ROLL NO. _____

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

AMIETE – ET/CS/IT (NEW 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. Fourier coefficient of repetitive impulse $\delta_T(t)$ with time period T is given by

(A) 1/ T **(B)** T
(C) 2T **(D)** 2π

b. System defined by y (n) = x(n) · x (n-2) is memory less

(A) yes **(B)** no
(C) requires additional data **(D)** can't defined.

c. Analog signal of bandwidth B is sampled at the minimum Nyquist rate. The folding frequency will be

(A) 2B **(B)** B*B
(C) B/2 **(D)** B only.

d. A discrete-time LTI system is BIB0 stable if its impulse response is

(A) absolutely summable, **(B)** integrable
(C) divisible **(D)** requires additional data.

e. Fig .1 shows _____ signal.
(Fill the blank.)

(A) Odd
(B) Even
(C) Continuous
(D) Real part

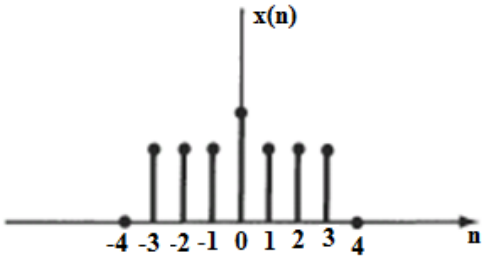

Fig.1

f. Laplace transform of unit step function is

(A) s **(B)** 1/2s
(C) 1/s **(D)** 2/s.

g. $X(t) \leftrightarrow 2\pi\, x(-w)$ indicates _____property of Fourier transform,

(A) Duality **(B)** symmetry
(C) both **(A)** and **(B)** **(D)** time reversal.

h. $x(-n) \leftrightarrow X(1/z)$ defines the following property of Z-transform

(A) time-scaling **(B)** time-expansion
(C) time-reversal **(D)** time-domain.

i. Ideal low-pass filter or continuous –time and discrete –time introduce _____phase distortion. (fill blank)

(A) all **(B)** dispersion
(C) constant **(D)** zero

j. Parseval's relation for a periodic signal $\int_{-\infty}^{\infty} \left| x(t)^2 \right| dt$ equal to

(A) $\frac{1}{2\pi} \int_{-\infty}^{\infty} |X(j\omega)|^2 d\omega$ **(B)** $\int_{-\infty}^{\infty} |X(j\omega)|^2 d\omega$

(C) $\frac{1}{\pi} \int_{-\infty}^{\infty} |X(j\omega)|^2 d\omega$ **(D)** None of the above

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

Q.2 a. Prove that

(i) $\delta(n) = u(n) - u(n-1)$
(ii) $r(n) = n\, u(n)$
(iii) Discrete - time unit step is running sum of the unit impulse.
(iv) Power of the signal $x(t) = \cos(t)$ is 0.5. **(8)**

b. Draw block diagram representation of causal LTI systems described by the following difference equations:
(i) $y(n) = 0.5\, y(n-1) + 0.25\, x(n)$ and (ii) $d\, y(t)/dt + 3y(t) = x(t)$. **(8)**

Q.3 a. Find the Exponential Fourier series for the signal shown in Fig. 2 **(8)**

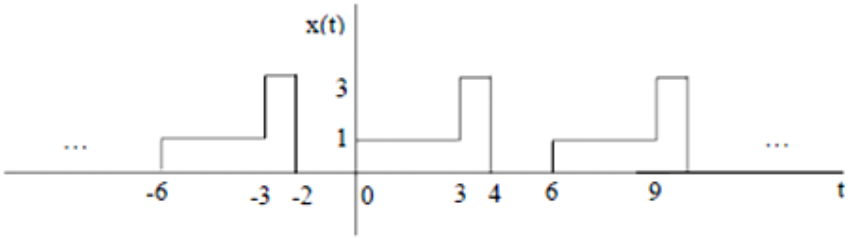

Fig.2

b. State and explain the properties of discrete time Fourier series. **(8)**

Q.4 a. The response of an LTI system with impulse response $h(t) = e^{-at} u(t)$, $a > 0$, to the input signal $x(t) = e^{-bt} u(t)$, $b > 0$; find the output signal y(t). **(8)**

b. An LTI system whose response to the input $x(t) = [e^{-t} + e^{-3t}] u(t)$ is $y(t) = [2e^{-t} - e^{-4t}] u(t)$. Find
(i) The frequency response of the system.
(ii) The differential equation relating the input and output of this system. **(8)**

Q.5 a. Consider a causal LTI system characterized by the difference equation $y(n) - (3 / 4) y (n-1) + (1 / 8) y (n - 2) = 2 x(n)$; Obtain impulse response of the system using discrete - time Fourier transform. **(8)**

b. State and prove the convolution and multiplication properties of discrete Fourier Transform. **(8)**

Q.6 a. Define Group delay. Consider the following frequency response for a causal and stable LTI system: $H(jw) = (1-jw) / (1+jw)$.

(i) If $| H(jw)| = A$, and determine the value of A.
(ii) Show that $\tau(w) > 0$ for $w > 0$; where $\tau(w)$ is group delay of the system **(8)**

b. State and prove the sampling theorem for low pass signal and band pass signal and also explain the reconstruction of signal from its sample value. **(8)**

Q.7 a. For an LTI system the input is given by $x(t) = e^{-3t} u(t)$ and the output is given by $y(t) = [e^{-t} - e^{-2t}] u(t)$. Determine the system function, ROC and characteristic equation of the system using Laplace Transform. **(8)**

b. For the circuit shown in Fig. 3,
(i) Determine the system function H(s) and
(ii) Impulse response h(t) using Laplace transformation only **(8)**

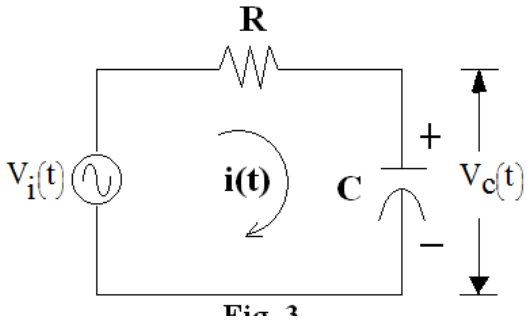

Fig. 3

Q.8 a. Consider the signal $x(n) = a^n$, $0 \le n \le N-1$, $a > 0$ and 0 otherwise. Find X (Z), state ROC and plot the pole-zero pattern for N=8. **(8)**

b. Find Inverse Z-transform of **(8)**

(i) $X(z) = (1/1024)\ [\ (1024 - z^{-10})\ /(1-0.5\ z^{-1})]\ ,\ |z| > 0.$

(ii) $X(z) = \log(1 + a\ z^{-1})\ ,\ |z| > |a|.$

Q.9 a. A Continuous random variable X is uniformly distributed between 0 and π. Determine the CDF and PDF for the random variable X. **(8)**

b. Define and explain the following terms as applied to random variables:

(i) Mean,
(ii) Variance
(iii) Co-variance
(iv) Autocorrelation. **(8)**