ROLL NO. _____

Code: AE77/AC77 Subject: DIGITAL SIGNAL PROCESSING

AMIETE – ET/CS

Time: 3 Hours **DECEMBER 2014** **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. LTI behavior of a system depends on

(A) System must be Linear and Time-Invariant
(B) Input signal must be bandlimited
(C) Sampling Rate must be high enough so that any aliased components are removed
(D) All of these

b. An ideal reconstruction system consists of

(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

c. Goertzel's algorithm requires computation proportional to

(A) N **(B)** 2N
(C) (N+1) **(D)** N^2

d. 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

e. Z transform of δ (n) is

(A) Z^{-n} **(B)** 1
(C) 1/Z **(D)** 1/(1- Z)

f. The phase or group delay

(A) Negative of the derivative of phase
(B) Derivative of phase
(C) Positive of the derivative of phase
(D) Integral of phase

g. Canonical form of structure is

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

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

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

i. This has an equi-ripple 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

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. Explain Periodic Sampling with an impulse train **(8)**

b. Comment on how oversampling and subsequent discrete time filtering and downsampling can permit an increase in step size of the quantizer. **(8)**

Q.3 a. Consider the LTI system with input and output related through the difference equation

$y[n] + \frac{1}{4} y[n-1] = x[n] + \frac{1}{2} x[n-1]$ **(8)**

(i) Find the system function and ROC
(ii) Give the pole-zero plot
(iii) Comment on the causality and stability of this system

b. What is Frequency-Response compensation? Illustrate distortion compensation by linear filtering. **(8)**

Q.4 a. Give the basic network structures for FIR Systems. **(8)**

b. Explain signal flow-graph representation of linear constant-coefficient difference equations. **(8)**

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? **(8)**

Q.6 a. Find out the DFT for a finite duration sequence x[n] with period N=5 **(8)**

b. Compute the Circular Convolution of two rectangular pulses where **(8)**
$x_1[n] = x_2[n] = \begin{cases} 1 & 0 \le n \le L-1 \\ 0 & \text{otherwise} \end{cases}$, where L=6

Q.7 a. Discuss the issues associated with accessing and storing data in the intermediate arrays of the FFT. **(8)**

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

Q.8 a. Explain how Fourier Analysis is done for non stationary signals. **(8)**

b. Describe how DFT is helpful in the spectrum analysis of random signals. **(8)**

Q.9 a. What is Hilbert Transformer? **(4)**

b. Give the Real and Imaginary-part sufficiency of the Fourier Transform for causal sequence. **(12)**