Roll No.:.....

National Institute of Technology Delhi

Name of the Examination: B.Tech.

Semester: 3^{rd}

Branch: ECE,CSE,EEE

Course Code: ECB 204

Course Title: Signals and Systems

Maximum Marks: 25

Time: 2 Hours

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.
3. Q.1 to Q.3 are 3 marks each and Q.4 to Q.7 are 4 marks each, if the question is divided in to parts then marks are equaly divided into all parts.

Q. 1. A discrete time signal is shown in *Fig.*1. Sketch and label carefully the following signal $y[n]$.

$$y[n] = x(3n + 6)u(3 - n)$$

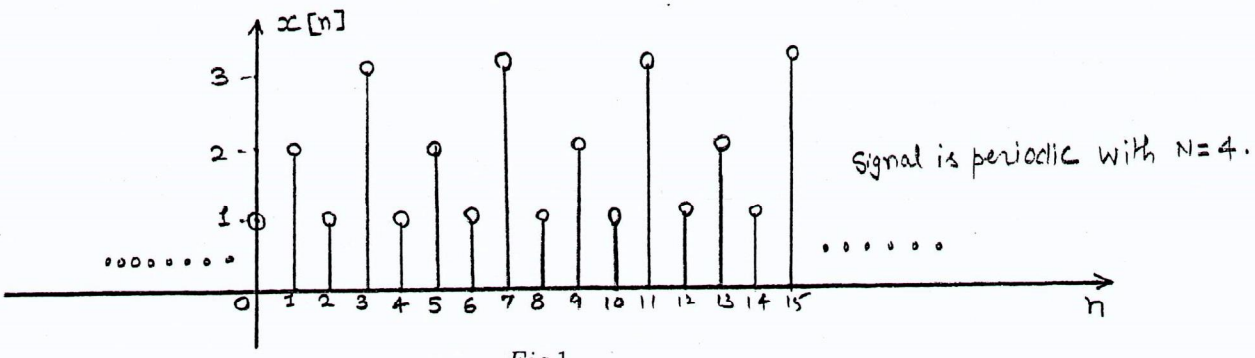

*Fig.*1

Q. 2. Determine whether or not the signal $x(t)$ is periodic. If the signal is periodic, determine its fundamental period.

$$x(t) = [cos(3t - \frac{\pi}{3})]^2$$

Q. 3. Let $x(t)$ be a signal with $x(t) = 0$ for $t < 5$. Determine the values of t for which the even part of signal $y(t)$ is guaranteed to be zero.

$$y(t) = x(3 - 5t) + x(\frac{t}{3} - 5)$$

Q. 4a. Determine the value of E_∞ and P_∞ for the given signal $x[n]$ and check whether the signal is energy or power or neither of both.

$$x[n] = cos(\frac{\pi}{4}n)$$

Q. 4b. Consider a discrete time system with input $x(t)$ and output $y(t)$ related by

$$y(t) = x(sin(t))$$

i. Is this system linear?
ii. Is this system causal?

Q. 5. Compute and plot the convolution $y[n] = x[n] * h[n]$, where

$$h[n] = u[n-1]$$

and

$$x[n] = \left[\frac{1}{3}\right]^{-n} u[-n-1]$$

Q. 6a. Determine whether the LTI system is stable for given impulse response $h[n]$.

$$h[n] = n\left[\frac{1}{3}\right]^{n} u[n-1]$$

Q. 6b. Determine whether each of the following statements is true or false. Justify your answer with suitable example.

i. The inverse of a causal system is always causal.
ii. If a LTI system is causal, it is stable.

Q. 7. Let $x_1(t)$ be a continuous time periodic signal with fundamental frequency w_1 and Fourier series coefficients a_k, Given that

$$x_2(t) = x_1(1-t) + x_1(t-1)$$

How is the fundamental frequency w_2 of $x_2(t)$ related to w_1 ? Also find Fourier series coefficients b_k of $x_2(t)$ as a function of coefficients a_k.

End of Question Paper