Department of Electrical and Computer Engineering
The University of Alabama in Huntsville
Spring 2015

CPE 381: Fundamentals of Signals and Systems for Computer Engineers

Homework #5

Due: Monday, April 20 at 2:15 pm
Please bring hardcopy to the class and upload softcopy to Angel

Student name: ....

1 14	2 10	3 10	4 10	5 6	6 10	7 20	8 10	9 2	10 4	11 4	$\sum$

1. (14 points)
   a) (4 points) Explain the difference between hard and soft real-time systems.
   b) (6 points) Maximum frequency of the input is 600Hz. The microcontroller processes each sample in 1200 clock cyles with clock frequency F_c = 1MHz. Can this system run in real-time?
   c) (4 points) What is the minimum frequency of the clock that allows real-time operation with 2x oversampling of the input?

2. (10 points) Consider a sinusoidal signal:

$$x(t) = 5 \cos(14 \pi t + \pi/8)$$

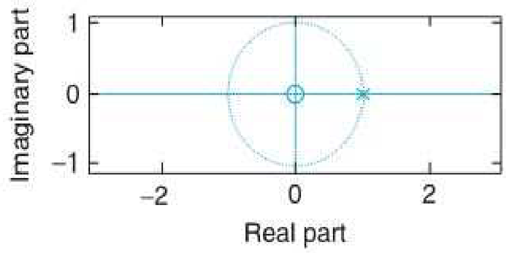
Determine an appropriate sampling period T_s and obtain the discrete-time signal x[n] corresponding to the largest allowed sampling period.

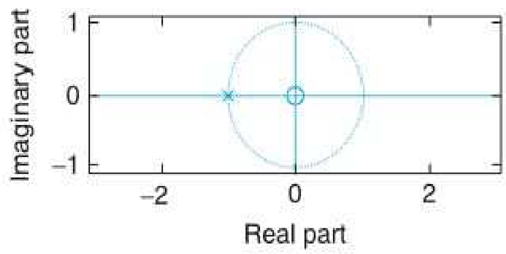
3. (10 points) Consider a discrete time IIR system represented by the difference equation:

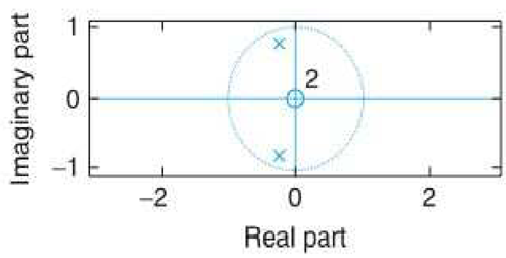
$$y[n] = 0.4\, y[n-1] + x[n]$$

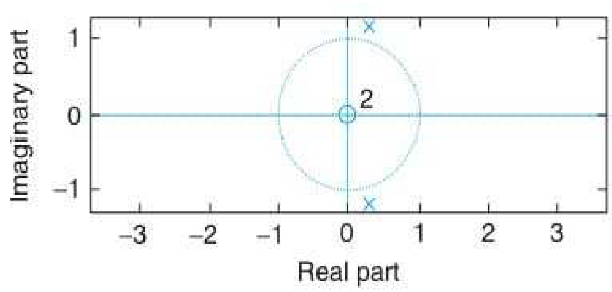
with x[n] as the input and y[n] as the output. Determine the transfer function of the system and find the impulse response. Under what conditions the system is BIBO stable?

4. (10 points) Describe the effect of pole location on the inverse Z-transform for the following cases.









5. (6 points) If X(z) is the Z-transform of a causal signal x[n], then

Initial value is x[0] = ____________________

Final value is $\lim_{n\to\infty} x[n] =$ ________________________

6. (10 points) Consider an RLC circuit represented by the second-order differential equation

$$\frac{d^2V_c(t)}{dt^2}+\frac{dV_c(t)}{dt}+V_c(t)=V_s(t)$$

where the voltage across the the capacitor V_c(t) is the output and the source V_S(t) = u(t) is the input. Let the initial conditions be zero. Find the voltage across the capacitor using difference equations.

7. (20 points) Let x[n] = {0, 1, 1, 1, 0} and h[n] = {1.5, 1, 0.5}.

   Compute and plot the convolution y[n] = x[n] * h[n].

8. (10 points) Let $h[n]=0.5^n u[n]$. What would be the response of the system $y[n]$ to $x[n] = u[n] – u[n-4]$? Plot the output $y[n]$.

9. (2 points) The frequency support of the DTFT of a discrete-time signal is

____________________ proportional to the time support of the signal.

10. (4 points) The DTFT of a discrete-time signal x[n] is represented as:

while the inverse transform can be represented as:

11. (4 points) Represent DTFT of the following signals:

a) $\delta[n]$

b) $\cos(\omega_0 n)\, u[n]$