

AMIETE – ET/CS/IT (OLD SCHEME)

Code: AE06/AC04/AT04
Time: 3 Hours

Subject: SIGNALS & SYSTEMS
Max. Marks: 100

DECEMBER 2010

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.
- 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 best alternative in the following: (2 × 10)

a. $u(n) - u(n-1)$ will result in

- (A) $u(n)$ (B) $u(-n-1)$
(C) $\delta(n)$ (D) $\delta(n-1)$

b. The system characterized by the equation $y(t) = a x(t) + b$ is

- (A) linear for any value of b . (B) linear if $b < 0$
(C) linear if $b > 0$. (D) non-linear.

c. Laplace transformation of $e^{-at} t^n$

- (A) $t/(s+a)^n$ (B) $a/(s+a)^{n+1}$
(C) $n/(s+a)^{n+1}$ (D) none of above

d. The system described by $y(t) = \int_{-\infty}^t x(\tau) d\tau$ is

- (A) unstable (B) stable
(C) can't defined. (D) marginally stable.

e. System function $H(\omega)$ equals

- (A) $Y(\omega) * X(\omega)$ (B) $Y(\omega) \times X(\omega)$.
(C) $Y(\omega) / X(\omega)$. (D) $X(\omega) / Y(\omega)$

f. Z-transform converts convolution of time signal into

- (A) division (B) sum
(C) multiplication (D) modulo sum

- g. Signal $x(t) = e^{-at}u(t)$, $a > 0$ is a
- (A) energy signal (B) power signal
 (C) data is insufficient (D) none of the above.
- h. Tossing a dice is an example of
- (A) continuous random variable. (B) conditional random variable
 (C) cumulative random variable (D) discrete random variable.
- i. The Fourier transform of $u(t)$ is
- (A) $1/(j2\pi f)$ (B) $j2\pi f$
 (C) $1 + j2\pi f$ (D) none of the above
- j. Convolution of $\delta(n)$ with itself gives
- (A) $2\delta(n)$ (B) $u(n)$
 (C) $\delta(n)$ (D) $r(n)$

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

- Q.2** a. (i) Derive the expression for the DFS, for a given $x(n)$ which is periodic with fundamental period N .
 (ii) Prove $a_k = a_{k+N}$
 (iii) if $x(n)$ is real and even a_k are real and even. (12)
- b. Discuss the difference between energy and power signal. (4)
- Q.3** a. Compute the convolution $y(t) = x(t) * h(t)$ for $x(t) = e^{2t}u(1-t)$ and $h(t) = e^{-t}u(t+3)$. (8)
- b. If $x(n) = \cos(n\pi/2)$ where $0 \leq n \leq 3$. Plot the following (8)
- (i) $x(n)$ (ii) $x(n-2)$
 (iii) $x(-3-n)$ (iv) $x(n-1)\delta(n+2)$
- Q.4** a. Two signals $x(t) = \cos 2\pi t$ and $y(t) = \cos 100\pi t$ are sampled with sampling frequency of 40 Hz. Obtain the associated discrete time signals $x(n)$ and $y(n)$ and comment on the result. (10)
- b. Define Duality: using the property of Duality find the Fourier transform $G(j\omega)$ of the signal $g(t) = \frac{2}{1+t^2}$. (6)

Q.5 a. Consider the periodic signal $x(t)$ shown in Fig.1 and given by

$$x(t) = \begin{cases} At^2 & 0 \leq t < T_0 \\ 0 & T_0 \leq t < 2T_0 \end{cases}$$

if $a_0 = 1/6$, show that $AT_0^2 = 1$. (8)

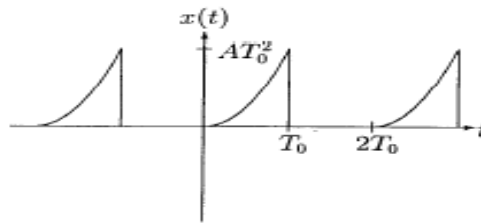


Fig1.

b. Consider the first order causal LTI system described by the difference equation $y(n) - a y(n-1) = x(n)$, with $|a| < 1$. Obtain (8)

- (i) frequency response of the system
- (ii) impulse response of the system

Q.6 a. For $X(s) = \frac{1}{s + 1/2}$, $\text{Re}\{s\} > -\frac{1}{2}$; draw Pole- Zero plot geometrically. (6)

b. Consider an LTI system with impulse response $h(n) = \alpha^n u(n)$ with $|\alpha| < 1$ and the input to the system is $x(n) = \beta^n u(n)$ with $|\beta| < 1$ compute $y(n)$. (10)

Q.7 a. The input to an LTI system is $x(t) = e^{-3t} u(t)$, then the output is $y(t) = [e^{-t} - e^{-2t}] u(t)$. Determine (8)

- (i) the system function
- (ii) ROC
- (iii) Differential equation.

b. Explain the concept of unilateral Z Transform with a suitable example. (4)

c. For $x(z) = 4z^2 + 2 + 3z^{-1}$, $0 < |z| < \infty$, determine $x(n)$ and plot the sequence. (4)

Q.8 a. Find the z- transform and ROC for the signal (8)

$$x(n) = (1/3)^n \sin\left(\frac{n\pi}{4}\right) u(n)$$

b. State dirichlet condition of Fourier Transform. Determine and plot the continuous - time Fourier transform of (8)

- (i) The unit impulse
- (ii) The rectangular pulse

Q.9

Write short notes on any **FOUR**:

(16)

- (i) Random Variables & Gaussian Random variable
- (ii) Sum of random Processes
- (iii) Stationary and Non- stationary Random Processes
- (iv) Mean and Standard deviation
- (v) Ergodic process