Dr Amit Kaul

5/12/2022 (12)

Roll No.:.....

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) Compute the convolution $y(n)=x(n)*h(n)$ of the following signals [using direct algebraic method]

(a) $x(n)=\alpha^n u(n), h(n)=\alpha^{-n}u(-n), 0<\alpha<1$ (b) $x(n)=\{\underset{\uparrow}{1},1,0,1,1\}, h(n)=\{1,-2,-3,\underset{\uparrow}{4}\}$ **(5)**

Q2) Solve the differential equation $\left(D^2+3D+2\right)y(t)=Dx(t)$ if the initial conditions are $y(0^+)=2$ and $\dot{y}(0^+)=3$ and the input is $10e^{-3t}$. **(5)**

Q3) Find the Fourier Transform of the signals defined below

(a) $\text{sgn}(t)=\begin{cases}1, & t>0\\ 0, & t=0\\ -1, & t<0\end{cases}$

(b) $x(t)=\begin{cases}A\left(1+\dfrac{t}{T}\right), & -T\le t<0\\ A\left(1-\dfrac{t}{T}\right), & 0\le t<T\\ 0, & |t|\ge T\end{cases}$ **(5)**

Q4) The impulse response of an LTI system is $h(t)=2e^{-3t}u(t)$. Find the response of the system for the input $x(t)=5e^{-5t}u(t)$, using Fourier transform. Verify the result with convolution integral. **(5)**

Q5) (a)Determine the output sequence from the output spectrum Y(ω) given below

$$Y(\omega)=\frac{1}{3}\frac{e^{j\omega}+1+e^{-j\omega}}{1-ae^{-j\omega}}$$

(b) Find the frequency response of the second order recursive filter whose impulse response is $h(n)=r^n\cos(\omega_0 n)u(n)$ for all n. **(5)**

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

(b) Determine the signal whose Z- transform is given by $X[z]=\log(1+az^{-1})\quad |z|>|a|$. **(5)**

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Q7) (a) Consider the following discrete time signal with a fundamental period of N=6. Determine its Fourier coefficients.

$$x(n) = 1 + \cos\left(\frac{2\pi}{6}n\right)$$

(b) A continuous -time periodic signal $x(t)$ is real valued and has fundamental period T=8. The non-zero Fourier series coefficients for $x(t)$ are

$$X_1 = X_{-1} = 2, X_3 = X_{-3} = 4j$$

Express $x(t)$ in the form of $x(t) = \sum_{n=0}^{\infty} A_n \cos(\omega_n t + \phi_n)$. (5)

Q8) Using convolution sum, derive the conditions to test the stability and causality of LTI system from its impulse response $h(n)$. With the aid of conditions obtained, determine whether the system with impulse response $h(n) = 3^n u(-n)$ is (i) causal (ii) stable. (5)

Q9) Write a short note on the following.

(i) Properties of Discrete Time Fourier Transform

(ii) Classification of Signals

(5+5)