ROLL NO. ___________

Code: AE57/AC57/AT57 Subject: SIGNALS AND SYS

AMIETE – ET/CS/IT

Time: 3 Hours **DECEMBER 2012** **Max. Marks: 1**

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. A discrete time system is described by y(n) = x(n)+x(n-1). Then the system is
(A) Time Invariant and Linear
(B) Time variant and Linear
(C) Time Invariant and Nonlinear
(D) Time variant and Nonlinear

b. The evolution of the following integral is

$$x(t) = \int_{-\infty}^{+\infty} (t + \cos \pi t).\delta(t-1).dt$$

(A) ∞ **(B)** π
(C) 0 **(D)** t

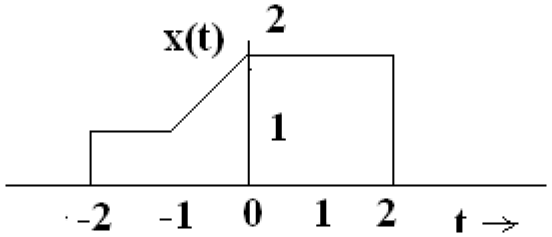
c. The energy of the signal x[n] = δ(n)+2 δ(n-1)+4 δ(n-2)-2 δ(n-3) is
(A) 22 J **(B)** 25 J
(C) 50 J **(D)** 0 J

d. The impulse response of the system is given by h(n) = $(2)^n$ u[n]. Then the response of the system for x(n)=u(n) is

(A) $[(2)^{n+1} + 1]u[n]$ **(B)** $[(2)^{n} + 1]u[n]$

(C) $[(2)^{n} - 1]u[n]$ **(D)** $[(2)^{n+1} - 1]u[n]$

e. Representation of the given signal x(t) using basic signals is (Fig.1)



(A) x(t)=u(t+2)+r(t+1)-r(t)-2u(t-2) **(B)** x(t)=u(t+2)+2r(t+1)-r(t)-2u(t-2)
(C) x(t)=u(t+2)+r(t+1)-r(t)-u(t-2) **(D)** x(t)=u(t+2)+r(t+1)-r(-t)-2u(t-2)

f. Laplace transform of signal x(t) is (Fig.2)

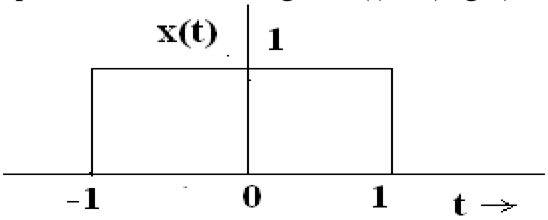


Fig.2

(A) $\frac{1}{s}[e^{+s} - e^{-s}]$ **(B)** $\frac{1}{s}[e^{+s} + e^{-s}]$

(C) $s[e^{-s} - e^{+s}]$ **(D)** $s[e^{-s} + e^{+s}]$

g. The region of convergence for the sequence $x(n)=(2)^n u(-n-1)+(3)^n u(n)$ is
(A) $|z| < 2$ **(B)** $|z| > 3$
(C) $2 < |z| < 3$ **(D)** Does not exists

h. The frequency response of the system h(n)=1/2[δ(n+1)+ δ(n-1)] is
(A) $\sin\omega$ **(B)** $\cos\ \omega$
(C) $e^{j\omega}$ **(D)** $e^{-j\omega}$

i. Inverse Fourier transform of $X(\omega)=\delta(\omega)$ is
(A) δ(t) **(B)** 0
(C) 2πδ **(D)** 1/(2π)

j. When a fair coin is tossed, the probability of getting two tails simultaneously on any given trial is
(A) 1 **(B)** 1/2
(C) 1/4 **(D)** 1/8

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

Q.2 a. Determine power and energy of the following signals

(i) $x(t) = e^{j\omega_0 t} \quad -\infty < t < \infty$

(ii) $x(t) = A\cos(\omega t)$

(iii) x(n)=u(n) **(8)**

b. Given x(t) as shown in Fig.3 **(8)**
Sketch the following
(i) x(-2t)
(ii) x(t-3)
(iii) x(t)u(t)
(iv) x(-t+1)

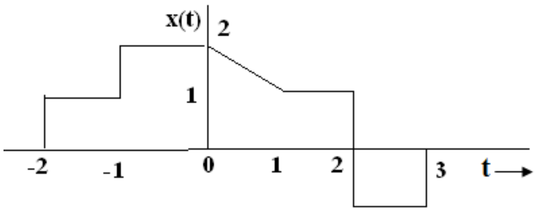


Fig.3

Q.3 a. Determine the Fourier's Series representation for signal; **(8)**

(i) $x(n) = 1 + \sin\left[\frac{1}{12}\pi n + \pi/3\right]$

(ii) $x(n) = 1 + 2\cos\left[\frac{\pi}{8} n + \pi/6\right]$

b. State and prove the following Fourier series properties of continuous periodic signals. **(8)**
(i) Frequency shift property
(ii) Scaling property

Q.4 a. State and prove Parseval's energy theorem for continuous aperiodic signals. **(8)**

b. The transfer function of the system is given by:

$$H(j\omega) = \frac{j\omega}{(j\omega)^2 + 3(j\omega) + 2}$$

Find the system equation and also impulse response of the system. **(8)**

Q.5 a. State and prove the following properties of discrete time Fourier Transform.
(i) Time shifting property
(ii) Differentiation in frequency domain **(6)**

b. Consider a discrete time LTI System with impulse response.
$h[n] = \alpha^n u[n]$ where $|\alpha| < 1$. Use Fourier Transform to determine the response to the input $x[n] = \beta^n u[n]$ with $|\beta| < 1$ **(10)**

Q.6 a. Determine the Nyquist rate for the following signals **(4)**
(i) $x(t) = 1 + \cos(200\pi t) + 4\sin(400\pi t)$
(ii) $x(t) = 2\cos(600\pi t)\cos(800\pi t)$

b. With diagrams explain sampling of discrete time signals. **(8)**

c. Find the frequency response and impulse response of the system with input $x(t) = e^{-2t}u(t)$ and output $y(t) = e^{-3t}u(t)$. **(4)**

Q.7 a. Find, the output y(t) of the system described by the differential equation $\frac{dy(t)}{dt} + 5y(t) = x(t)$ by Laplace Transform method. Assume that the input

$x(t) = 3e^{-2t}u(t)$ and initial condition is $y(0^+) = -2$.

b. Find x(t) from $X(S) = \frac{1}{(1+s)^2}$ Using convolution property. **(4)**

c. Find the inverse Laplace transform of $X(s) = \frac{2}{s^2 + 4s + 8}$ **(4)**

Q.8 a. Find the Z-transform of the following sequence and find the ROC **(8)**

i) $x[n] = \left[\frac{1}{3}\right]^{n-2} \sin \Omega_0 (n-2)\, u[n-2]$

ii) $x[n] = 5\left(\frac{1}{2}\right)^n u[n] - 2(3)^n u[-n-1]$

b. State and prove
(i) Initial value theorem of z-transform.
(ii) Time Expansion property of z-transform. **(8)**

Q.9 a. Define the following terms with refers to probability theory **(6)**
(i) Sample space
(ii) Event
(iii) Mutually exclusive event
(iv) Conditional probability
(v) Joint probability
(vi) Power spectral density

b. What is wide sense stationary process mention its properties. **(4)**

c. Write short notes on:
(i) Gaussian processes
(ii) Ergodic processes **(6)**