Code: AE06/AC04/AT04 **Subject: SIGNALS & SYSTEMS**
Time: 3 Hours **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(ω) 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/ (j2πf)   **(B)** j2πf
   (C) 1+ j2πf   **(D)** none of the above

j. Convolution of δ(n) with itself gives

   (A) 2 δ (n)   **(B)** u(n)
   (C) δ (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 $0 \le n \le 3$. Plot the following   **(8)**
           (i)   x(n)   (ii)   x(n-2)
           (iii)   x(-3-n)   (iv)   x(n-1) δ (n+2)

Q.4   a.   Two signals x(t) = cos2πt and   y(t) = cos 100πt 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 $g(t) = \dfrac{2}{1+t^2}$.   **(6)**

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

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

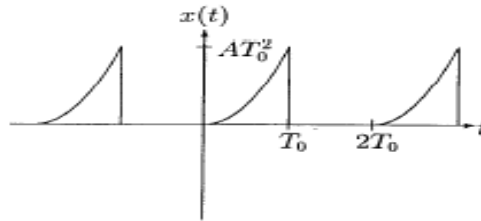if $a_0 = \frac{1}{6}$, show that $AT_0^2 = 1$. **(8)**

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 $X(s) = \dfrac{1}{s+1/2}$, $Re\{s\} > -\dfrac{1}{2}$; 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 $|\beta| < 1$ computer y(n). **(10)**

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

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

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

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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