

Homework Assignment #2
Due Friday September 12, 2008

Part A: Periodic Signals Revisited

1. We have seen in class that sampling a CT periodic signal at regular intervals may or may not yield a periodic DT signal, depending on the sampling frequency. Pick a CT periodic signal that was posted on Rhea as part of homework 1, and create two DT signals, one periodic and one non-periodic, by sampling at different frequencies. Post your answer on a Rhea page.
2. One can create a periodic signal by adding together an infinite number of shifted copies of a non-periodic signal periodically (i.e. $\sum x(t+kT)$ or $x[n+kN]$ for all integers k). Pick a non-periodic signal that was posted on Rhea as part of homework 1 and create a periodic signal using this method. Post your answer on a Rhea page.

Part B: Find the Bug.

3. The following MATLAB program attempts to plot 13 cycles of a 13 Hz sinusoid, but it has a bug.

```
F0 =13;
T0 =1/F0;
Ts = 0.07;
t = 0:Ts:13*T0;
x = real(exp(j*(2*pi*F0*t-pi/2)));
plot(t,x)
```

Explain what the bug is, and modify the above code to fix this bug. Post your answer on a Rhea page.

Part C: Linearity

4. Explain in your own words what is a linear system. Give an example of a linear system and “prove” that it is linear. Give an example of a non-linear system and “prove” that it is non-linear. Write your answers on a Rhea page.

Part D: Time Invariance

5. Explain in your own words what is a time-invariant system. Give an example of a time-invariant system and “prove” that it is time-invariant. Give an example of a time-variant system and “prove” that it is time-variant. Write your answers on a Rhea page.

Part E: Linearity and Time Invariance

A discrete-time system is such that when the input is one of the signals in the left column, then the output is the corresponding signal in the right column:

Input	Output	
$X_0[n]=d[n]$	$Y_0[n]=d[n-1]$	
$X_1[n]=d[n-1]$	$Y_1[n]=4d[n-2]$	
$X_2[n]=d[n-2]$	$Y_2[n]=9 d[n-3]$	
$X_3[n]=d[n-3]$	$Y_3[n]=16 d[n-4]$	
...	...	
$X_k[n]=d[n-k]$	$Y_k[n]=(k+1)^2 d[n-(k+1)]$	For any non-negative integer k

Note: it is possible that your browser displays the letter “delta” above as a d.

6. a) Can this system be time-invariant? Explain.
- b) Assuming that this system is linear, what input $X[n]$ would yield the output $Y[n]=u[n-1]$?

Post your answers on a Rhea page.