Code: AE77/AC77   Subject: DIGITAL SIGNAL PROCESSING

AMIETE – ET/CS

Time: 3 Hours   **DECEMBER 2012**   Max. Marks: 100

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1   **Choose the correct or the best alternative in the following:** (2×10)

a. Down sampling by Lowpass filtering followed by compression is termed as

   (A) Interpolation   **(B)** Aliasing
   (C) Decimation   **(D)** None of these

b. The relationship between the quantized signal level and the full scale level of the A/D converter

   (A) $\Delta = (X_m)/ 2^B$ **(B)** $\Delta = (2 X_m)/ 2^B$
   (C) $\Delta = (X_m)/ 2^{B+1}$ **(D)** $\Delta = (4 X_m)/ 2^B$

c. Canonical form of structure is

   (A) Direct Form I   **(B)** Direct Form II
   (C) Both **(A)** & **(B)**   **(D)** None of these

d. If the continuous time system has poles only in the left half of the s-plane then the discrete time filter must have poles _____

   (A) Outside the unit circle only   **(B)** Inside the unit circle only
   (C) Anywhere on z plane   **(D)** $2< |Z|<3$

e. The DFT values are equal to samples of Z transform and are at equally spaced points _____

   (A) Outside the unit circle   **(B)** Inside the unit circle
   (C) On the unit circle   **(D)** On entire z plane

f. $W_N^{N/2}$ is equal to

   (A) 1   **(B)** $j\omega$
   (C) $- j\omega$ **(D)** -1

g. Since Z Transform are analytic functions inside their ROC it means that

(A) They have well defined derivative at every point inside the ROC
(B) Z - Transform and all its derivatives are continuous functions within ROC
(C) Both **(A)** & **(B)**
(D) None of these

h. Relationships between real and imaginary parts of Z - Transform on a closed contour within ROC is referred to as _____

(A) Poisson's formula in mathematical literature
(B) Hilbert Transform relations in system theory
(C) None of these
(D) Both **(A)** & **(B)**

i. Effect of windowing on a signal's spectrum can be.

(A) Reduced Resolution   **(B)** Leakage
(C) Both **(A)** & **(B)**   **(D)** None of these

j. Out of all the windows available, the one which has the narrowest mainlobe for a given length is

(A) Kaiser window   **(B)** Rectangular window
(C) Hamming window   **(D)** Hanning window

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Explain discrete time processing of continuous time signals. **(8)**

b. Derive the Frequency domain relationship between the input and output of an ideal Continuous to Discrete (C/D) Converter and assist it with spectrum diagrams. **(8)**

Q.3 a. Consider the LTI system with input x [n] and output y [n] are related through the difference equation.

$$y[n] + \frac{1}{4}\ y[n\text{-}1] = x[n] + \frac{1}{2}\ x[n\text{-}1]$$

    (i)   Find the system function and its ROC **(4)**
    (ii)   Draw its pole-zero plot **(2)**
    (iii)   Comment on the causality and stability of this system **(2)**

b. Explain Allpass systems. Obtain its frequency response and discuss the applications of Allpass system. **(8)**

Q.4 a. (i) Obtain the direct form I and direct form II Realization of the system.

$$H(z) = \frac{\left(1 + 2z^{-1} + z^{-2}\right)}{\left(1 - 0.75z^{-1} + 0.125z^{-2}\right)}$$ **(4)**

  (ii) Obtain the Linear phase Realization of system given by **(4)**

$$H(z) = \sum_{n=0}^{5} z^{-n}$$

  b. Explain Transposition. Give the transposed flow graph of **(8)**

$$H(z) = \frac{1}{\left(1 - az^{-1}\right)}$$

Q.5 a. Explain the design of optimum approximation of FIR filters. **(8)**

  b. Differentiate between:
  (i) IIR and FIR Filters
  (ii) Butterworth filter and Chebyschev filter **(8)**

Q.6 a. Compute the 4 point DFT of the sequence $x[n] = \{1, j, -1, -j\}$. **(6)**

  b. Prove the statement "Circular Convolution is Linear Convolution with Aliasing" and obtain the Linear convolution of $x_1(n) = \{1, 2, 3, 4\}$ and $x_2(n) = \{1, -1, 1, -1\}$ using circular convolution. **(10)**

Q.7 a. Explain DIF- FFT Algorithm using signal flow graphs for N=8. Compare its computational complexity with DFT. **(8)**

  b. Write a short note on implementation of DFT using Convolution with the help of one example. **(8)**

Q.8 a. Explain the processing steps in discrete time Fourier Analysis of a continuous time signal. **(8)**

  b. Elaborate on the Time dependent Fourier Analysis of Non-stationary signals. **(8)**

Q.9 a. Explain Hilbert Transform relationships mentioning how it eliminates the constraints on the Fourier Transform. **(8)**

  b. Give the relationship between magnitude and phase of the Fourier transform of a sequence. **(8)**