

AMIETE – ET/CS (Current & New Scheme)

Time: 3 Hours

June 2018

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. Determine the convolution $y(n)$ of two sequences $x(n) = \{1, 2, 1, 2\}$ and $h(n) = \{1, 0, 1, 0\}$
- (A) $y(n) = \{1, 2, 2, 4, 1, 2, 0\}$ (B) $y(n) = \{1, 2, 2, 4, 2, 1, 0\}$
 (C) $y(n) = \{0, 2, 1, 4, 2, 2, 1\}$ (D) $y(n) = \{1, 2, 1, 2, 1, 0, 1\}$
- b. As the window becomes shorter, the ability to resolve closely spaced sinusoids in the spectral estimate
- (A) increases (B) decreases
 (C) does not change (D) increases then decreases
- c. The minimum sampling frequency for $x_a(t)$ is real with $X_a(f)$ non-zero only for $9 \text{ KHz} < |f| < 12 \text{ KHz}$ is
- (A) 4.5 KHz (B) 12 KHz
 (C) 9 KHz (D) 6 KHz
- d. If $x[n + N] = x[n]$ then $X[k + N]$ is
- (A) 1 (B) 0
 (C) $X[k]$ (D) $X[N]$
- e. LTI behavior of a system depends on
- (A) Input signal must be bandlimited
 (B) System must be Linear and Time-Invariant
 (C) Sampling Rate must be high enough so that any aliased components are removed
 (D) All of these
- f. If the Fourier series coefficients of a signal are periodic then the signal must be
- (A) discrete-time, periodic (B) continuous-time, non-periodic
 (C) discrete-time, non-periodic (D) continuous-time, periodic

- g. Time dependent Fourier Transform can be analyzed using
 (A) Overlap add method (B) Overlap save method
 (C) Both (A) & (B) (D) None of these
- h. Z transform of $\delta(n)$ is
 (A) Z^{-n} (B) 1
 (C) $1/z$ (D) $1/(1-z)$
- i. Canonical form of structure is
 (A) Direct Form I (B) Direct Form II
 (C) Both (A) & (B) (D) None of these
- j. In high-speed filtering applications
 (A) parallel realization is preferred (B) cascaded realization is preferred.
 (C) linear realization is preferred (D) None of these

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

- Q2** a. The continuous time signal $x_a(t) = \sin(20\pi t) + \cos(40\pi t)$ is sampled with a sampling period T to obtain the discrete time signal $x[n] = \sin(\frac{\pi n}{5}) + \cos(\frac{2\pi n}{5})$. (i) Determine a choice for T consistent with this information. (ii) Is your choice for T in part (i) unique? If so, explain why? If not, specify another choice of T consistent with the information given. (8)
- b. With the help of complete calculations show that SNR increases by approximately 6 dB with each bit added to word length. (8)
- Q.3** a. The Difference equation of a causal discrete time LTI system is given as

$$y[n] = -\frac{1}{2}y[n-1] + x[n]$$
 (i) Find the frequency response $H(e^{j\omega})$ for the system.
 (ii) Find the output response of this system to the input $x(n) = (1/2)^n u(n)$ (8)
- b. (i) What are Inverse systems? (2)
 (ii) Explain minimum phase systems and discuss their unique fundamental properties. (6)
- Q.4** a. By what factor do coefficient multipliers reduce/increase in Direct Form structures for linear phase FIR systems? Draw the structures. (8)
- b. Discuss the factors that influence the choice of structure of realization of a LTI system. (8)

- Q.5** a. Determine the magnitude response of $y(n) = \frac{1}{2}[x(n) + x(n-2)]$. (8)
- b. Discuss the Parks- McClellan algorithm for type-I low pass filter. (8)
- Q.6** a. Find out the DFT for a finite duration sequence $x[n]$ with period $N=5$ (8)
- b. Discuss overlap add method for performing linear convolution of large length signal. (8)
- Q.7** a. Consider a sequence $x(n) = \{1, 2, 3, 4\}$ its DFT is given by $x(k) = \{10, -2 + j2, -2, -2 - j2\}$. The sampling rate is 10 Hz. (8)
- (i) Determine the sampling period, time index and sampling time instant for a discrete time sample $x(3)$ in time domain.
- (ii) Determine the frequency resolution, frequency bin number and frequency for each of the DFT coefficients $X(1)$ and $X(3)$ in frequency domain.
- b. Explain Goertzel Algorithm approach to compute DFT. (8)
- Q.8** a. Discuss the effect of windowing on Fourier analysis of sinusoidal signals. (8)
- b. Explain properties of periodogram. (8)
- Q.9** a. Explain Hilbert Transform relationships mentioning how it eliminates the constraints on the Fourier Transform. (8)
- b. Give the Real and Imaginary-part sufficiency of the Fourier Transform for causal sequence. (8)