M.E. First Semester (Electrical & Elect.) (New-CGS)

13283 : Advanced Digital Signal Processing : 1 EEEME 3

P. Pages : 2

Time : Three Hours

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AX - 3567

Max. Marks : 80

Notes : 1. Due credit will be given to neatness and adequate dimensions.
2. Assume suitable data wherever necessary.
3. Diagrams and chemical equations should be given wherever necessary.
4. Retain the construction lines.
5. Illustrate your answer necessary with the help of neat sketches.
6. Use of pen Blue/Black ink/refill only for writing the answer book.

1. a) Determine the response of the following systems to the input signal. **6**

$$x(n)=\begin{cases}|n|, & -3\le n\le 3\\ 0, & \text{otherwise}\end{cases}$$

a) $y(n)=x(n)$ (Identity System)

b) $y(n)=x(n-1)$ (Unit Delay System)

c) $y(n)=x(n+1)$ (Unit Advance System)

d) $y(n)=\frac{1}{3}[x(n+1)+x(n)+x(n-1)]$ (Moving Average Filter)

e) $y(n)=\text{median}\{x(n+1),x(n),x(n-1)\}$ (Median Filter)

f) $y(n)=\sum_{k=-\infty}^{n}x(k)=x(n)+x(n-1)+x(n-2)$ ---- (Accumulator)

b) The impulse response of a linear time invariant system is, **7**

$h(n)=\{1,\underset{\uparrow}{2},1,-1\}$

Determine the response of the system to the input signal.

$x(n)=\{\underset{\uparrow}{1},2,3,1\}$

OR

2. a) Perform the circular convolution of the following two sequences, **6**

$x_1(n)=\{\underset{\uparrow}{2},1,2,1\}$

$x_2(n)=\{\underset{\uparrow}{1},2,3,4\}$

b) Determine the eight – point DFT of the signal **7**

$x(n)=\{1,1,1,1,1,1,0,0\}$

and sketch its magnitude & phase.

3. a) Determine the impulse response of an FIR lattice filter with parameter **6**

$k_1=0.6, k_2=0.3, k_3=0.5 \& k_4=0.9$

b) Differentiate between analog filter & Digital filter. **7**

OR

4. a) Obtain the direct form I, direct form II, cascade & II^{el} structures for the following system, **7**

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

b) Determine a parallel & a cascade realization of the system, 6

$$H(z)=\frac{1+z^{-1}}{(1-z^{-1})(1-0.8e^{j\pi/4}z^{-1})(1-0.8e^{-j\pi/4}z^{-1})}$$

5. a) Given the specification $\alpha_p = 3dB$, $\alpha_s = 16dB$, $f_p = 1KHz$ & $f_s = 2KHz$. Determine the order of the filter using Chebyshev approximation. Find H(s). 7

b) Determine the order & poles of low pass Butterworth filter that has a 3dB attenuation at 500 Hz & an attenuation of 40 dB at 1000 Hz. 7

OR

6. a) Given the specification $\alpha_p = 1dB, \alpha_s = 30dB$, $\Omega_p = 200r/sec, \Omega_s = 600 rad/sec$. Determine the order of the filter. 7

b) Prove that 7

$$\Omega_c = \frac{\Omega_p}{\left(10^{0.1\alpha_p}-1\right)^{1/2N}} = \frac{\Omega_s}{\left(10^{0.1\alpha_s}-1\right)^{1/2N}}$$

7. a) If the sample sequence of a random process has N = 1000 samples, 7
   a) Determine the freq. resolution of the Bartlett, Welch (50% overlap), & Blackman – Tukey methods for a quality factor Q = 10.
   b) Determine the record length for the Bartlett, Welch (50%, overlap), & Blackman – Tukey methods.

b) The Bartlett method is used to estimate the power spectrum of a signal x(n) consisting of 2400 samples. 7
   a) Determine the smallest record length of each segment that yields a frequency resolution of $\Delta_f = 0.07$.
   b) Determine the quality factor Q_B.

OR

8. a) Explain Tukey & Blackman method for periodograms. 7

b) Explain why AR model is widely used in random signal processing. 7

9. a) Explain in detail quadrature mirror filter bank. 7

b) What is aliasing? What is the need for anti – aliasing filter prior to down sampling? 6

OR

10. a) What is a multirate system? What are its applications. 6

b) Explain the polyphase decomposition process. 7

11. a) Explain special purpose DSP processor in detail. 13

OR

12. a) Explain in detail how special purpose DSP can be used for FFT implementation. 6

b) Explain in detail any one architecture of TMS320C54XX/TMS320C67XX series DSP processor. 7

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