College of Engineering, Pune-5

(An autonomous institute of government of Maharashtra)

End Semester Examination

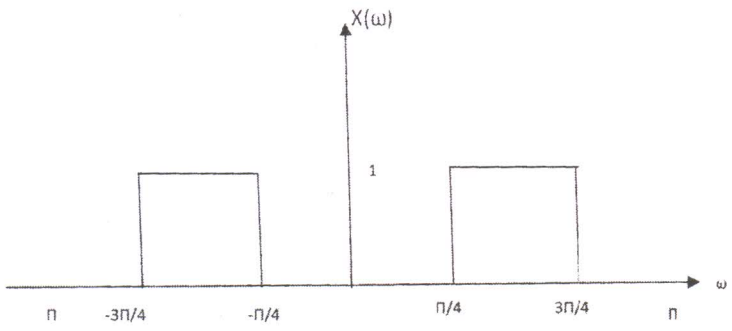
(Code: CT355) Computer Algorithm in Signal Processing

Programme: T.Y. B.Tech. (Computer Engineering)
Year: 2012-13 Date:30/11/2012
Duration : 3 Hrs [Max. Marks: 50]

Instructions to candidates:

1) Question No. 5 is Compulsory. Out of remaining five, solve only four
2) Only first five questions will be evaluated.
3) When one question is attempted solve all the sub-questions serially.
4) Assume suitable data, if necessary.
5) Figures to the right indicate full marks.
6) Use of logarithmic tables, mollier charts, non-programmable electronic calculators and steam tables are allowed.

Q.1 A Find the inverse DTFT of $X(\omega)$ shown in figure below 4 mark



B Write a difference equation to implement the system with a frequency response 3 marks

$$H(\omega) = \frac{1 - 0.5e^{-j\omega} + e^{-3j\omega}}{1 + 0.5e^{-j\omega} + 0.75e^{-2j\omega}}$$

C Consider the eight point periodic sequence 3 marks
X(n) = (1,3,4,5,6,5,4,3)

1) Is the sequence even symmetric
2) Find out x(n-3) mod 8
3) Find out x(n-5) mod 8
4) Find out time reversal of sequence x(n)

Q.2 A Given x(n)={0,1,2,3}. Find X(k) using DIT FFT algorithm. 4 matks
Draw the flowgraph clearly and write down the values at intermediate stages

B Let G[k] and H[k] denote the 7 point DFTs of two sequences g(n) and h(n), 4 mark

0<= n<=6, respectively. If G[K] = {1+j2, -2+j3, -1-j2, 0, 8+j4, -3+j, 2+j5}.
$h(n) = g((n-3)_7)$.
Determine H[K] without calculating IDFT of G[k], i.e g(n).

C The Z transform of a sequence x(n) is given as 2 mark

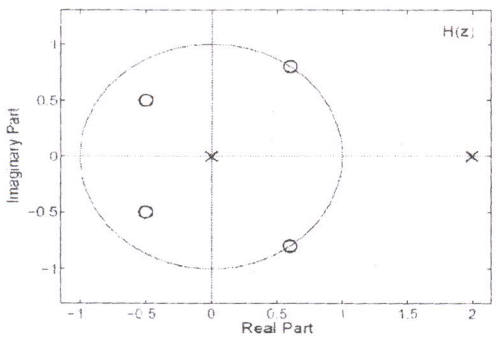
$$X(z) = \frac{Z + 2Z^{-2} + Z^{-3}}{1 - 3Z^{-4} + Z^{-5}}$$

If the region of convergence include the unit circle, find the DTFT of x(n) at $\omega = \Pi$.

Q.3 A Consider the sequence 4 mark
$X(n) = \delta(n) + 2\,\delta(n-2) + \delta(n-3)$

1) Find the four point DFT of x(n)
2) Let y(n) is the four point circular convolution of x(n) with itself, find Y(K) first and hence find out y(n)

B 03 marks



3-1: Pole-Zero Diagram

For the pole zero plot above answer the following question. Justify your answer with at most two statements.

A) If ROC is $|Z| > 2$
   1) Is the system stable?
   2) Is the system causal ?

B) If ROC $|z| < 2$
   1) Is the system stable?
   2) Is the system causal?

C A signal $X_a(t)$ is band limited to 10 Khz is sampled with a sampling frequency of 20 Khz. The DFT of N=1000 samples of x(n) is then Computed 3mark
1) What is the Spectral spacing between the spectral samples?
2) To What analog frequency does the index K=150 corresponds?
3) To What analog frequency does the index K=800 corresponds?

Q.4 A The linear time invariant system is characterized by the system function
3 marks

$$H(Z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Specify the ROC of H(Z) and determine h(n) for the following conditions.
1) The system is stable
2) The system is causal
3) The system is purely anticausal

B Find the linear convolution through circular convolution of x(n) and y(n). 2 mark

$x(n) = \delta(n) + \delta(n-1) + \delta(n-2)$
$y(n) = 2\delta(n) - \delta(n-1) + 2\delta(n-2)$

C Consider the LTI system which is stable and for which H(Z) , the Z transform of the impulse response is given by 5 marks

$$H(Z) = \frac{3 - 7z^{-1} + 5z^{-2}}{1 - 2.5z^{-1} + Z^{-2}}$$

Suppose X(n) , the input to the system is a unit step sequence. Determine the output

Q.5 A Select proper option 3 mark

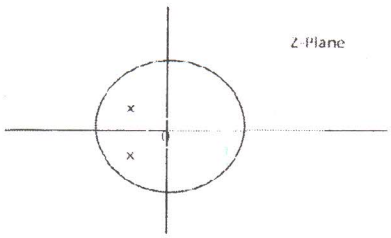
1) Which type of filter gives linear phase
   a) FIR filter
   b) IIR filter
   c) both FIR and IIR
   d) depends on design

2) In filter design windowing technique ,increasing the length of window function, --------the width of main lobe, which in turn--------- transition width
   a) Increases, increases
   b) Increases, decreases
   c) Decreases, increases
   d) Decreases, Decreases

3) Increasing the length of filter, ---------- number of ripples in the passband and stopband
   a) Increases
   b) Decreases
   c) Does not change
   d) Can't predict

4) The impulse response of ideal low pass filter is ----------
   a) causal and infinite
   b) Noncausal and Finite
   c) Noncausal and infinite
   d) bidirectional and infinite

5) The following Pole zero diagram corresponds to



a) High pass filter
b) Bandpass filter
c) Bandstop filter
d) Low pass filter

6) Which type of filters are stable
a) FIR
b) IIR
c) Both
d) Can not predict

B The desired response of a low-pass filter is 5 mark

$H_d(\omega) = e^{-j2\omega}$, $-\Pi/4 <= \omega <= \Pi/4$

$= 0$, $\Pi/4 < \omega <= \Pi$

Design FIR filter to meet above response with hamming window function
Of length seven.
Use following formula for Hamming window

$W(n) = 0.54 - 0.46\cos 2\Pi n/M-1$ $0 <= n <= M-1$

$= 0$ otherwise

C What is Gibb's phenomenon? How it is alleviated 2 mark

Q.6 A Compare FIR and IIR filter. In which applications one type will be preferred over the other ? 3mark

B What are the requirements of a Digital Signal Processor? 3 marks
How DSP processor differs from Microprocessor

C Determine the direct form I and II realization for a third transfer function 4 marks

$$H(Z) = \frac{0.28Z^2 + 0.319Z + 0.04}{0.5z^3 + 0.3Z^2 + 0.17Z - 0.2}$$

----------GOOD LUCK----------