2002 SCHEME

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EC36

Third Semester B.E. Degree Examination, June 2012
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. Evaluate the following integrals :

i) $\int_{-2}^{1}(t+t^2)\delta(t-3)dt$; ii) $\int_{-2}^{4}(t+t^2)\delta(t-3)dt$

iii) $\int_{0}^{3}e^{t-2}\,\delta(2t-4)dt$; iv) $\int_{-\infty}^{t}\delta(\tau)d(\tau)$. **(04 Marks)**

b. Determine whether the signals are periodic, if periodic determine their fundamental period.

i) $x(n)=\text{Cos}\left(\frac{8\pi n}{7}+2\right)$; ii) $e^{j\left(\frac{n}{8}-\pi\right)}$; iii) $x(n)=\text{Cos}\frac{n}{4}\text{Cos}\frac{\pi n}{4}$. **(07 Marks)**

c. Sketch the following signals, and determine whether the signals are power or energy or neither :

i) $x(t) = A\,[u(t + a) - u(t - a)]$, $a > 0$.

ii) $x(t) = e^{-a|t|}$, $a > 0$

iii) $x(t) = tu(t)$. **(09 Marks)**

2 a. Derive the expression for convolution sum for LTI system. **(04 Marks)**

b. Consider a LTI system with unit impulse response $h(t) = e^{-t}\,u(t)$. If the input applied to the system is $x(t) = e^{-3t}\,[u(t) - u(t - 2)]$. Find and sketch the output y(t) of the system. **(08 Marks)**

c. Test for the linearity, time variance, causality and memoriness properties for the systems.

i) $x(n) = n\ x(n)$; ii) $y(t) = x(t/2)$. **(08 Marks)**

3 a. Prove the associative property of convolution integral of LTI system. **(04 Marks)**

b. Sketch the direct form – I and direct form – II implementations for the difference equation.

$y(n) + 1/2\ y(n-1) - y(n-3) = 3\,x(n-1) + 2x\,(n-2)$. **(08 Marks)**

c. Find the output of the system given by the differential equation :

$$\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+4y(t)=\frac{d}{dt}x(t)\ ;\ y(0)=0\ ;\ \left.\frac{dy(t)}{dt}\right|_{t=0}=1,\ \text{and}\ x(t)=e^{-2t}u(t).$$

(08 Marks)

4 a. Prove the convolution property of Fourier series. **(06 Marks)**

b. Obtain FT of the signal $x(t) = e^{-at}\,u(t)$; $a > 0$. Draw its magnitude and phase spectra. **(06 Marks)**

c. Evaluate the FS representation for the signal $x(t) = \text{Sin}\,(2\pi t) + \text{Cos}\,(3\pi t)$. Sketch the magnitude and phase spectra. **(08 Marks)**

5 a. Find the DTFT of the signal : i) $x(n) = \delta(n)$ and ii) $x(n) = a^{|n|}$; $|a| < 1$. **(06 Marks)**

b. Find the inverse DTFT for $X(e^{j\Omega}) = \dfrac{6}{(e^{-j2\Omega} - 5e^{-j\Omega} + 6)}$. **(06 Marks)**

c. Find the time domain signal corresponding to the DTFS coefficients $X(K) = \text{Cos}\left(\dfrac{6\pi}{17}K\right)$. **(08 Marks)**

6 a. Specify the Nyquist rate and Nyquist intervals for each of the following signals :
i) $g(t) = \text{Sinc}\,(200\,t)$; ii) $g(t) = \text{Sinc}^2\,(200\,t)$. **(04 Marks)**

b. State and prove low pass sampling theorem. **(08 Marks)**

c. The impulse response of the continuous time system is given as $h(t) = \dfrac{1}{RC}e^{-(t/RC)}u(t)$.
Determine the frequency response and plot the magnitude and phase plots. **(08 Marks)**

7 a. List and explain any four properties of ROC of Z-transform. **(06 Marks)**

b. Find the Z-transform and ROC of the following : i) $x(n) = -b^n\,u(-n-1)$; ii) $x(n) = n\,u(n)$. **(06 Marks)**

c. Obtain frequency response and the impulse response of the system, described by the difference equation by using DTFT method.
$y(n) + 1/2\,y(n-1) = x(n) - 2x(n-1)$. **(08 Marks)**

8 a. State and prove, final value theorem of Z-transform. **(04 Marks)**

b. Determine the unilateral Z-transform for the signals
i) $x(n) = \{2,\ 3,\ \underset{\uparrow}{5},\ 7,\ 0,\ 1\}$; ii) $x(n) = \alpha^n\,u(n)$. **(06 Marks)**

c. Using partial fraction expansion method, find the inverse Z-transform of

i) $X(z) = \dfrac{\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}$; $\dfrac{1}{4} < |z| < \dfrac{1}{2}$

ii) $X(z) = \dfrac{1+2z^{-1}+z^{-2}}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$; $|z| > 1$. **(10 Marks)**

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