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06EC44

Fourth Semester B.E. Degree Examination, December 2011

Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. A continuous-time signal x(t) is shown in Fig.Q1(a). Sketch and label each of the following :

i) $x(t)u(1-t)$ ii) $x(t)[u(t)-u(t-1)]$ iii) $x(t)\,\delta\left(t-\frac{3}{2}\right)$

iv) $x(t)\,[u(t+1)-4(t)]$ v) $x(t)\,u(t-1)$ **(10 Marks)**

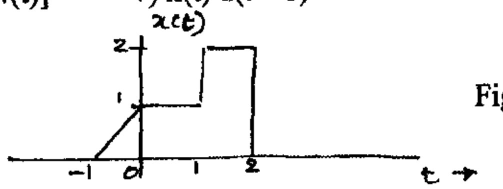

Fig.Q1(a)

b. Consider the following sinusoidal signal. Determine whether each x(n) is periodic and if it is find its fundamental period.

i) $x(n) = 10\sin(2n)$ ii) $x(n) = 15\cos(0.2\pi n)$ iii) $x(n) = 5\sin[6\pi n/35]$ **(06 Marks)**

c. If $x(n) = \{1\ 2\ 3\ \underset{\uparrow}{4}\ 5\ 6\ 7\}$, find : i) $y(n) = x(2n-3)$, ii) $y(n) = x(-2n+1)$ **(04 Marks)**

2 a. Find the convolution of x(t) with h(t), where

$x(t) = A[u(t)+u(t-T)]$ and $h(t) = A[u(t)-u(t-2T)]$ **(10 Marks)**

b. A discrete system has impulse response $h(n) = a^n u(n+3)$. Is this system BIBO stable, causal and memory less? **(03 Marks)**

c. The impulse response of the system is given by $h(t) = e^{-2|t|}$, find the step response of the system. **(07 Marks)**

3 a. Determine the condition of the impulse response of the system if system is :

i) memory less ii) causal iii) stable iv) invertible. **(10 Marks)**

b. Solve the differential equation : $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2x(t)$, with initial conditions $y(0) = 0,\ y'(0) = 1$ for the input $x(t) = \cos t\; u(t)$. **(10 Marks)**

4 a. Determine the Fourier series representation of the following signals :

i) $x(t) = 3\cos\left[\frac{\pi}{2}t + \frac{\pi}{4}\right]$ ii) $x(t) = 2\sin(2\pi t - 3) + \sin 6\pi t$ **(10 Marks)**

b. Determine the Fourier series representation for the square wave shown in Fig.Q4(b).

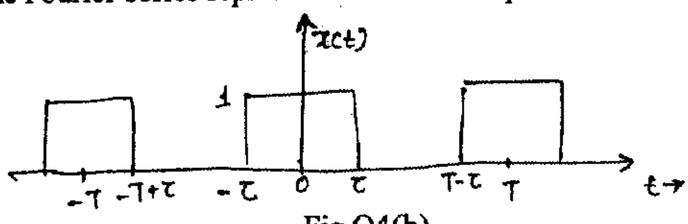

Fig.Q4(b) **(10 Marks)**

PART – B

5 a. Use the differentiation in time and differentiation in frequency properties to determine the FT of Gaussian pulse defined by $g(t) = \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}}$. **(10 Marks)**

b. Find the FT of $x(t) = \frac{1}{1+jt}$. **(05 Marks)**

c. Find the inverse FT of $x(j\omega) = \frac{(1-j\omega)}{6+j\omega+\omega^2}$. **(05 Marks)**

6 a. State and prove Rayleigh's energy theorem. **(08 Marks)**

b. Find the frequency response and impulse response of the system with input x(t) and output y(t) is given by :
i) $x(t) = e^{-2t}u(t)$ and $y(t) = e^{-3t}u(t)$ ii) $x(t) = e^{-2t}u(t)$ and $y(t) = 2t\,e^{-2t}u(t)$ **(08 Marks)**

c. Determine the difference equation description for the system with impulse response.

$$h(n) = 3\delta(n) + 2\left(\frac{1}{2}\right)^n u(n) + \left(-\frac{1}{2}\right)^n u(n)$$ **(04 Marks)**

7 a. Determine the ZT of the following sequence :
i) $x(n) = \alpha^{|n|}$ for $|\alpha| < 1$ ii) $x(n) = n^2u(n)$. **(10 Marks)**

b. Find the inverse ZT of :
i) $x(z) = \frac{16z^2 - 4z + 1}{8z^2 + 2z - 1}$ for $|z| > \frac{1}{2}$ ii) $x(z) = e^{z^2}$ for all z $|z| \neq \infty$. **(10 Marks)**

8 a. A system has the transfer function,

$$H(z) = \frac{2}{1 - 0.9e^{j\frac{\pi}{4}}z^{-1}} + \frac{2}{1 - 0.9e^{j\frac{\pi}{4}}z^{-1}} + \frac{3}{1 + 2z^{-1}}.$$

Find the impulse response assuming the system is (i) stable and (ii) causal. **(10 Marks)**

b. A system is described by the difference equation :

$$y(n) - y(n-1) + \frac{1}{4}y(n-2) = x(n) + \frac{1}{4}x(n-1) - \frac{1}{8}x(n-2).$$

Find the transfer function of the system. **(05 Marks)**

c. State and prove final value theorem in ZT. **(05 Marks)**

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