ROLL NO. ________________

Code: AE57/AC57/AT57/AE112 Subject: SIGNALS AND SYSTEMS

AMIETE – ET/CS/IT (Current & New Scheme)

Time: 3 Hours **December 2016** **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.**

Q1. Choose the correct or the best alternative in the following. (2×10)

a. The discrete LTI system is represented by impulse response $h(n)=(1/3)^n u(n)$, then the system is

(A) Noncausal and stable **(B)** Noncausal and unstable
(C) Causal and stable **(D)** Causal and unstable

b. The evolution of the following integral is

$$x(t)=\int_{-\infty}^{+\infty}(t^3+\cos \pi t).\delta(t-1).dt$$

(A) 0 **(B)** π
(C) ∞ **(D)** t

c. The impulse response of the system is given by $h(n) = (3)^n\, u[n]$, then the output of the system for the input $x(n)=u(n)$ is

(A) $\left[(3)^{n+1}+1\right]u[n]$ **(B)** $\left[(3)^{n+1}-1\right]u[n]$
(C) $\left[(3)^{n}+1\right]u[n]$ **(D)** $\left[(3)^{n-1}-1\right]u[n]$

d. The signal $x[n]=\cos\left(\frac{n\pi}{12}\right)+\sin\left(\frac{n\pi}{9}\right)$ is periodic with a period equal to

(A) 12 **(B)** 18
(C) 72 **(D)** 36

e. The frequency response of the system $h(n)=[\delta(n+1)+\delta(n-1)]$ is
(A) sinw **(B)** 2cosw
(C) cos2w **(D)** sin2w

f. The Fourier Transform of the function $x(t) = \text{sgn}(t)$ is

(A) $\frac{2}{j\omega}$ **(B)** $\frac{4}{j\omega}$

(C) $\frac{1}{j\omega}$ **(D)** $\frac{1}{j\omega}+1$

g. The convolution of signal $x(n) = 2^n u(n)$ with $h(n) = 3^n u(n)$ is

(A) $[3^{n+1} - 2n]$ u(n) **(B)** $[3^{n+1} - 2^{n+1}]$u(n)

(C) $[3^{n+1} - 2^{n+1}]$ u(n) **(D)** $[3^{n+1} - 2^{n+1}]$u(n)

h. The Laplace Transform of X(t) $=e^{-3t}$ sin(2t)u(t) is

(A) $\frac{s}{(s+2)^2+3}$ **(B)** $\frac{s}{(s+3)^2+4}$

(C) $\frac{3}{(s+2)+3}$ **(D)** $\frac{s}{(s+3)+4}$

i. The Z-transform of $x(n)=(1/2)^n u(-n)$ is

(A) $\frac{1}{1+2z}$ **(B)** $\frac{z}{1+2z}$

(C) $\frac{1}{1-2z}$ **(D)** $\frac{1}{2+z}$

j. The density function of a random variable X is expressed as

$$f_x(x) = \begin{cases} ae^{-ax} & x > 0; \quad a = \text{constant} \\ 0 & otherwise \end{cases}$$

Then, its expected values E[x] is

(A) 1/a **(B)** e^{-a}

(C) a **(D)** a e^{-a}

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

Q.2 a. Explain the following signals with suitable examples **(4)**

(i) Periodic and non-periodic signals

(ii) Deterministic and random signals

b. For the signal x(t) shown in figure-1, find **(6)**

(i) x(t-1)u(t)

(ii) x(2t-1)

(iii) x(-2t+1)

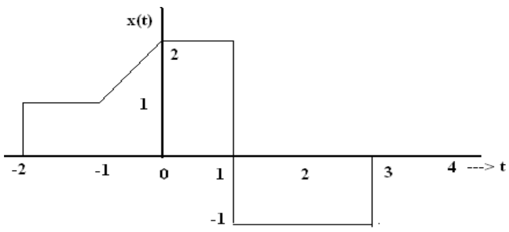

Figure-1

c. The impulse response of the system is given by **(6)**

$$h(n) = \left(\frac{1}{2}\right)^n u(n+1)$$

Determine whether the corresponding system is memoryless causal and stable.

Q.3 a. Determine the Fourier's Series representation for the following signals **(10)**

(i) $x(t) = 1 + 2\cos(w_o t) + \sin(w_o t) + \cos\left(2w_o t + \dfrac{\pi}{4}\right)$

(ii) $x(n) = 1 + \sin\left[\dfrac{\pi}{12}n + \dfrac{\pi}{3}\right]$

b. Find the Fourier Series representation of the signal x(n) shown in figure-2 **(6)**

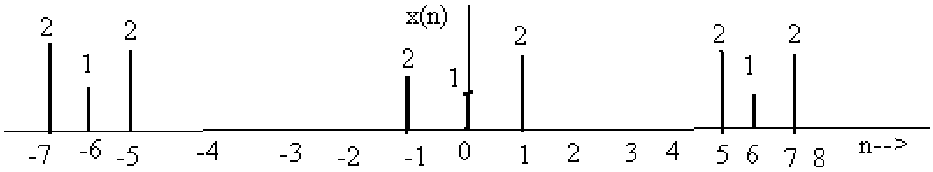

Figure-2

Q.4 a. State and prove the following properties of continuous signal Fourier Transform. **(8)**
(i) Time shifting property
(ii) Convolution property

b. Find the Fourier Transform of the signal $x(t)=(1-t)e^{-2t}\,u(t)$ **(4)**

c. Find the Inverse Fourier Transform of **(4)**

$$X(jw) = \frac{jw}{(jw)^2 + 3(jw) + 2}$$

Q.5 a. Find the Fourier transform of periodic signal $x[n] = \cos w_o n$, with $w_o = 2\pi/5$ and plot it. **(6)**

b. A causal LTI system is described by the difference equation **(6)**
3y(n) – 4y(n – 1) + y(n – 2) = 3x(n) Find
(i) The system Transfer function.
(ii) The unit sample response of system.

c. State and prove time shifting property of Discrete-time Fourier Transform. **(4)**

Q.6 a. The impulse response of the system is given by **(6)**
$h(t) = e^{(1+t)}u(-t+2)$,
find its frequency response

b. Why sampling is required? Explain sampling theorem for a Low pass signal and also discuss how information can be reconstructed from the sample values? **(6)**

c. Determine the Nyquist rate of sampling for the following signals **(4)**
(i) $x(t) = 1 + \sin(200\pi t) - \sin(300\pi t)$
(ii) $x(t) = \cos^2(600\pi t)$

Q.7 a. Find the Laplace transform of the following signals. **(8)**
(i) $X(t)=e^{-2t}u(t)+e^{-t}\text{Cos}(3t)\,u(t)$
(ii) $x(t)=e^{-b|t|}$

b. Find the Inverse Laplace transform of the following X(s) **(4)**

$$X(S)=\frac{3}{(S^2+10S+34)}$$

c. State the properties of ROC in Laplace transform. **(4)**

Q.8 a. Find the Z-transform of the following sequence and find the ROC **(6)**

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

(ii) $x[n]=2n^2u[n]$

b. State and prove the Scaling property of Z- transform **(4)**

c. The system equation is given by **(6)**
y(n)-(7/2)y(n-1)+(3/2)y(n-2)=3x(n)-4x(n-1)
Determine
(i) Transfer function H(Z)
(ii) Impulse response h(n), assuming System is causal.

Q.9 a. For a stationary Ergodic process X(t) if autocorrelation function $R_x(\tau)$ is given by $R_x(\tau)=\dfrac{\tau^2}{2+4\tau^2}$
Then find the mean and variance of X(t) **(4)**

b. Write a note on Gaussian noise **(4)**

c. Define the following terms with reference to probability theory **(8)**
(i) Wide sense stationary process
(ii) Power spectral density
(iii) Conditional probability
(iv) Covariance function