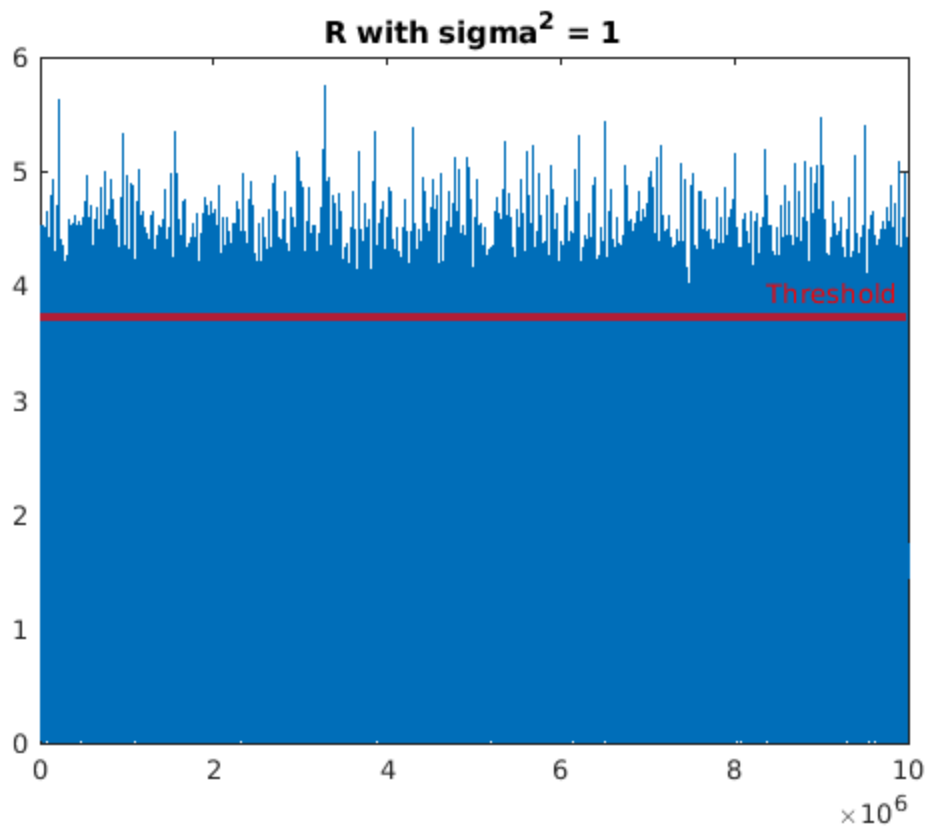
```
    fprintf("Fraction above threshold for sigma^2 = %f: %f # %f\n", sigma(i),  
percent(i), p(i));
```

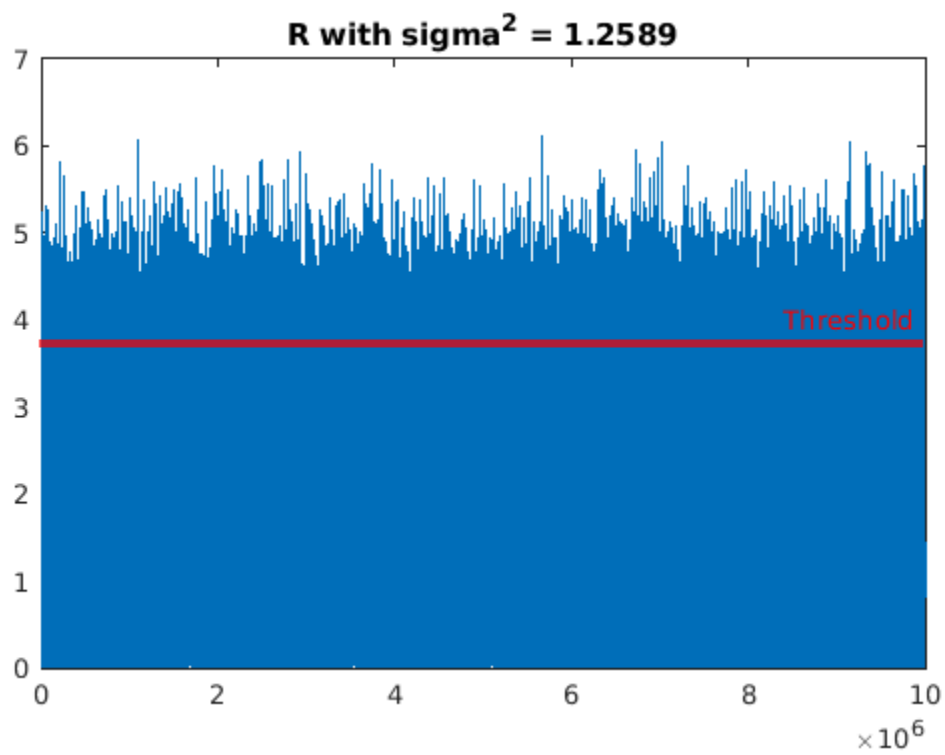
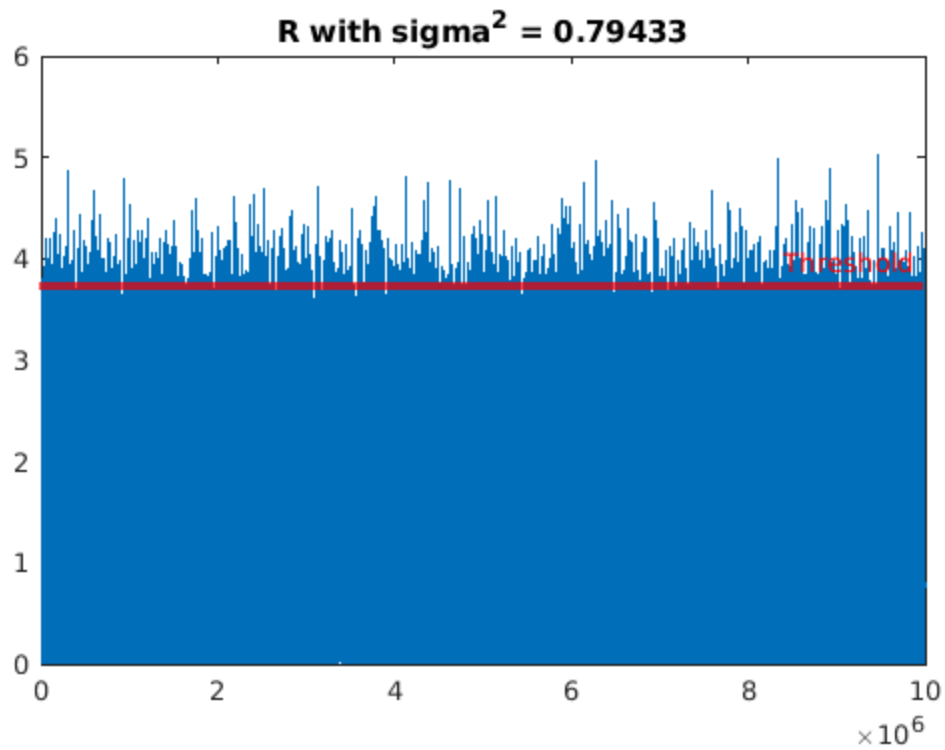
```
end
```

```
Fraction above threshold for sigma^2 = 1.000000: 0.000994 # 0.001000
```

```
Fraction above threshold for sigma^2 = 0.794328: 0.000162 # 0.000167
```

```
Fraction above threshold for sigma^2 = 1.258925: 0.004152 # 0.004140
```





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