ROLL NO. _____

Code: AE77/AC77/AE121 **Subject: DIGITAL SIGNAL PROCESSING**

AMIETE – ET/CS (Current & New Scheme)

Time: 3 Hours **JUNE 2017** **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.**

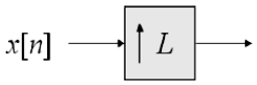
Q.1 Choose the correct or the best alternative in the following: **(2×10)**

a. Sampling theorem is:

(A) $f_m < f_s$ **(B)** $f_m > f_s$

(C) $f_s >= 2f_m$ **(D)** $f_s = 2f_m$

b. The following block represents



(A) Up-sampler **(B)** down sampler

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

c. Which window is used to alter FIR filter coefficients so that they smoothly approach zero at both ends.

(A) Blackman window **(B)** Rectangular window

(C) Laplace window **(D)** Hilbert transform

d. Z transform of δ(n) is

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

(C) 1/Z **(D)** 1/(1 – Z)

e. The signal $x(n) = \sum_{n=-\infty}^{\infty} \delta(n)$ is

(A) ∞ **(B)** 0

(C) 1 **(D)** undefined

f. In an N-point DFT of finite duration sequence $x(n)$ of length L, the value of N should be

(A) $N \geq L$ **(B)** $N < L$

(C) $N = 0$ **(D)** $N = L^2$

g If the continuous time signal is $x_c(t) = \cos(16000\pi t)$ with sampling period $T = 1/6000$, will result in

(A) inequality **(B)** aliasing
(C) interpolation **(D)** recovery without aliasing

h. An ideal Hilbert transformer is _____ that imparts a _____ phase shift on the input signal.

(A) an all-pass filter, 90° **(B)** an all-pass filter, –90°
(C) a low-pass filter, 90° **(D)** a low-pass filter, –90°

i. 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

j. The two types of error produced by A/D conversion are

(A) quantization and rounding **(B)** rounding, saturation
(C) quantization, saturation **(D)** rounding, adaptive

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

Q.2 a. Derive the frequency domain relation between input and output of an ideal continuous to discrete converter. **(8)**

b. Explain how can we reconstruct the CT band limited signal from its samples. **(8)**

Q.3 a. A discrete-time causal LTI system has the system function **(8)**

$$H(z) = \frac{(1+0.2z^{-1})(1-9z^{-2})}{1+0.81z^{-2}}$$

(i) Is the system stable?

(ii) Find expressions for a minimum-phase system $H_{min}(z)$ and an all pass system $H_{ap}(z)$ such that $H(z) = H_{min}(z)H_{ap}(z)$

b. Consider the LTI system with input x[n] and output y[n], which are related through the difference equation: $y[n] - 5/2\, y[n-1] + y[n-2] = x[n]$

(i) Obtain 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)**

Q.4 a. Obtain two canonical realizations of the system function:

$$H(z)=\frac{1+2z^{-1}-z^{-2}}{1+z^{-1}-z^{-2}}$$ **(10)**

b. Consider the causal LTI system with system function $H(z)=1-\frac{1}{3}z^{-1}+\frac{1}{6}z^{-2}+z^{-3}$. Draw the Direct form and transposed Direct form representation of this system. **(6)**

Q.5 a. Explain the process of windowing using illustrations. Obtain frequency domain characteristics of rectangular window function. **(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 the 10-point inverse DFT of $X(k)=1+2\delta(k)$. **(8)**

b. Find the DFT of a sequence $x(n)=\{1,\ 1,\ 0,\ 0\ \}$. **(8)**

Q.7 a. Explain DIT- FFT Algorithm using signal flow graphs for N=8. Hence find DFT of sequence [1 -1 1 -1 1 -1 1 -1] using DIT-FFT algorithm. **(8)**

b. Derive Goertzel Algorithm and state its use. **(8)**

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

b. Discuss the time-dependent Fourier transform with a suitable example. **(8)**

Q.9 a. Show that when complex cepstrum of a sequence is causal, both poles & zeros of its z-transform lie inside the unit circle. **(8)**

b. Write technical note on digital Hilbert transformer and its applications. **(8)**