Homework Assignment 3 Suggestions

2.9 Let $\mathcal{T}$ be an LTI, relaxed, and BIBO stable system with input $x(n)$ and output $y(n)$. Show that:

a) If $x(n)$ is periodic with period N [i.e., $x(n) = x(n+N)$ or all $n \geq 0$], the output $y(n)$ tends to a periodic signal with the same period.

<u>Suggestion:</u>

This is an interesting result. To approach this problem, write the convolution expression for $y(n)$ as $y(n) = \sum_{k=-\infty}^{\infty} h(k)x(n-k)$. Note that if the signal is causal, the upper limit of the sum will be n since $x(n-k) = 0$ for $k > n$. Now, you can explicitly write the expression for $y(n+N)$ which you hope to show approaches $y(n)$ eventually (i.e., it becomes periodic with the same period as the input).

If you write the series for $y(n+N) = \sum_{k=-\infty}^{n+N} h(k)x(n-k)$, you can break the sum up into two parts, one going from $-\infty$ to n, the other going from $n+1$ to $n+N$. Now, you almost have it. Take the limit as $n \to \infty$ and note that the magnitude of the impulse response must go to zero for a BIBO system which means the second part of that sum goes to zero, leaving you with $y(n+N) \to y(n)$.

2.17 For this problem, write down the expression for the convolution $x(n)*h(n)$ Using this expression, the problem is straightforward arithmetic.

2.28 This is another problem where if you write down the expression for convolution, it should be clear. The key is to recognize the upper and lower bounds such that the signals are not zero.

2.35 Find the response for $x(n) = u(n)$. The recognize that the response to an input of $u(n-10)$ will be the same, except shifted by 10. Be sure to include the step response factor with the solution since one response will begin at n=0 (use u(n)), and the other will begin at n=10 (use u(n-10)).

2.45 Recognize that the diagram is Form 2. Use that to identify the a's and b's in the difference equation. Once you have the difference equation, you can find the impulse response using $x(n) = \delta(n)$. Once you have the impulse response, you can find the step response from $s(n) = \sum_{k=0}^{n} h(k)$.