MODULATION AND DEMODULATION

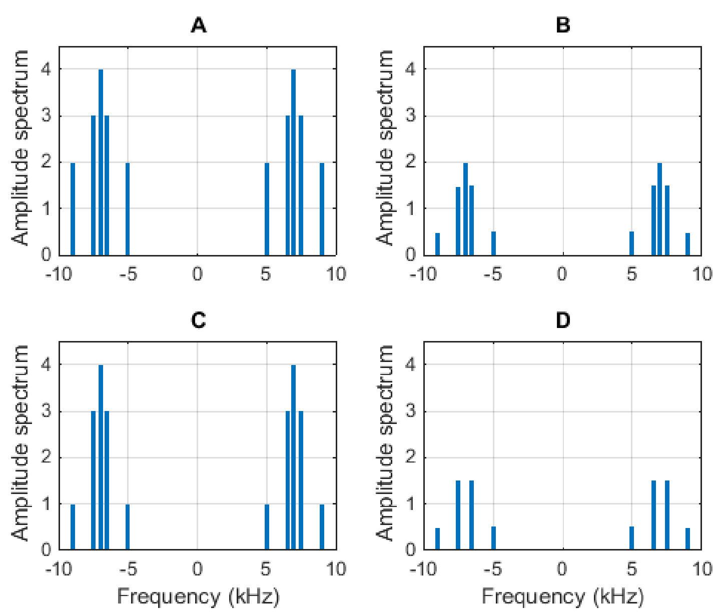
SECTION 3 QUESTION 1 (2 points possible)

Suppose the transmitted signal $y(t)$ is obtained by multiplying a continuous-time signal $m(t)$ with a cosinusoidal carrier $c(t)$, that is $y(t)$ = $m(t)$ * $c(t)$, where t is in seconds, and $m(t)$ and $c(t)$ are given below.

$$m(t) = 4 + 6\cos(2\pi 500t) + 2\cos(2\pi 2000t)$$

$$c(t) = \cos(2\pi 7000t)$$

Which of the following is the spectrum of the Fourier Transform of the transmitted signal $y(t)$?



- A
- B
- C ✖
- D

Modulation

Topic 10: Summary and Review

Final Exam

Final Exam
Final Exam due Dec 07, 2015 at 16:00 UTC

MATLAB download and tutorials

MATLAB Sandbox

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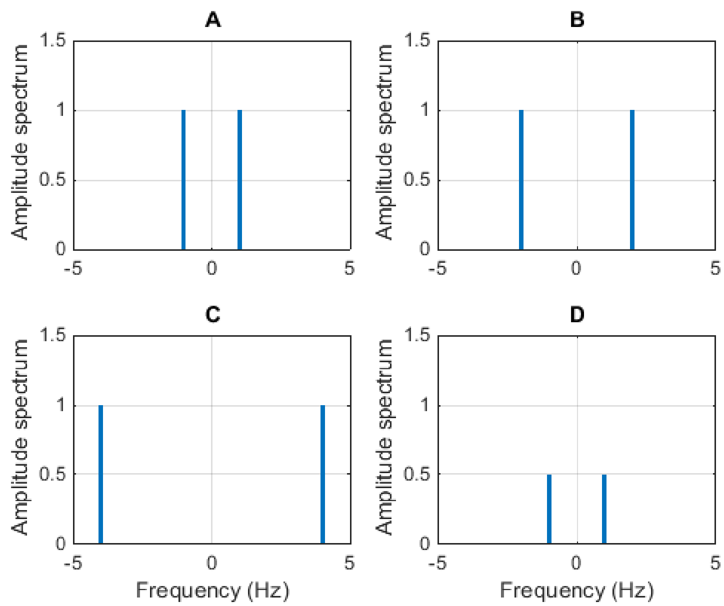
You have used 1 of 1 submissions

SECTION 3 QUESTION 2 BACKGROUND

Given a signal $x(t)$=$\cos(2\pi t)$, which is a cosinusoidal with amplitude of 1 and frequency of 1 Hz.

SECTION 3 QUESTION 2 PART A (2/2 points)

Which of the following figures shows the correct amplitude spectrum of the Fourier Transform of $x(t)$?



Please select the correct answer.

- A
- B
- C
- D ✔

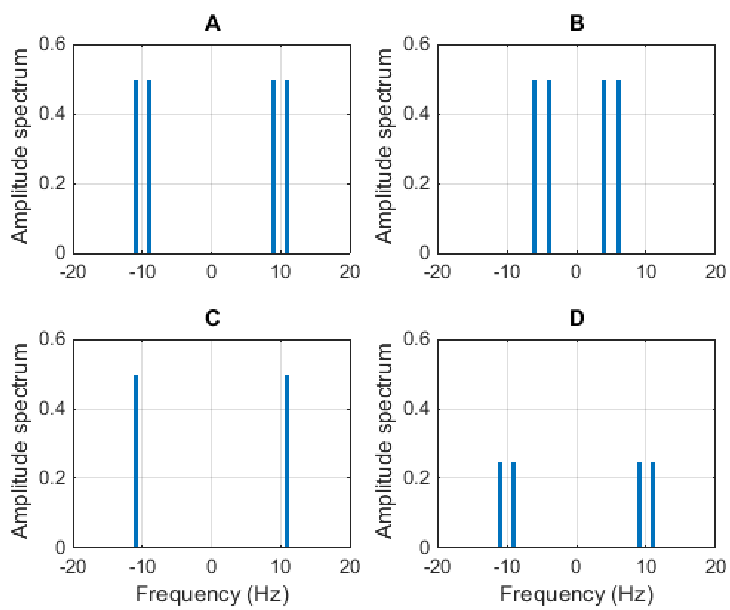
You have used 1 of 1 submissions

SECTION 3 QUESTION 2 PART B (2/2 points)

Now we use $x(t)$ to modulate a cosinusoidal carrier $c(t)$ with amplitude 2 and frequency 10 Hz, resulting in the modulated signal $y(t)$, where

$$c(t) = 2\cos(2\pi * 10 * t)$$

and $y(t) = x(t)*c(t)$. Which of the figures shows the amplitude spectrum of the Fourier Transform of $y(t)$? Note that the amplitude of the carrier is two!



Please select the correct answer.

- A ✔
- B
- C
- D

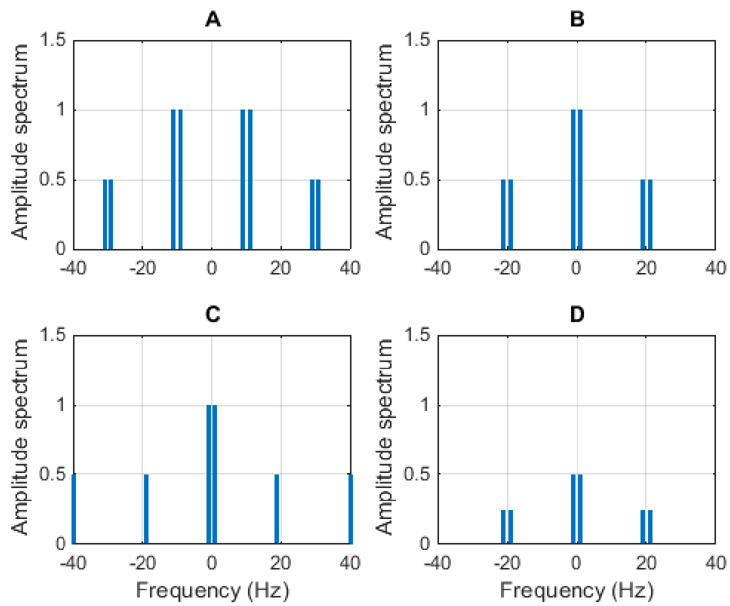
You have used 1 of 1 submissions

SECTION 3 QUESTION 2 PART C (2 points possible)

Suppose that we mix the signal $y(t)$ from part B with a 10Hz cosie wave as the first step in recovering the original signal $x(t)$. To do this we multiply $y(t)$ by $c(t)$ to obtain the signal $d(t)$, where

$$c(t) = 2\cos(2\pi * 10 * t),$$

and $d(t) = y(t) * c(t)$. Which of the figures below shows the amplitude spectrum of the Fourier Transform of $d(t)$? Note that the amplitude of the cosine used for mixing is 2.



- A
- B
- C
- D ✖

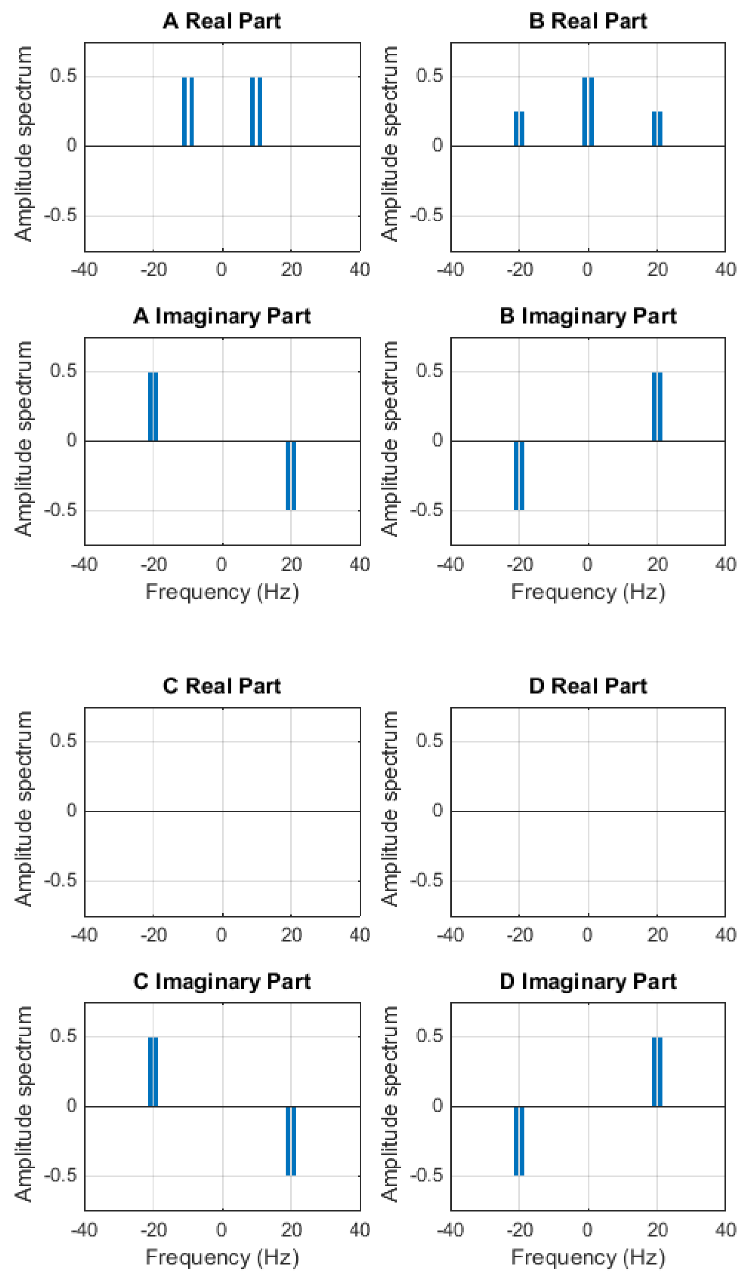
You have used 1 of 1 submissions

SECTION 3 QUESTION 2 PART D (2 points possible)

Suppose instead of mixing with $c(t)$ as in part C, we mix $y(t)$ with a carrier that has a diffrent phase. In particular, multiply $y(t)$ by $m(t)$, where

$$m(t) = 2\sin(2\pi * 10 * t)$$

to obtain the signal $b(t)$ = $y(t)$*$m(t)$. Which of the figures below shows the Fourier Transform spectrum of $b(t)$?



A ✖

- B
- C
- D

You have used 1 of 1 submissions

SECTION 3 MATLAB QUESTION (3 points possible)

In this exercise you have to design a frequency division multiplexing (FDM) scheme in order to send two messages through a shared communication channel.

The initial MATLAB code loads two messages and stores them inside the variable **signal(c,:)**, where **c**=1,2. Note that due to the low pass filtering applied, the two messages have different bandwidths, which are specified by the variable **Fcutoff**. The next part of the code should implement the FDM transmitters required to transmit these two messages simultaneously through the channel as the waveform stored inside the variable **tx_wave**. However, this part of the code is incorrect. It is your job to correct it.

The next part of the code sends **tx_wave** through the channel and receives the message **rx_wave**. It attempts to recover the two sent messages by demodulating the received signal using the carrier frequencies stored in the variable **Fc**. However, this variable is set incorrectly in the initial code. The final part of the code plots the figures described below.

If you run the initial code, you will observe three figures. Figure 1 shows the amplitude spectrum of the transmitted and received signals in subplots 1 and 2, respectively. Due to the incorrect design of the transmitter, the spectra of the two messages overlap, so that we cannot distinguish them in subplot 1. In subplot 2 we can observe the amplitude spectrum of the received signal. We can observe that most frequencies are already occupied, however there are two free bands that can be used to send our two messages.

Figure 2 shows the amplitude spectrum of the two recovered messages. The two messages are different, so if you correct the code, you should see differences in their amplitude spectra.

Finally, figure 3 compares the original and the recovered messages in the time interval between 1 and 1.05 seconds. Blue lines represent the original messages and red lines the recovered ones. If you design the FDM properly, the plots of the original and the recovered signals should be nearly identical and the NMSE should be less than 10e-5.

Your task is to choose the carrier frequency of each message, implement the FDM transmitters used to transmit the two messages, combine the outputs of the two FDM transmitters so that the messages can be transmitted simultaneously, and to store waveform for transmission inside the variable **tx_wave**. You are free to use any of the functions used in the previous labs, e.g. the function **modulate**.

Modify the code between the lines

% % % % Revise the following code % % % %

and

% % % % Do not change the code below % % % %

Please, do not change other parts of the code.

```
    zoom_stop =210001;
    ind = zoom_start:zoom_stop;
    plot(t(ind),signal(c,ind),'b'); hold on;
    plot(t(ind),rxa(c,ind),'--r'); hold off;
    legend('Original','Recovered','Location','NorthEastOutside')
    xlabel('Time(sec)')
    ylabel('Amplitude')
    title(['Message ' num2str(c) ' Waveform (zoom) : nmse = ' nu
    axis([t(zoom_start) t(zoom_stop) -0.4 0.4]);
    grid;
end

% move figure 1 and 2 on top
figure(2);
figure(1);

```

Unanswered

Figure 1

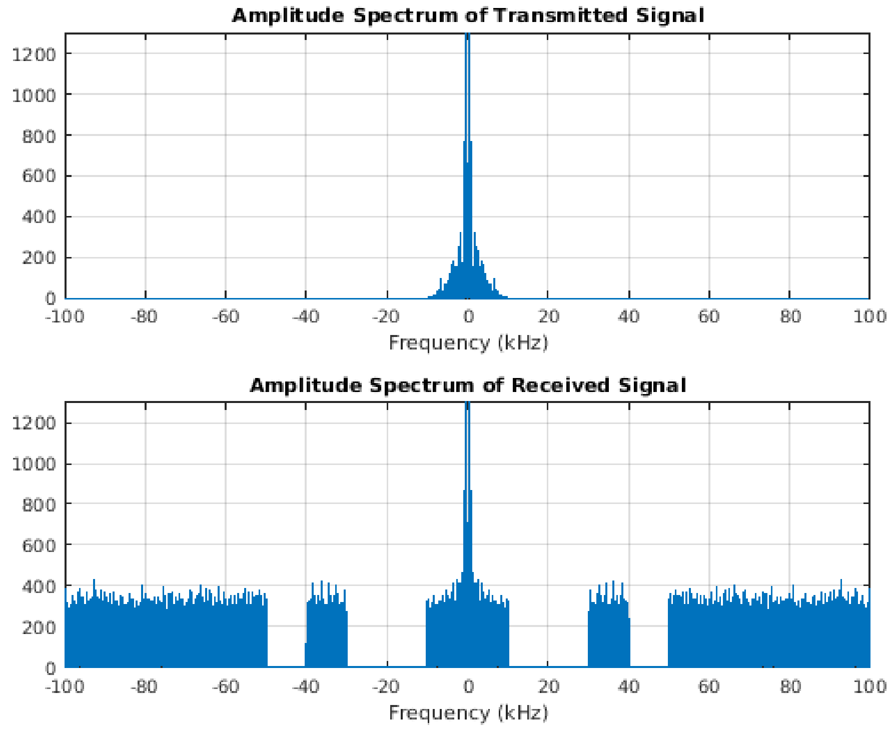


Figure 2

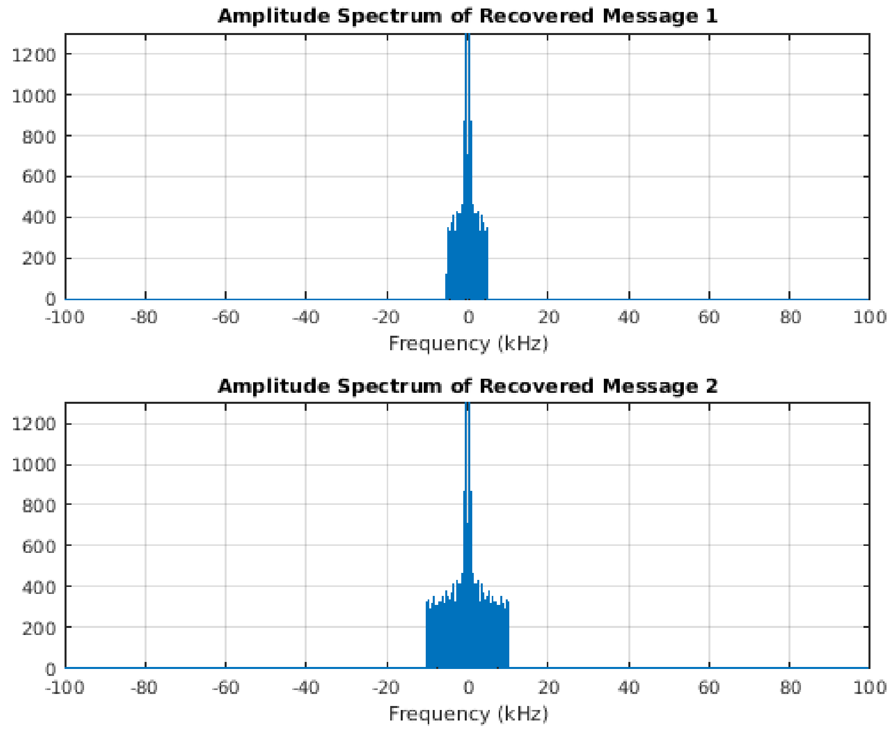
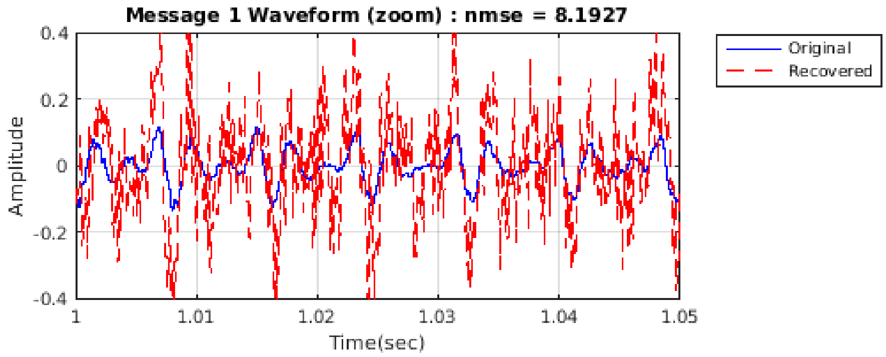
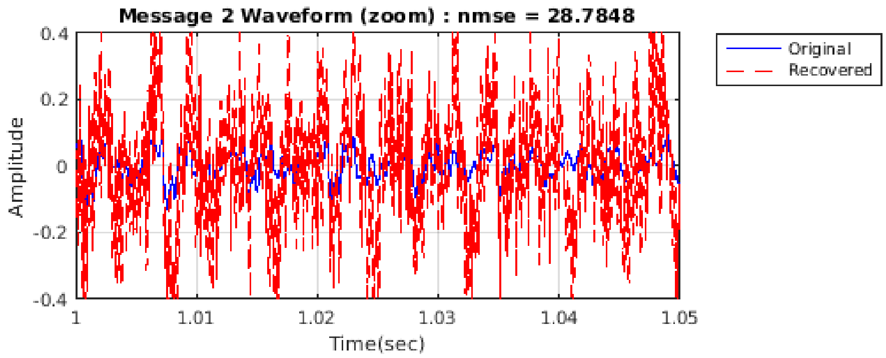


Figure 3





Run Code

You have used 0 of 5 submissions