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10EC44

Fourth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Signals & Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define signal and system with example. And briefly explain operations performed on independent variable of the signal. **(06 Marks)**

b. Determine whether the following signal is energy signal or power signal and calculate its energy or power

$x(t) = \text{rect}\left(\frac{t}{T_0}\right)\cos\omega_0 t.$ **(04 Marks)**

c. Find whether the following system is stable, memory less, linear and time invariant? $y(t) = \sin[x(t+2)]$ **(04 Marks)**

d. Two signals x(t) and g(t) as shown in Fig. Q1 (d). Express the signals x(t) interms of g(t). **(06 Marks)**

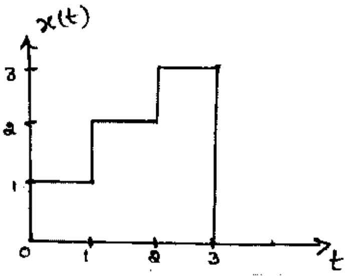

Fig. Q1 (d) – (i)

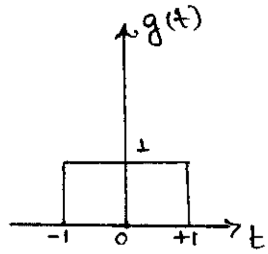

Fig. Q1 (d) – (ii)

2 a. Given the signal x(t) as shown in Fig. Q2 (a). Sketch the following:

i) $x(-2t+3)$ ii) $x\left(\frac{t}{2}-2\right)$ **(04 Marks)**

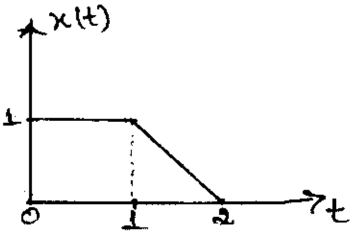

Fig. Q2 (a)

b. For a DT LTI system to be stable show that,

$$S \stackrel{\Delta}{\equiv} \sum_{K=-\infty}^{K=+\infty} |h(K)| < \infty$$ **(05 Marks)**

c. Two discrete time LTI systems are connected in cascade as shown in Fig. Q2 (c). Determine the unit sample response of this cascade connection. **(06 Marks)**

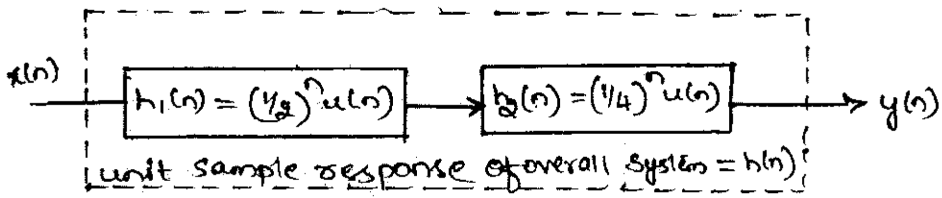

Fig. Q2 (c)

d. Find convolution of 2 finite duration sequences,
$h(n) = a^n u(n)$ for all n and
$x(n) = b^n u(n)$ for all n
i) when $a \neq b$ ii) when $a = b$ **(05 Marks)**

3 a. Determine the LTI systems characterized by impulse response.
i) $h(n) = n\left(\frac{1}{2}\right)^n u(n)$ ii) $h(t) = e^{-t}u(t+100)$
Stable and causal. **(06 Marks)**

b. Find the forced response of the following system:
$y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$ for $x(n) = \left(\frac{1}{8}\right)^n u(n)$. **(08 Marks)**

c. Draw direct form II implementation for the system described by the following equation and indicate number of delay elements, adders, multipliers.
$y(n) - 0.25y(n-1) - 0.125y(n-2) - x(n) - x(n-2) = 0$ **(06 Marks)**

4 a. Prove the following properties of DTFS:
i) Convolution in time. ii) Modulation theorem. **(06 Marks)**

b. Determine the complex exponential Fourier series for periodic rectangular pulse train shown in Fig. Q4 (b). Plot its magnitude and phase spectrum. **(08 Marks)**

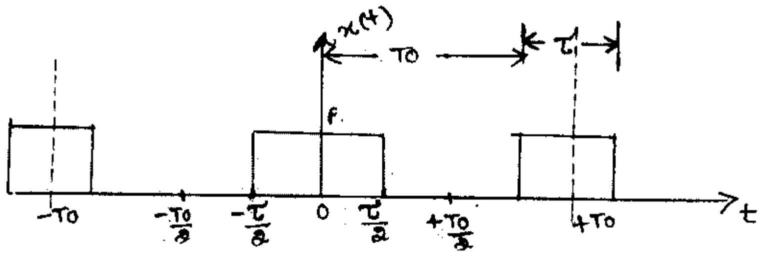

Fig. Q4 (b)

c. Determine the DTFS representation for the signal $x(n) = \cos\left(\frac{n\pi}{3}\right)$. Plot the spectrum of x(n). **(06 Marks)**

PART – B

5 a. State and prove the following properties of DTFT:
i) Parsevai's theorem ii) Linearity **(06 Marks)**

b. Find the DTFT of the signals shown,
i) $x(n) = \left(\frac{1}{4}\right)^n u(n+4)$ ii) $x(n) = u(n)$ **(08 Marks)**

c. Find the inverse Fourier transform of the rectangular spectrum shown, **(06 Marks)**

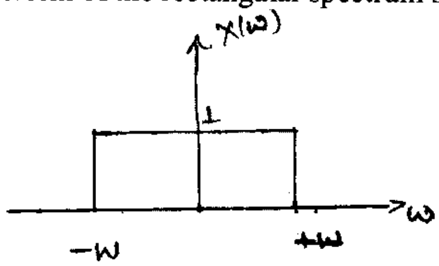

Fig. Q5 (c)

6 a. Consider the continuous time LTI system described by,

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

Using FT, find the output y(t) to each of the following input signals.

i) $x(t) = e^{-t}u(t)$

ii) $x(t) = u(t)$ **(08 Marks)**

b. Find the Nyquist rate and Nyquist interval for each of the following signals:

i) $x(t) = \text{sinc}^2(200t)$

ii) $x(t) = 2\,\text{sinc}(50t)\sin(5000\pi t)$ **(06 Marks)**

c. An LTI system is described by $H(f) = \dfrac{4}{2 + j2\pi f}$ find its response y(t) if the input is $x(t) = u(t)$ **(06 Marks)**

7 a. Define ROC and list its properties. **(04 Marks)**

b. State and prove time reversal property of z-transform. **(04 Marks)**

c. Determine the inverse z-transform of $x(z) = \dfrac{1}{(1+z^{-1})(1-z^{-1})^2}$; ROC; $|z| > 1$ **(06 Marks)**

d. Determine z-transform and ROC of $x(n) = \left(\frac{1}{3}\right)^n \sin\left(\frac{\pi}{4}n\right)u(n)$ **(06 Marks)**

8 a. A causal, stable discrete time system is defined by,

$$y(n) = \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2) + x(n) - 2x(n-1)$$

Determine

i) System function H(z) and magnitude response at zero frequency.

ii) Impulse response of the system.

iii) Output y(n) for $x(n) = \delta(n) - \frac{1}{3}\delta(n-1)$ **(12 Marks)**

b. Solve the following difference equation for the given initial conditions and input,

$$y(n) - \frac{1}{9}y(n-2) = x(n-1)$$

With $y(-1) = 0$, $y(-2) = 1$ and $x(n) = 3u(n)$ **(08 Marks)**

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