Subject: DIGITAL SIGNAL PROCESSING

Time: 3 Hours **JUNE 2011** **Max. Marks: 100**

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. An ideal reconstruction system consists of

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(A) A LPF followed by a converter to convert from sequence to impulse train.
(B) A converter to convert from sequence to impulse train followed by a LPF.
(C) A converter to convert from impulse train to sequence followed by a LPF
(D) A LPF followed by a converter to convert from impulse train sequence.

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

(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. The deviation of the group delay from a constant indicates the degree of

(A) Linearity of the phase **(B)** Symmetry of the phase
(C) Non Linearity of the phase **(D)** Non Symmetry of the phase

d. Attenuation in dB is given as

(A) $-20 \log_{10} \left| H\left(e^{j\omega}\right)\right|$ **(B)** - Gain in dB
(C) Both **(A)** & **(B)** **(D)** None of the above

e. Canonical form of structure is

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

f. This form of structure is not used in FIR filters

(A) Direct Form I **(B)** Cascade
(C) Direct Form II **(D)** Parallel

g. This has an equiripple characteristics in the passband and varies monotonically in the stopband

(A) Type I Chebyshev filter **(B)** Type II Chebyshev filter
(C) Butterworth filter **(D)** Elliptical filter

h. The multiplication of two Discrete Fourier Transforms is same as

(A) Linear Convolution of the sequences
(B) Correlation of the sequences
(C) Cross Correlation of the sequences
(D) Circular Convolution of the sequences

i. What is incorrect about Chirp Transform Algorithm

(A) Its based on expressing the DFT as a convolution.
(B) It is less flexible than FFT.
(C) It doesn't minimize the computational complexity.
(D) It can be used to compute any set of equally spaced samples of the FT on the unit circle.

j. The wideband spectrogram results from a window that is short in time and characterized by

(A) Poor Resolution in frequency dimension and good Resolution in time dimension.
(B) Good Resolution in frequency dimension and poor Resolution in time dimension.
(C) Poor Resolution in frequency dimension and poor Resolution in time dimension.
(D) Good Resolution in frequency dimension and good Resolution in time dimension.

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

Q.2 a. 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)**

b. (i) Explain Digital to Analog conversion in detail. **(6)**
(ii) What is Quantization error? **(2)**

Q.3 a. The system function of an LTI system is **(2+2+4)**

$$H(z) = \frac{1}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)}$$

(i) Find out the difference equation that is satisfied by the input and output of the system.
(ii) Give the Pole-Zero plot for the system.
(iii) Give the various choices for ROC and comment on the causality and stability.

b. (i) What are Inverse systems? **(2)**
(ii) Explain minimum phase systems and discuss their unique fundamental properties. **(6)**

Q.4 a. Discuss the most commonly used forms for implementing an IIR system and obtain their flow graphs. **(12)**

b. Obtain the transposed form for

$$H(z) = \frac{1}{\left(1 - a\,z^{-1}\right)}$$ **(4)**

Q.5 a. Explain the design of FIR filters using Windowing, giving properties of all the common windows. **(8)**

b. The Bilinear Transformation is used to design an ideal discrete time LPF with cutoff frequency ($\omega_c = 3\pi/5$) from an ideal continuous time LPF with cutoff frequency $\Omega_c = 2\pi(300)$ rad/s. Find T. Is this value of T unique? **(6+2)**

Q.6 a. Enlist all the properties of DFT for a finite duration sequence and describe each one of them briefly. **(6)**

b. (i) Prove the statement "Circular Convolution is Linear Convolution with Aliasing" **(5)**

(ii) If $x[n] = \cos\left(\frac{\pi n}{2}\right)$, Find the 4 point DFT X(K). **(5)**

Q.7 a. Derive Goertzel Algorithm and state its use. **(8)**

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

Q.8 a. What is Time dependent or Short Time Fourier Transform? Explain the effect of window on the frequency spectrum of a signal found by using Time dependent Fourier Transform. **(8)**

b. What is Periodogram and modified Periodogram? Give the properties of Periodogram. **(8)**

Q.9 a. What is Hilbert Transform? State its application. **(4)**

b. Explain Hilbert Transform relations for complex sequences. **(12)**