ROLL NO. _____

Code: AE06/AC04/AT04 **Subject: SIGNALS & SYSTEMS**

AMIETE – ET/CS/IT (OLD SCHEME)

Time: 3 Hours **DECEMBER 2011** **Max. Marks: 100**

NOTE: There are 9 Questions in all.

- **Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.**
- **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. Signal $x(t) = e^{-at} u(t)$, $a > 0$ is a

(A) Power signal **(B)** Energy signal
(C) neither **(A)** and **(B)** **(D)** can't decide

b. The Fourier transform of an impulse function is

(A) $\delta(w)$ **(B)** $2\pi w$
(C) 1 **(D)** sinc(w)

c. $\delta(n - N) * \delta(n + N)$ will result in

(A) Zero **(B)** Always 1
(C) N **(D)** can't decide from given data

d. Convolution is used to find _____ of an LTI System.(Fill the blank)

(A) Impulse response **(B)** Frequency response
(C) time response **(D)** phase response

e. Z-transform of x (-n) will be

(A) $X(Z^{-1})$ **(B)** X (-1/ Z)
(C) $X(1 / Z^{-1})$ **(D)** Z

f. Laplace Transforms of the functions $x(t) = 4 \sin(100t)u(t)$ is

(A) $100 /(s^2 +400^2)$ **(B)** $400 /(s^2 +100^2)$
(C) $100 / (s + 400)^2$ **(D)** $400 / (s + 100)^2$

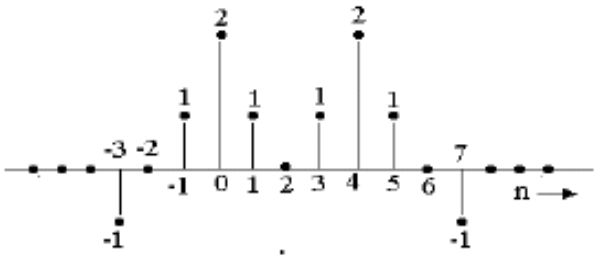
g. The signal $y(t) = \sin(x(t))$ is

(A) linear, causal **(B)** linear, non- causal
(C) non- linear, causal **(D)** non-linear, non-causal

h. The ideal band-limited interpolation uses

(A) sinc function **(B)** sine wave
(C) square wave **(D)** pulse

i.



For the signal shown in the above fig. The integral $\int_{-\pi}^{\pi} \left|X\left(e^{j\omega}\right)\right|^2 d\omega$ will give

(A) 2π **(B)** 4π
(C) 16π **(D)** 28π

j. For a random variable *f(x)* the integral $\int x\, f(x)\, dx$, defines

(A) variance **(B)** mean
(C) pdf **(D)** co-variance

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

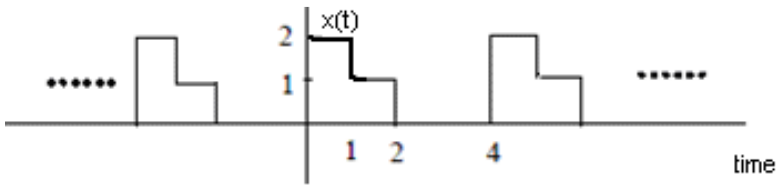
Q.2 a. Define Signal. Give detailed classification of various signals with example. **(6)**

b. $$x[n]=\begin{cases} 0 & \text{if} \quad n<2 \\ 2n-4 & \text{if} \quad 2\le n<4 \\ 4-n & \text{if} \quad 4\le n \end{cases}$$

(i) Sketch x(n). (ii) Sketch y(n) = x(n-1). **(4)**

c. The response of an LTI system to a step input, x(t) = u(t) is y(t) = $(1-e^{-2t})u(t)$. What is the response to an input of x(t) = 2u(t)- 4u(t-1)? **(6)**

Q.3 a.



Determine the Fourier series representation for the above signal. **(10)**

b. Consider an LTI system with impulse response $h(n)= a^n u(n)$, $-1< a <1$, with the input signal $x(n) = \cos(2\pi n / N)$. Determine y(n). **(6)**

Q.4 a. State and explain convergence conditions for continuous–time Fourier transform. **(3)**

b. Consider a stable LTI system characterized by the differential equation

$$\frac{dy(t)}{dt} + 5y(t) = x(t)$$

Determine (i) frequency response and (ii) impulse response. **(5)**

c. State and prove Parseval's theorem for continuous time periodic signal. **(8)**

Q.5 a. Determine the discrete –time Fourier transform of unit–step sequence x(n) = u(n). Comments on the result obtained. **(8)**

b. For the signal $x(n) = \cos \omega_0 n$ with $\omega_0 = 2\pi/5$, obtain and plot $X\left(e^{j\omega}\right)$ **(4)**

c. Draw low-pass filter magnitude characteristics with all necessary tolerance limits. **(4)**

Q.6 a. Describe discrete – time processing of continuous- time signals in detail, with necessary block diagrams. **(8)**

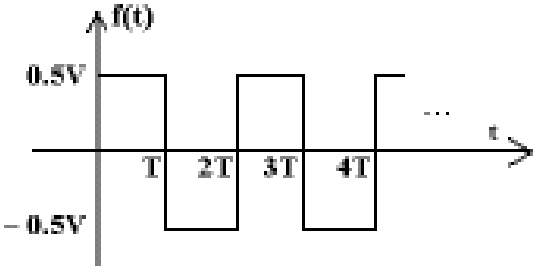
b. For the first-order LTI system described by y(n)- ay(n-1) = x(n) with | a | < 0, obtain magnitude and phase of the frequency response. **(8)**

Q.7 a. Obtain z- transform for
(i) $x_1(n) = (1/3)^n [\sin(\pi n / 4)] u(n)$
(ii) $x_2(n) = -a^n u(-n-1)$
Plot pole –zero diagram and state ROC for both. **(8)**

b. State initial value theorem for Z-transform.List its utility. For the sequence $x(n) = 7 (1/3)^n u(n) - 6 (1/2)^n u(n)$, find x(0) using initial value therom. **(8)**

Q.8 a. For signal $x(t) = e^{-at} u(t)$, determine (i) Fourier transform (ii) Laplace transform. If a = 0, whether both transforms exit? If, yes determine the same. **(8)**

b.



Obtain the Laplace transform of the square wave given in above figure. **(8)**

Q.9 a. Write short note on:-
(i) Gaussian random variable. (ii) Joint probability. **(8)**

b. The pdf of random variable x is given by $f_x(x) = k$, $a \le x \le b$ and $f_x(x) = 0$, otherwise.
Determine (i) the value of constant k .
(ii) when a = -1 and b = 2, calculate p(| x | ≤ 0.5). **(8)**