Homework No. 3

Due 1:10 pm, Nov. 2, 2011

Notice: Please use the A4 format to write down your answers!

1. Determine the homogeneous and particular solutions for the system described by the following differential equation for the given inputs and initial conditions:

$$y''(t)+4y(t)=3x'(t),\ \mathrm{y}\left(0^{-}\right)=-1,\ \mathrm{y}'\left(0^{-1}\right)=1$$

(1) $x(t)=t$ (5%)

(2) $x(t)=e^{-t}$ (5%)

(3) $x(t)=\cos(t)+\sin(t)$ (10%)

2. Consider a discrete-time LTI system described by the following difference equation for the given initial conditions:

$$y[n]-5y[n-1]+6y[n]=x[n]+x[n-1],\ \mathrm{y[-1]=y[-2]=0}$$

(a) Determine the complete solution $y[n]$ of the equation when $x[n]=u[n]$. (10%)

(b) What is the natural response $y^{(n)}[n]$ in this case? (5%)

(c) What is the forced response $y^{(f)}[n]$ in this case? (5%)

3. Consider a system whose input $x(t)$ and output $y(t)$ satisfy first-order differential equation:

$$y'(t)+2y(t)=x(t)$$

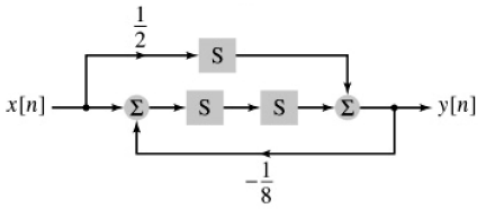
The system also satisfies the condition of initial rest; determine the system output $y(t)$ when the input is $x(t)=e^{3t}u(t)$. (20%)

4. Draw the direct form I and direct form II implementations for the following difference and differential equations:

(a) $y[n]+\frac{1}{2}y[n-1]-y[n-3]=3x[n-1]+2x[n-2].$ (10%)

(b) $\frac{d^3}{dt^3}y(t)+2\frac{d}{dt}y(t)+3y(t)=x(t)+3\frac{d}{dt}x(t).$ (10%)

5. Find difference and differential-equation descriptions for the systems depicted in Fig. 1 (a) and (b). (20%)



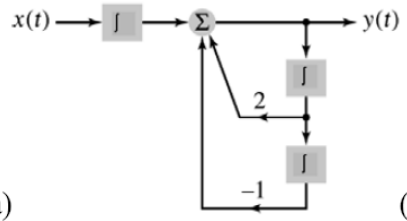


Figure 1 (a) (b)