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EC36

Third Semester B.E. Degree Examination, June / July 08
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note : ***1. Answer any FIVE full questions.***
2. Abbreviations : FT → Fourier Transform.
DTFT → Discrete – time Fourier transform.

1 a. Define the following : i) Time – invariance ii) Stability iii) Causality iv) Invertibility. **(04 Marks)**

b. A discrete – time system is characterized by the following input – output relationship : $Y(n) = x(n) + 3\,u(n+1)$. Check the following properties : i) Stability ii) Causality iii) Linearity iv) Time – invariance v) Memory. **(08 Marks)**

c. The energy in a real – valued signal x(n) is defined by, $E = \sum_{n=-\infty}^{\infty} x^2(n)$. Suppose that x(n) has an even part defined by $\left(\frac{1}{2}\right)^{|n|}$ and the total energy of the signal x(n) is 5J, find the energy in the odd part of the signal. **(08 Marks)**

2 a. Convolute the two discrete – time sequences given below :
$x_1(n) = \alpha^n\, u(n)$
$x_2(n) = \alpha^{-n}\, u(-n)$. Take $|\alpha|<1$. **(08 Marks)**

b. Prove the following properties of convolution sum : i) Associativity ii) Distrubutivity iii) Commutativity. **(08 Marks)**

c. Find the frequency response of an LTI system whose impulse response is given below : $h(t) = -\delta(t+1) + \delta(t) - \delta(t-1)$. **(04 Marks)**

3 a. Consider an LTI system characterized by $h(n) = 2^{-n}\, u(n)$.
i) If the system is excited by an input, $x(n) = 2\delta(n) + 4\delta(n-1) + 4\delta(n-2)$, find the response of the system for n = 0, 1, ….6.
ii) Find the stability and frequency response of the system. **(10 Marks)**

b. Evaluate the step response of the following LTI systems.
i) $h(t) = e^{-|t|}$ ii) $h(t) = u(t+1) - u(t-1)$. **(10 Marks)**

4 a. If x(n) $\xleftrightarrow{\text{DTFT}}$ $X(e^{j\Omega})$ or $X(\Omega)$, show that $E = \sum_{n=-\infty}^{\infty} |x(n)|^2 = \frac{1}{2\pi}\int_{-\pi}^{\pi} |X(\Omega)|^2\, d\Omega$ **(06 Marks)**

b. Find the DTFT of x(n) = u(n). **(07 Marks)**

c. Find the inverse DTFT of $X(\Omega) = X(e^{j\Omega}) = \frac{1}{\left[1 - a\, e^{-j\Omega}\right]^2}$. **(07 Marks)**

a. If x(t) $\xleftrightarrow{FT}$ X(jw) or X(w) and y(t) $\xleftrightarrow{FT}$ Y(jw) or Y(w), show that

$Z(t) = x(t) * y(t) \xleftrightarrow{FT} Z(w) = X(w)\, Y(w)$. **(07 Marks)**

b. Find the FT of x(t) = Sgn(t). Also plot the magnitude and phase spectra. **(07 Marks)**

c. Find the FT of the triangular pulse shown in fig.5(c). **(06 Marks)**

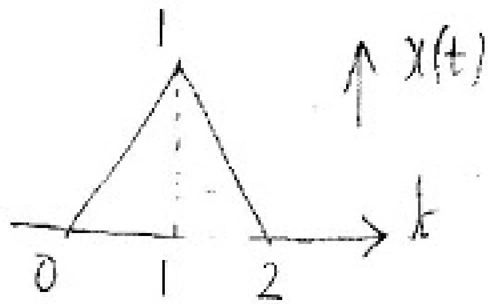

Fig.5(c)

a. State and prove low pass sampling theorem. **(10 Marks)**

b. Consider a continuous – time LTI system described by the following differential equation: $\frac{dy(t)}{dt} + 2y(t) = x(t)$. Find the following :

i) Frequency response.

ii) Response of the system to an input $x(t) = e^{-t}\, u(t)$.

iii) Find the step response. **(10 Marks)**

a. A causal discrete LTI system is described by $y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n)$. Find the frequency response and impulse response of the system. **(07 Marks)**

b. State and prove final value theorem, using Z – transform. **(07 Marks)**

c. Find the inverse Z – transform of $X(z) = e^{1/z}$. Take x(n) to be a causal sequence. **(06 Marks)**

a. Solve the difference equation, y(n) = y(n-1) – y(n-2) + 2, n≥0. Take y(-2) = 1 and y(-1) = 2. **(10 Marks)**

b. A causal discrete – time LTI system is described by $y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n)$.

i) Find H(z)

ii) Find h(n)

iii) Find step response of the system.

iv) Find system stability

v) Find frequency response of the system. **(10 Marks)**

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