

ADDENDUM

Hw Problem #6:

After reviewing the example code for hw problem #6, I have made some modifications to it:

```
t = 0:.02:2*pi;
s=square(t);
y = zeros(10,length(t));
x = zeros(size(t));
for k=1:2:19
    x = x + sin(k*t)/k;
    y((k+1)/2,:) = x;
end
plot(t,s,'k--');
hold on;
plot(t,y') ;
```

Remember the square wave goes from -1 to 1, try using the axis command to scale the Y-axis so it goes a little beyond +/- 1. Also note that the line: `y = zeros(10,length(t));` declares the y variable to have 10 rows, but that is for the 19 harmonics example.

Brandon

READ INSTRUCTIONS CAREFULLY! Failure to follow them will result in point deductions.

Please complete the following problems, with the following guidelines:

- You are permitted to discuss the questions with each other, but you must independently write your own solutions and abide by the University Honor Code (no sharing of solutions and no plagiarism).
 - You may use any resource on the Internet or in the libraries to supplement the text.
 - **Show all of your work** for numerical problems, **and explain your reasoning** for all “word” answers.
 - Please hand-write your solutions neatly, using only the front side of each page, with your name and assignment number.
 - Make sure your problem set is stapled in the upper left-hand corner.
 - Late homeworks will receive half credit
1. Signals are continuous or discrete functions that occur in the time or spatial domain. Systems are “black boxes” that modify signals. How do signals and systems apply to medical imaging?
 2. If an image is a 2-D discrete signal and all of a system’s characteristics can be defined by the system’s impulse response, then convolution can describe passing the image through the system. What is the advantage of using the Fourier transform and performing analysis in the Frequency domain?
 3. Why is separability a desirable characteristic of an image operation?
 4. Consider $\delta(x)$
 - a. What is its value for $x \neq 0$?
 - b. What is its value for $x = 0$?
 - c. What is its frequency content?
 - d. What is the area of this function?
 5. Convolution in the time or space domain results in multiplication in the frequency domain. Convoluting a linear shift- invariant system with the delta function produces the impulse response or point spread function of the system. This is the same as multiplying the frequency response by 1 for all frequencies. What is the use of determining the impulse response?

6. There is a MATLAB example with code at <http://www.mathworks.com/products/matlab/demos.html?file=/products/demos/shipping/matlab/xfourier.html>.

Provide the matlab graphical output for the first 13 harmonics plotted against the square wave that they approximate. Explain what happens as more harmonics are added.

7. Determine if the following signals are separable.

a. $\delta(x, y)$

b. $f(x, y) = e^{2\pi j(2x+3y)}$

c. $f(x, y) = \sin(2\pi(2x + 3y))$

8. Determine whether the following signals are periodic. If they are, find the fundamental period

a. $x(t) = e^{j5t}$

b. $\text{comb}(x, y)$

c. $g[m, n] = \sin m \cos \pi n$ Note: $g[m, n]$ is a discrete signal

9. Evaluate the following:

a. $f(x)\delta(x)$, where $f(x) = e^x$

b. $f(x, y) * \delta(x, y + 4)$, where $f(x) = x + \sqrt{y}$