(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3082 **Roll No.** | | | | | | | | | | |

B.Tech.

(SEM IV) EVEN SEMESTER THEORY EXAMINATION, 2009-2010

SIGNALS AND SYSTEMS

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt **all** questions. All questions carry **equal** marks.*

*(ii) Be precise in your answer. **No** second answer book will be provided.*

1. Attempt any **four** parts of the following : **(4x5=20)**

(a) A rectangular pulse $x(t) = A$ for $0 \leq t \leq T$; 0 elsewhere is applied to an integrator circuit. Find the total energy of the output $y(t)$ of the integrator.

(b) For each of the systems, state whether the system is linear, shift invariant, stable, causal, invertible.

(i) $y(n) = \log[x(n)]$

(ii) $y(n) = x(n^2)$

(c) Determine the output $y(t)$ of a LTI system with impulse response $h(t) = u(t+1) - 2u(t) + u(t-1)$ and input, $x(t) = 2$ for $|t| \leq 2$ and 0 for $|t| > 2$.

(d) Is unit ramp signal can be converted in to unit impulse signal ? If yes then how ?

(e) How the output of an LTI system is related to unit impulse response.

(f) Check whether the following signals are periodic or not. If periodic, determine their fundamental period.

(i) $x(n) = \cos(\pi n/7) \sin(\pi n/7)$

(ii) $x(t) = [2\cos^2(\pi t/2) - 1] \cos(\pi t) \sin(\pi t)$

2. Attempt any four parts of the following : **(4x5=20)**

(a) Find the FT of unit step function.

(b) Find the Trignometric form of Fourier series. Also give Diriclet's condition.

(c) Show that convolution of the signals in time domain is equal to the multiplication of their individual FT in the frequency domain.

(d) Find the FT of signum function.

(e) Find the FT of Rectangular pulse f(t)=1 for 0<t<T; 0 otherwise.

(f) Show that $F(j\omega) = \int_{-\infty}^{\infty} f(t)\exp(-j\omega t)\,dt$.

3. Attempt any two parts of the following : **(2x10=20)**

(a) Consider a continuous-time ideal bandpass filter whose frequency response is

$$H(j\omega) = \begin{cases} 1, & \omega_c \le |\omega| \le 3\,\omega_c \\ 0, & \text{elsewhere} \end{cases}$$

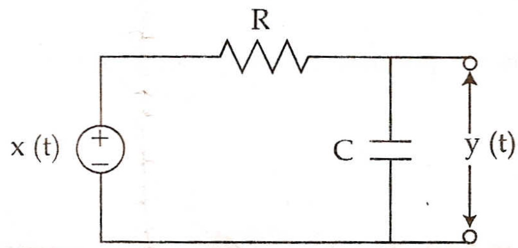
(i) If h(t) is the impulse response of this filter, determine a function g(t) such that $h(t) = (\sin \omega_c t/\pi t)g(t)$.

(ii) As ω_c is increased, does the impulse response of the filter get more concentrated or less concentrated about the origin ?

(b) (i) A particular first-order causal and stable discrete time LTI system has a step response whose maximum overshoot is 50% of its final value. If the final value is 1, determine a difference equation relating the input x[n] and output y[n] of this filter.

(ii) For causal and stable LTI system given by second order difference equation, determine whether or not the step response of the system is oscillatory, $y[n] - y[n-1] + (1/4)\,y[n-2] = x[n]$.

(c) Consider the continuous-time LTI system implemented as the RC circuit as shown in figure. The voltage source x(t) is considered the input to this system. The voltage y(t) across the capacitor is considered the system output. Is it possible for the step response of the system to have an oscillatory behavior ?



4. Attempt any four parts of the following : **(4x5=20)**

(a) Find the Laplace Transform of unit ramp function.

(b) Show that $\lim_{t \to \infty} x(t) = \lim_{s \to 0} s\,X(s)$

(c) Find, the Laplace transform of Rectangular pulse train of amplitude 1 and fundamental period T/2.

(d) Find the initial and final values of the function whose Laplace transform is given as $X(s) = (2s+10)/s(s+2)$.

(e) Find the Nyquist rate for each of the following signals :

(i) $x(t) = \text{sinc } 5t$

(ii) $x(t) = 25 \exp(500\pi t)$

(f) An analog signal is given as $y(t) = 2 \cos 50\pi t$. Calculate

(i) the minimum sampling rate to avoid aliasing.

(ii) if the signal is sampled at the rate of 100 Hz. What is the discrete time signal after sampling ?

5. Attempt any four parts of the following : **(4x5=20)**

(a) Obtain the response of system given by the linear constant coefficient difference equation

$y(n) + y(n-1) - 2y(n-2) = u(n-1) + 2u(n-2)$ using Z-transform method. Assume zero initial condition.

(b) Show that convolution in time domain sequence is same as multiplication in z-domain.

(c) Give the statement and proof of final value theorem.

(d) By using partial fraction expansion method, find the inverse Z-Transform of $H(z) = (-4 + 8z^{-1})/1 + 6z^{-1} + 8z^{-2})$.

(e) Find system function H(z) for a system described by the difference equation $y(n) - 2y(n-1) + 2y(n-2) = x(n) + (1/2)x(n-1)$.

(f) Using long division, determine the inverse Z-Transform of $X(z) = 1/[1 - (3/2)z^{-1} + (1/2)z^{-2}]$ when the region of convergence is $|z| > 1$.

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