Code: AE06/AC04/AT04 | **DECEMBER 2008** | **Subject: SIGNALS & SYSTEMS**

Time: 3 Hours | **Max. Marks: 100**

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: (2x10)

a. Two sequences $x_1(n)$ and $x_2(n)$ are related by $x_2(n) = x_1(-n)$. In the Z-domain, their ROC are

(A) same **(B)** reciprocal of each other
(C) negative of each other **(D)** complement of each other

b. The autocorrelation of a sinusoid is

(A) Sinc pulse **(B)** another sinusoid
(C) Rectangular pulse **(D)** Triangular pulse

c. Which of the following is true for the system represented by $y(n) = x(-n)$

(A) Linear **(B)** Time invariant
(C) Causal **(D)** Non Linear

d. The fourier transform of impulse function is

(A) $\delta(\omega)$ **(B)** $2\pi\omega$
(C) 1 **(D)** $\sin cf$

e. Convolution is used to find

(A) amount of similarity between the signals
(B) response of the system
(C) multiplication of the signals
(D) Fourier transform

f. The final value of $x(t) = \left[2 + e^{-3t}\right]u(t)$ is

(A) 2 **(B)** 3
(C) e^{-3t} **(D)** 0

g. Discrete time system is stable if the poles are

(A) within unit circle **(B)** outside unit circle
(C) on the unit circle **(D)** None

h. The z transform of $-u(-n-1)$ is

(A) $\frac{1}{1-z}$ **(B)** $\frac{z}{1-z}$
(C) $\frac{1}{1-z^{-1}}$ **(D)** $\frac{z}{1-z^{-1}}$

i. The area under Gaussian pulse $\int_{-\infty}^{\infty} e^{-\pi t^2} dt$ is

(A) Unity **(B)** Infinity
(C) Pulse **(D)** Zero

j. The spectral density of white noise is

(A) Exponential **(B)** Uniform
(C) Poisson **(D)** Gaussian

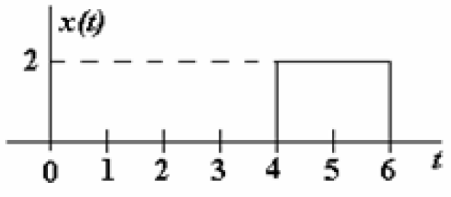
Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

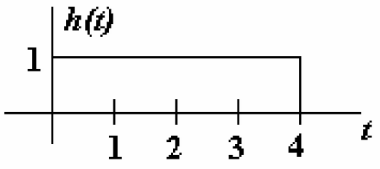
Q.2 a. Check whether the following signals are energy or power signal and hence find the corresponding energy or power? **(6)**

(i) $x(t) = Ae^{-\alpha(t)} \cdot u(t), \quad \alpha > 0$

(ii) $x(t) = \cos^2 \omega_0 t$

b. Find the convolution of two rectangular pulse signals shown below **(10)**

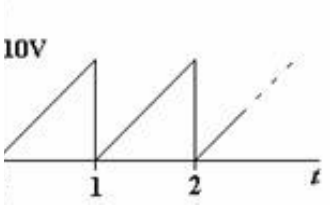




$x(t) = 2\Pi\left(\frac{t-5}{2}\right)$ $h(t) = \Pi\left(\frac{t-2}{4}\right)$

Q.3 a. Given the Gaussian pulse $x(t) = e^{-\pi t^2}$ determine its fourier transform. **(8)**

b. Find the exponential Fourier Series of the following signal? **(8)**



Q.4 a. State and prove the following properties of DTFT. **(6)**
(i) Time shifting, frequency shifting
(ii) Conjugate symmetry
(iii) Time reversal.

b. Consider a stable Causal LTI system whose input $x(n)$ and output $y(n)$ are related through second order difference equation

$$y(n) - \left(\frac{3}{4}\right)y(n-1) + \frac{1}{8}y(n-2) = 2x(n)$$

determine the response for the given input

$$x(n) = \left(\frac{1}{4}\right)^n u(n)$$

(10)

Q.5 a. A continuous time signal is given below

$$x(t) = 8\cos 200\pi t$$ **(8)**

Determine
(i) Minimum sampling rate
(ii) If fs=400Hz what is discrete time signal obtained after sampling.
(iii) If fs=150Hz what is discrete time signal obtained after sampling.

b. State and prove Parsevals theorem for Continuous domain periodic signal. **(8)**

Q.6 a. Compute the Magnitude and Phase of the Frequency Response of the First order Discrete time LTI system given by equation **(10)**

$$y(n) - Ay(n-1) = Bx(n) \qquad \text{where } |A| < 1$$

b. Determine the Fourier Transform of unit step $x(t) = u(t)$. **(6)**

Q.7 a. By using convolution theorem determine the inverse Laplace transform of the following functions **(8)**

(i) $\dfrac{1}{s^2\left(s^2 - a^2\right)}$ (ii) $\dfrac{1}{s^2(s+1)}$

b. Check the stability & causality of a continuous LTI system described as

$$H(s)=\frac{(s-2)}{(s+2)(s-3)}$$ **(8)**

Q.8 a. Find the z-Transform $X(Z)$ and sketch the pole-zero with the ROC for each of the following sequences. **(8)**

(i) $x(n)=\left(\frac{1}{2}\right)^n u(n)+\left(\frac{1}{3}\right)^n u(n)$

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

b. Determine the inverse z Transform of $x(z)=\frac{z}{3z^2-4z+1}$ if the region of convergence are (i) $|z|>1$, (ii) $|z|<\frac{1}{3}$, (iii) $\frac{1}{3}<|z|<1$, **(8)**

Q.9 a. Consider the probability density function $f_X(x)=ae^{-b|x|}$, where X is a random variable whose allowable value range from $x=-\infty$ to $x=+\infty$. Find

(i) Commulative distribution function $F_X(x)$.

(ii) Relationship between a and b.

(iii) $P[1\le X\le 2]$ $[\text{assume } b=6]$ **(8)**

Determine mean, mean square and Variance.

b. Find the power spectral density for the cosine signal $x(t)=8\cos[2\pi(3)t+\pi/3]$ and also compute power in the signal. **(8)**