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NEW SCHEME

Third Semester B.E. Degree Examination, July 2007
EC/ EE/TE/IT/BM/ML
Signals and Systems

Time: 3 hrs.] [Max. Marks:100

Note : ***1. Answer any FIVE full questions.***
2. Make any suitable assumptions for missing data.

1 a. Distinguish between:
i) Continuous time and discrete time signals
ii) Even and odd signals
iii) Periodic and non-periodic signals
iv) Energy and power signals. **(08 Marks)**

b. Find the even and odd parts of the following signals:
i) $x(t) = [\text{Sin}(\pi t) + \text{Cos}(\pi t)]^2$
ii) $x(t) = (1 + t^3)\text{Cos}^3(10t)$. **(04 Marks)**

c. Find the average power and energy of the following signals. Determine whether they are power / energy signals.
i) $x[n] = \begin{cases} \text{Sin}(\pi n); & \text{for } -4 \le n \le 4 \\ 0; & \text{otherwise} \end{cases}$
ii) $x[n] = \begin{cases} \text{Cos}(\pi n); & \text{for } -4 \le n \le 4 \\ 0; & \text{otherwise} \end{cases}$
iii) $x[n] = \begin{cases} \text{Cos}(\pi n); & \text{for } n \ge 0 \\ 0; & \text{otherwise} \end{cases}$
iv) The raised cosine pulse (positive half cycle) x(t) which is defined as:
$$x(t) = \begin{cases} \frac{1}{2}[\text{Cos}(\omega t) + 1]; & -\frac{\pi}{\omega} \le t \le \frac{\pi}{\omega} \\ 0; & \text{otherwise} \end{cases}$$ **(08 Marks)**

2 a. Explain any four properties of continuous and / or discrete time systems. Illustrate with suitable examples. **(08 Marks)**

b. Check the given properties for the following systems:
i) Causality: (1) $y(t) = e^{x(t)}$ (2) $y[n] = x[n-2] - 2x[n-17]$
ii) Time – invariant / variant: (1) $y(t) = t.x(t)$ (2) $y[n] = x[2n]$
iii) Linearity: (1) $y(t) = x(t/2)$ (2) $y[n] = x[n].x[n-1]$ **(12 Marks)**

3 a. Obtain the convolution of the given two signals. Also sketch the result.
Given: $h(t) = \begin{cases} 1 & \text{for } 1 < t < 3 \\ 0; & \text{elsewhere} \end{cases}$, $x(t) = \begin{cases} (1-t) & \text{for } 0 \le t \le 1 \\ 0; & \text{elsewhere} \end{cases}$ **(08 Marks)**

b. The impulse response of a LTI system is given by $h[n] = \{1, \underset{\uparrow}{2}, 1, -1\}$. Determine the response of the system for the input and $x[n] = \{\underset{\uparrow}{1}, 2, 3, 1\}$ and sketch the output. **(06 Marks)**

c. Solve the difference equation of a system defined by:

$$y[n]-\frac{1}{4}y[n-1]-\frac{1}{8}y[n-2]=x[n]+x[n-1],$$

given that: $x[n] = 2^n.u[n]$; $y[-1] = 2$, $y[-2] = -1$. **(06 Marks)**

4 a. Evaluate the DTFS representation for the signal, $x[n]=\text{Sin}\left(\frac{4\pi}{21}n\right)+\text{Cos}\left(\frac{10\pi}{21}n\right)+1$.

Sketch the magnitude and phase spectra. **(08 Marks)**

b. State and prove the following Fourier transform:

i) Time shifting property ii) Time differentiation property. **(06 Marks)**

c. Find the DTFT for the following signal x[n] and draw its amplitude spectrum:

Given: i) $x[n] = a^n.u[n]$; $|a| < 1$ ii) $x[n] = \delta(n)$ unit impulse (delta). **(06 Marks)**

5 a. The system produces the output of $y(t) = e^{-t}.u(t)$, for an input of $x(t) = e^{-2t}.u(t)$. Determine impulse response and frequency response of the system. **(10 Marks)**

b. The input and the output of a causal LTI system are related by differential equation

$$\frac{d^2y(t)}{dt^2}+6\frac{dy(t)}{dt}+8y(t)=2x(t)$$

i) Find the impulse response of this system

ii) What is the response of this system if $x(t) = te^{-2t}u(t)$? **(10 Marks)**

6 a. State and bring out the importance of the sampling theorem. Give the proof of the theorem for low pass signals. **(08 Marks)**

b. Explain the reconstruction of signals from its samples. What is Aliasing? How to overcome this effect? **(08 Marks)**

c. Determine the Nyquist sampling rate for the following signals:

i) $x(t) = \text{Sin}(1000t)$ ii) $x[n]=\text{Cos}(\pi n)+\left(\frac{1+\text{Sin}2\pi n}{2}\right)$. **(04 Marks)**

7 a. Explain briefly the ROC and its important properties of Z-transform. **(06 Marks)**

b. State and prove time reversal and time convolution property of Z-transform. **(06 Marks)**

c. Determine the Z-transform of the following signals:

i) $x[n] = \alpha^n u[n]$

ii) $y[n] = -\alpha^n u[-n-1]$

Depict the ROC and pole and zero locations of X(z) in the z-plane. **(08 Marks)**

8 a. A casual system has input x[n] and output y[n]. Use the transfer function to determine the impulse response of this system:

$$x[n]=\delta[n]+\frac{1}{4}\delta[n-1]-\frac{1}{8}\delta[n-2] \;;\quad y[n]=\delta[n]-\frac{3}{4}\delta[n-1].$$ **(06 Marks)**

b. Obtain the sequence x[n] from the given transform by using convolution property.

$$X[z]=\frac{z^2}{(z-2)(z-3)}.$$ **(07 Marks)**

c. By using unilateral Z-transform, solve the following difference equation:

$Y[n] + 3y[n-1] = x[n]$

with $x[n] = u[n]$ and the initial condition $y[-1] = 1$. **(07 Marks)**

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