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# SE-7383

## B. E. - IV (Sem. VII) (E&C) Examination

**May / June – 2011**

## Digital Signal Processing

Time : **3** Hours] [Total Marks : **100**

**Instructions :**

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
**Fillup strictly the details of ☛ signs on your answer book.**
Name of the Examination :
☛ **B. E. - 4 (Sem. 7) (E&C)**
Name of the Subject :
☛ **Digital Signal Processing**
☛ Subject Code No. : **7 3 8 3** ☛ Section No. (1, 2,.....) : **Nil**

Seat No. :

Student's Signature

(2) Assume suitable data wherever necessary.
(3) Figures to the right indicate full marks.
(4) Acronyms carry their usual meanings.

**1** Do as directed : **20**

(a) Show that discrete time sinusoidal signal is periodic only if its frequency can be expressed as ratio of two integers. **3**

(b) Consider the discrete time system is exited by the sequence : **9**

$$x(n) = 1 \quad \text{for} \quad 0 \le n \le 3$$
$$= 0 \quad \text{o/w}$$

(i) $y(n) = x(-n)$ (ii) $y(n) = 2x(n)$

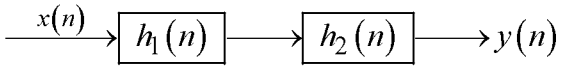
(iii) $y(n) = x(n-1) + x(n+1)$

(c) Classify the following systems as under : **8**

| System | Causal / noncausal | Linear / nonlinear | Stable / Unstable | TV / TIV |
|---|---|---|---|---|
| I | | | | |
| II | | | | |

(I) $-y(n) = x(n^2)$ (II) $y(n) = n\,x(n)$

2 (a) Two discrete time LTI systems are connected in cascade as shown in Fig. 1. Determine the unit sample response of this cascade connection. 8




**(Fig. 1)**

$$h_1(n)=\left(\frac{1}{2}\right)^n u(n)$$

$$h_2(n)=\left(\frac{1}{4}\right)^n u(n)$$

(b) Determine the response $y(n)$, $n \geq 0$ of the system described by the equation 7

$y(n)-3y(n-1)-4y(n-2)=x(n)+2x(n-1)$ to the input $x(n)=4^n u(n)$. Assume $y(-1)=y(-2)=0$.

**OR**

2 (a) A difference equation describing a filter is given by 8

$$y(n)-\frac{3}{4}y(n-1)+\frac{1}{8}y(n-2)=x(n)+\frac{1}{2}x(n-1)$$

Draw direct form I and direct form II structures.

(b) Three systems with impulse responses 8

$h_1(n)=\delta(n)-\delta(n-1)$, $h_2(n)=h(n)$ and $h_3(n)=u(n)$ are connected in cascade.

(i) What is the impulse response $h_c(n)$ of the overall system ?

(ii) Does the order of the interconnection affect the overall system response ?

3 Attempt any **two** : 14

(a) Compute the convolution of the following signals by means of *z*-transform :

$$x_1(n)=\begin{cases}\left(\frac{1}{3}\right)^n & n \geq 0\\ \left(\frac{1}{2}\right)^{-n} & n<0\end{cases}$$

$$x_2(n)=\left(\frac{1}{2}\right)^n u(n)$$

(b) Determine all possible signals that have following $z$-transform :

$$X(z)=\frac{1}{1-z^{-1}+\frac{1}{4}z^{-2}}$$

(c) Compute the response of the system $y(n)=0.7\ y(n-1)-0.12y(n-2)+x(n-1)+x(n-2)$ to the input $x(n)=n\,u(n)$ using $z$-transform. Is the system stable ?

4 (a) Do as directed : **10**

(1) Why ideal low pass filter is not practically realizable ?

(2) Draw typical pole-zero plot for linear phase filter.

(3) Write time shift property of DFT.

(4) Write the total number of complex multiplication and addition for N-point radix-2 FFT.

(5) Compute N-point DFT of $\delta(n)$ and $\delta(n-L)$

(b) (i) Determine impulse response of the linear phase FIR filter of length $M=4$ for which the frequency response at $\omega=0$ and $\omega=\frac{\pi}{2}$ is specified as **3**

$$H_r(0)=1,\ H_r\left(\frac{\pi}{2}\right)=\frac{1}{2}$$

(ii) Explain frequency domain sampling and concept of DFT. **7**

5 (a) Develop 8-point radix-2 FFT algorithm using DIT approach. **8**

(b) Design the digital FIR linear phase lowpass filter having cut-off frequency is $\frac{\pi}{4}$ using $M=7$. **7**

**OR**

5 (a) Explain divide and conquer approach to find DFT. **7**

(b) Consider the analog resonator having system function **8**

$$H(s) = \frac{s + 0.1}{s^2 + 0.2s + 9.01}$$

Convert into digital IIR filter using bilinear transformation. The digital filter is to have a resonant frequency of $\omega_r = \frac{\pi}{2}$.

6 Attempt any **three** : **15**

(a) Explain overlap-add method to find linear filtering of long data sequence.

(b) Explain symmetric and asymmetric filter.

(c) Explain Butterworth filter.

(d) Explain Approximate derivative method for designing digital IIR filter.

(e) Determine DFT of $x(n) = \{1, 2, 3, 4\}$ using twiddle factor matrix and verify answer by finding IDFT.

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