EE 322/522

Fall '93

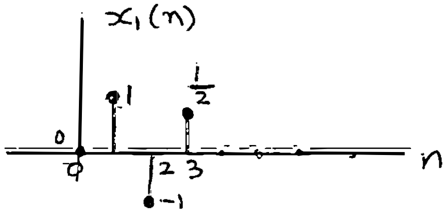
MID-TERM 2

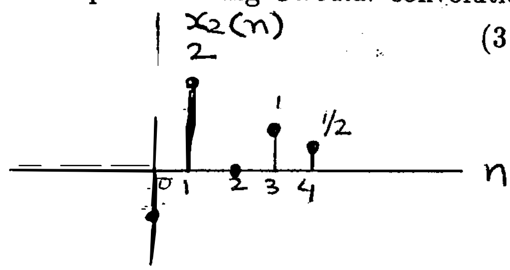
1 hr. 15 min.

9th Nov., 1993

The exam will be graded out of 25 points. You may attempt more problems to earn extra points.
GOOD LUCK!

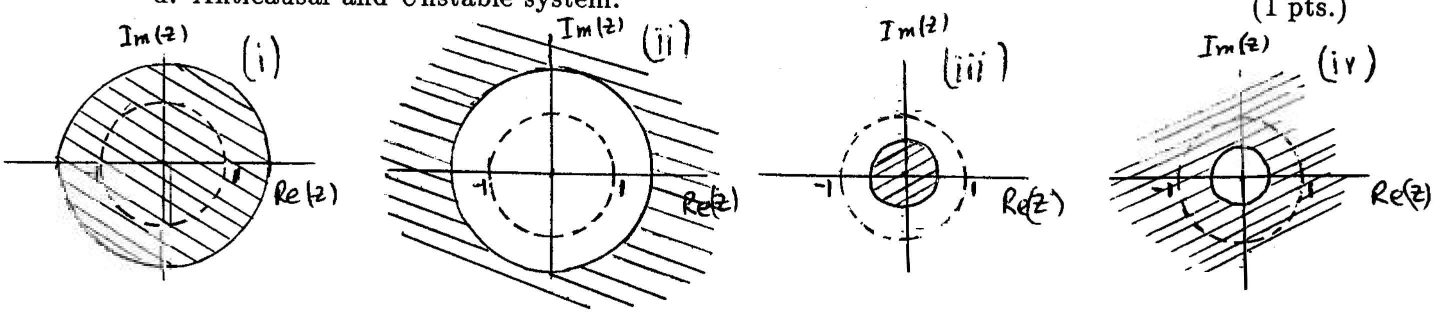
1. (a) Perform *Linear* convolution of the following two sequences using *Circular* convolution. (3 pts.)





b) Verify your results in part (a) by performing the linear convolution using z-transform. You must specify the ROC of the z-transforms. (3 pts.)

2. In the following ROC sketches the dashed circles represent the unit circles. Select among the following ROC's which correspond to,
   a. Causal and Stable system (1 pts.)
   b. Anticausal and Stable system (1 pts.)
   c. Causal and Unstable system (1 pts.)
   d. Anticausal and Unstable system. (1 pts.)



3. In z-domain, the Transfer Function of a system is given by :

$$H(z) = \frac{z(z+2)}{z^2 - \frac{5}{2}z + 1}$$

   (a) Find and sketch the poles and zeros of the system. (1 pts.)
   (b) Based on your pole-zero plot, hand-sketch the Magnitude Response ($|H(e^{j\theta})|$) of the system. What type of filter does this system approximate? (HINT : $\theta = 0$, $\frac{\pi}{2}$ and π, correspond to $z = 1$, j and -1, respectively.) (2 pts.)

(c) Find the *difference equation* corresponding to this $H(z)$. (2 pts.)

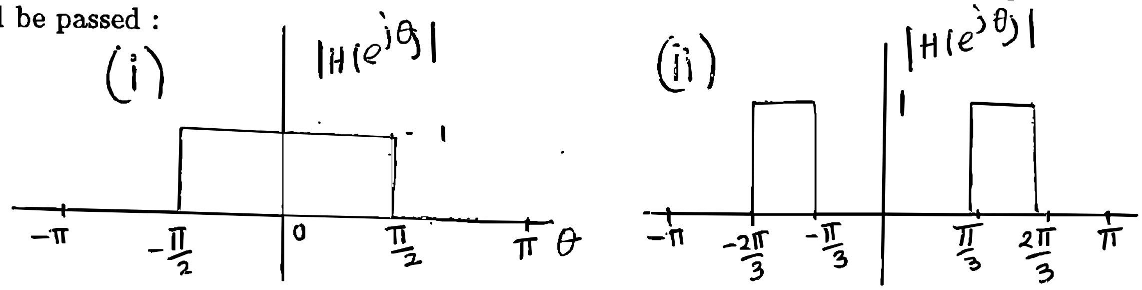
(d) Use Partial Fraction Expansion (PFE) method to find the $h(n)$ for the following ROCs (*Please identify the stable case*) :

(i) $\frac{1}{2} < |z| < 2$,

(ii) $|z| > 2$ and

(iii) $|z| < \frac{1}{2}$. (7 pts.)

4. The magnitude responses of two ideal digital filters show the range of *digital* frequencies that will be passed :



Now assume that analog signals are sampled with the sampling frequency of $f_s = 20KHz$.

(a) What is maximum analog frequency (f_{max}) that this sampler can handle? (0.5 pts.)

(b) What is the range of *analog* frequencies that these filters would be able to pass? (2.5 pts.)

5. (i) Assume that you have 0.1 seconds (T_0) of a *real* signal $x(t)$ and you sample it with $f_s = 1KHz$. Let $X(k)$ denote the DFT of $x(n)$.

(a) How many samples (=N) of $x(n)$ will you have? (0.5 pts.)

(b) What is the maximum frequency (f_{max}) that $x(t)$ can have so that there will be no aliasing effect due to sampling? (0.5 pts.)

(c) Assuming that N found in part-a is the DFT length, what is the frequency separation between two adjacent DFT values in digital ($\Delta\theta$) and in analog (Δf)? (1 pts.)

(d) What analog (f) and digital frequencies (θ) do the DFT components, $X(13)$ and $X(87)$ correspond to? According to properties of DFT, how do these two DFT components relate to each other? (1.5 pts.)

(e) If you want the frequency resolution (Δf) to be 1Hz, what Record Length (T_0) would you need? (0.5 pts.)

Total Points 29