Discussion problem assignment:

问题一：

For LTI systems defined in Example 2.14 and 2.15, determine the system function for each system.

答案：

$$\frac{dy(t)}{dt}+2y(t)=x(t) \qquad x(t)=e^{st}\rightarrow y(t)=H(s)e^{st}$$

$$sH(s)e^{st}+2H(s)e^{st}=e^{st}$$

$$H(s)=\frac{1}{s+2}$$

$$y[n]-\frac{1}{2}y[n-1]=x[n] \qquad x[n]=z^n\rightarrow y[n]=H(z)z^n$$

$$H(z)z^n-\frac{1}{2}H(z)z^{n-1}=z^n$$

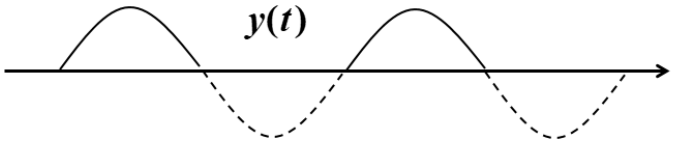
$$H(z)\left[1-\frac{1}{2}z^{-1}\right]z^n=z^n \qquad H(z)=\frac{1}{1-\frac{1}{2}z^{-1}}$$

但是，从同学们的答案来看，同学们对系统函数的概念还没有很好掌握，所以用的也都是第二章的方法。先求单位冲激响应，再求系统函数。

第二题：

An rectifier system is defined as $y(t)=\begin{cases}x(t), x(t)>0\\ 0, x(t)<0\end{cases}$. Assume the input signal is the electric supply $x(t)=220\text{V}\times\cos(2\pi\times 50\times t)$ working at a frequency of 50 Hz. Prove that the output signal $y(t)$ is periodic and determine the Fourier series a_0 for $y(t)$. Confirm that the system is not an LTI system.

答案：



The rectifier system will remove the negative part of the signal. It is easy to see that the signal y(t) is periodic. $T=0.02$

$$a_k=\frac{1}{T}\int_T y(t)e^{-jk\omega_0 t}dt$$

$$a_0=\frac{1}{0.02}\int_{-T/4}^{T/4}y(t)dt=\frac{1}{0.02}\int_{-0.005}^{0.005}220\text{V}\cos(2\pi\times 50\times t)dt=\frac{220\text{V}}{\pi}$$

The input signal has only frequency components of 50 Hz, while the output signal has many new frequency components including non-zero DC.