ROLL NO. _____

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. The period of the signal $x(n) = \cos(n\pi/2)\cos(n\pi/4)$ is

(A) 8 **(B)** 4
(C) 32 **(D)** 12

b. The system characterized by the equation $y(n) = ax(n) + b$ is

(A) linear for any value of b **(B)** linear if $b > 0$
(C) linear if $b < 0$ **(D)** nonlinear

c. The _____ limit cycles are avoided by scaling the input signal.

(A) zero **(B)** overflow
(C) both **(A)** and **(B)** **(D)** none of these

d. An LTI system characterized by the difference equation $y(n) = x(n) - x(n-5)$ is a/an

(A) comb filter **(B)** bandpass filter
(C) highpass filter **(D)** allpass filter

e. The Z-transform of the signal $x(n) = \sum_{k=-\infty}^{0} \delta(n-k)$ has the following region of convergence.

(A) $|Z| > 1$ **(B)** $|Z| = 1$
(C) $|Z| < 1$ **(D)** $0 < |Z| < 1$

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. In an 8-point DFT by radix-2 FFT, there are _____ stages of computations with _____ butterflies per stage.

(A) two, two **(B)** four, three
(C) three, four **(D)** three, three

h. The direct form-II is also called as_____

(A) Canonic form **(B)** Direct form-I
(C) Cascade form **(D)** Parallel form

i. For the same specifications, the order of Butterworth filter is _____ to that of Chebyshev filter.

(A) more **(B)** less
(C) equal **(D)** none of these

j. A system characterized by the system function $H(z) = \frac{1}{2}(1 + z^{-1})$ is a

(A) lowpass filter **(B)** highpass filter

(C) bandpass filter **(D)** bandreject filter

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

Q.2 a. The signal $x(t) = 2\cos(40\pi t) + \sin(60\pi t)$ is sampled at $f_s = 75$ Hz. What is the common period of the sampled signal $x(n)$ and how many full periods of $x(t)$ does it take to obtain one period of $x(n)$? **(8)**

b. What is quantization error? Derive signal to quantization noise ratio for a sinusoidal signals. **(8)**

Q.3 a. Let $h(n) = 0.8\delta(n) + 0.36(-0.8)^{n-1}u(n-1)$. Identify the filter type and establish whether the impulse response is a linear-phase sequence. **(8)**

b. Consider a first-order stable system with system function $H(z) = K\frac{1+az^{-1}}{1+bz^{-1}}$. For what values of K, a and b, this system acts as an allpass filter. **(8)**

Q.4 a. Compute the N-point DFT of the length-N sequence $0 \le n \le N-1,\ 0 \le r \le N-1$ **(8)**

b. A length-8 sequence is given by $x(n) = \{-4,5,2,-3,0,-2,3,4\},\ 0 \le n \le 7$, with an 8-point DFT given by $X(k)$. Without computing the IDFT, determine the sequence $y(n)$ whose 8-point DFT is given by $Y(k) = W_4^{3k}X(k)$. **(8)**

Q.5 a. Develop DIF-FFT algorithm for $N = 8$ and draw its signal flow graph. **(8)**

b. Explain Goertzel algorithm and its two applications. **(8)**

Q.6 a. What are the advantages in representing the systems in block diagram form? What do you mean by transposed structures? **(6)**

b. Find the direct form-II and transposed realization of the following transfer function:

(i) $H(z) = \frac{4z+28}{z+1}$

(ii) $H(z) = \frac{4z+28}{z^2+6z+5}$ **(10)**

Q.7 a. What is windowing technique? Explain how it is used for design of digital FIR filters with the help of example. **(8)**

b. Explain bilinear transformation method and frequency warping. **(8)**

Q.8 a. A continuous-time signal is sampled at a sampling rate of 10 KHz and the 1024-point DFT is computed. Determine the frequency spacing between spectral samples. Justify your answer. **(7)**

b. Discuss the time-dependent Fourier transform with a suitable example. **(9)**

Q.9 a. Determine the Hilbert transform of the unit impulse function $\delta(n)$. **(8)**

b. Let $x(n)$ denote a causal, complex-valued sequence with Fourier transform $X(e^{j\omega}) = X_R(e^{j\omega}) + jX_I(e^{j\omega})$. If $X_R(e^{j\omega}) = 1 + \cos(\omega) + \sin(\omega) - \sin(2\omega)$, determine $X_I(e^{j\omega})$. **(8)**