National Institute of Technology, Hamirpur (HP)

Name of the Examination: B.Tech.

Branch   :Electrical Engineering

Course Name   :Signals & Systems

Semester   :5th

Course Code   : EE-313

Time: 3 Hours

Maximum Marks: 50

Note :

1. All Questions are compulsory
2. Draw the relevant diagrams/figures
3. Assume data wherever required

Q1) (a) Impulse response of discrete time LTI system is given below. Determine whether the given system is causal and/or stable. Justify your answer.

$$h[n] = \left(-\frac{1}{2}\right)^n u[n] + (1.01)^n u[n-1]$$

(b) Determine the range of values of "a" and "b" for the stability of LTI system with impulse response $h[n] = \begin{cases} b^n & ; \ n < 0 \\ a^n & ; \ n \geq 0 \end{cases}$

(5)

Q2) The impulse response of a linear time-invariant system is $h(n) = [1, \underset{\uparrow}{2}, 1, -1]$. Determine the response of the system to the input signal $x(n) = [\underset{\uparrow}{1}, 2, 3, 1]$ using graphical method. Verify the result using convolution sum.

(5)

Q3) Determine the response y[n], n ≥ 0 of the system described by the second order difference equation, $y[n] - 2y[n-1] - 3y[n-2] = x[n] + 4x[n-1]$,

when the input signal is, $x[n] = 2^n u[n]$ and with initial conditions y [-2] =0, y [-1] =5.   (5)

Q4) Determine the Fourier series and power density spectrum of the rectangular pulse train signal illustrated in figure below.

(5)
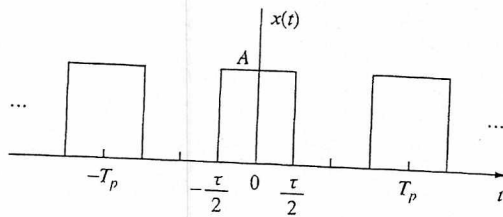
Q5) The input and output of a causal LTI system are described by the differential equation

$$\frac{d^2 y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t)$$

(a) Find the frequency response of the system.

(b) Using the result in (a) find the impulse response of the system.

(c) What is the response of the system if $x(t) = te^{-t}u(t)$.

(5)

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Q6) (a) Determine the Z- transform of the signal $x[n] = -a^n u[-n-1]$.

(b) Find the inverse Z- transform of the given $X(z) = \log\left(\dfrac{1}{1-az^{-1}}\right), |z| > |a|$ (5)

Q7) Using the properties of DTFT, find the DTFT of the following signals

(a) $\left(\dfrac{1}{4}\right)^{|n-2|}$

(b) $n3^{-n}u[-n]$ (5)

Q8) Let $x[n]$ be a real periodic sequence with fundamental period N_0 and Fourier coefficients $c_k = a_k + jb_k$, where a_k and b_k are both real.

(a) Show that $a_{-k} = a_k$ and $b_{-k} = -b_k$.

(b) Show that $c_{N_0/2}$ is real if N_0 is even. (5)

Q9) Write a short note on the following.
   a. Properties of Z- transform
   b. Classification of Systems (5+5)