Roll No.:.....

National Institute of Technology Delhi

Name of the Examination: B.Tech.

Branch: ECE
Course Title: Signals and Systems
Time: 3 Hours

Semester: 3^{rd}
Course Code: ECB 204
Maximum Marks: 50

Note:

1. Answers should be CLEAR, TO THE POINT AND LEGIBLE.
2. All parts of a single question must be answered together and in the same sequence as given in question paper. ELSE QUESTION SHALL NOT BE EVALUATED.

Section - A: Attempt all questions

Q.1 (a) A continuous time signal is shown in *Fig.*1. Sketch and label carefully the following signal $y(t)$.

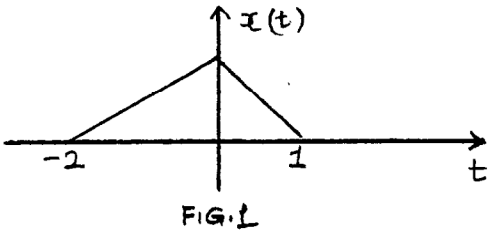

FIG.1

$$y(t) = x(-2t + 4)$$

[1 Marks]

Q.1 (b) Determine whether or not the signal $x(t)$ is periodic. If the signal is periodic, determine its fundamental period. $x(t)=\sin^2(2t)$

[1 Marks]

Q.1 (c) Let $x(t)$ be a signal with $x(t) = 0$ for $t < 3$. Determine the values of t for which the signal $y(t)$ is guaranteed to be zero.

$$y(t) = x(1 - t)x(2 - t)$$

[1 Marks]

Q.1 (d) Calculate the value of P_∞ for given signal x(t).

$$x(t) = cos(t)$$

[1 Marks]

Q.1 (e) For the given system $y(t) = [cos(3t)]x(t)$ check whether the system is

(1) Memoryless
(2) Time invariant
(3) Linear
(4) Causal
(5) Stable

[1+1+1+1+1 Marks]

Q.1 (f) Find the even part of signal $x(t) = e^{-2t}u(t)$.

[1 Marks]

Section - B: Attempt any four questions

Q.2 For given second order differential equation for causal and stable LTI systems, determine whether the corresponding impulse response is under-damped, over-damped, critically-damped or oscillatory.

$$\frac{d^2y}{dt^2} + 16\frac{dy}{dt} + y(t) = x(t)$$

[5 Marks]

Q.3 The system function of a causal LTI system is

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

Determine and sketch the response $y(t)$ when the input is $x(t) = e^{|-2t|}$ for $-\infty < t < \infty$

[5 Marks]

Q.4 Determine following statement is true or false. If statement is true, construct a convincing argument for it. If it is false, give a counterexample.
Statement: **The Laplace transform of e^t for $-\infty < t < \infty$ does not converge anywhere on the s-plane.**

[5 Marks]

Q.5 Let

$$x[n] = (-1)^n u[n] + \alpha^n u[-n - n_0]$$

Determine the constraints on the complex number α and integer n_0, given that the ROC of $X(z)$ is $|z| \leq 2$.

[5 Marks]

Q.6 For a continuous time signal find the exponential fourier series coefficients a_k for given signal x(t).

$$x(t) = 2 + cos(\tfrac{2\pi}{3}t) + 4sin(\tfrac{5\pi}{3}t)$$

[5 Marks]

Section - C: Attempt any two questions

Q.7 A signal $x(t)$ with Fourier transform $X(j\omega)$ undergoes impulse train sampling to generate

$$x_p(t) = \sum_{n=-\infty}^{\infty} x(nT)\delta(t - nT)$$

Where $T = 10^{-4}$ For each of given $X(j\omega)$ check whether $x(t)$ can be exactly recovered from $x_p(t)$ or not.
a) $X(j\omega) = 0$ for $|\omega| > 5000\pi$
b) $X(j\omega) = 0$ for $|\omega| > 15000\pi$

[5+5 Marks]

Q.8 Let x[n] be a signal whose rational z-transform $X(z)$ contains a pole at $z = 1/2$ given that

$x_1[n] = (\frac{1}{4})^n x[n]$ is absolutely summable and

$x_2[n] = (\frac{1}{8})^n x[n]$ is not absolutely summable, determine whether x[n] is left sided, right sided ot two sided.

[10 Marks]

Q.9 Suppose the following facts are given about the signal $x(t)$ with Laplace transform $X(s)$.
a) $x(t)$ is real and even
b) $X(s)$ has four poles and no zeros in the finite s-plane.
c) $X(s)$ has a pole at $s = (1/2)e^{j\frac{\pi}{4}}$
d) $\sum_{t=-\infty}^{\infty} x(t)dt = 4$.
Determine $X(s)$ and its ROC.

[10 Marks]

End of Question Paper