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M S RAMAIAH INSTITUTE OF TECHNOLOGY

(AUTONOMOUS INSTITUTE, AFFILIATED TO VTU)

BANGALORE – 560 054

SEMESTER END EXAMINATIONS – JANUARY 2015

Course & Branch	:	**B.E: Electrical & Electronics Engg.**	**Semester**	:	**V**
Subject	:	**Digital Signal Processing**	**Max. Marks**	:	**100**
Subject Code	:	**EE501**	**Duration**	:	**3 Hrs**

Instructions to the Candidates:

- Answer one full question from each unit.

UNIT – I

1. a) Distinguish between Digital Signal Processing and Analog Signal processing. (06)
   b) Let x(n)={2,1,1,0,3,2,0,3,4,6} with a 10 point DFT X(k). Evaluate the following without explicitly computing the DFT. (06)
   i) $\Sigma^{9}_{k=0} e^{\frac{-j4\pi k}{5}} X(k)$ ii) $\Sigma^{9}_{k=0} |X(k)|^2$ iii) X(0)
   c) Derive DFT formula from DTFT. (08)

2. a) Find the 10 point inverse DFT of (06)
   X(K)= { 3, K=0
   {1, 1≤ K ≤ 9, without explicitly using IDFT formula.
   b) Find the N point DFT of the sequence $x(n)=4+\cos^2(2\pi n/N)$, n=0,1,....., N-1 (06)
   c) Prove the following properties of DFT (08)
   i) Circular frequency shift
   ii) Circular time shift
   iii) Parseval's theorem

UNIT – II

3. a) Perform x(n) $(*)_N$ h(n) for the sequence x(n) and h(n) given below , using overlap and add fast convolution technique h(n)={ 1 , -2 , 1 }, and x(n)= { 1, 2, 3, 4, 5 , 6, -1, -2, -3, -4, -5, -6} consider block length 6. (06)
   b) A designer is having a number of 8 point FFT chips. Show explicitly how he should interconnect three chips in order to compute a 24 point DFT. (06)
   c) Find the real valued x(n) using DITFFT method , where the 3 samples of a 4 point DFT is given as X(0)=12, X(1)= 1+j2, X(2)=4 also find y(n) where $Y(K)=W_2^{k}X(K)$ without explicitly using the DFT formula. (08)

4. a) Derive 8 point radix 2 DIF FFT algorithm. (10)
   b) The sequence x[n]= {1, 2, 3, 3, 2 , 1 , -1, -2, -3, 5, 6, -1, 2 ,0,2,1} is filtered through a filter whose impulse response is h[n]= {3, 2, 1, 1}. Compute the output of the filter y[n] using overlap and save method. Use 9 point circular convolution. (10)

UNIT – III

5. a) Derive the expression for h(n), using frequency sampling technique for even and odd values of N. (06)
   b) Write a note on i) Rectangular window, ii) Hanning window and Hamming window. (06)

c) The desired frequency response of a low pass filter is given by (08)
$H_d(w) = \{e^{-j3w}, |w| \le 3\pi/4$
$0, 3\pi/4 \le |w| \le \pi\}$
Determine the frequency response of the FIR filter, if a Hamming window is used with N=7

6. a) Design an ideal band pass filter with frequency response $H_d(w)=1$ for $\pi/4 \le |w| \le 3\pi/4$. Use windowing technique with $\Delta w=2.87$ rad/sample(transition width) and $\delta s=0.03$, in your design. Calculate 10 samples of h(n). (12)

b) Design a low pass FIR filter using frequency sampling technique having cut off frequency of $\pi/2$ rad/sample. The filter should have linear phase and length of 19. (08)

UNIT – IV

7. a) Design a LPF using BLT to satisfy the following specifications: (12)
   i. Monotonic stop and pass band,
   ii. -3.01dB cut off frequency of 0.5π radian,
   iii. Magnitude down by at least 15 dB at 0.75π radian.
   Verify your design and give the difference equation.

b) Write the advantages and disadvantages of IIR filter. (08)

8. a) For a Butterworth LPF, show that, (06)

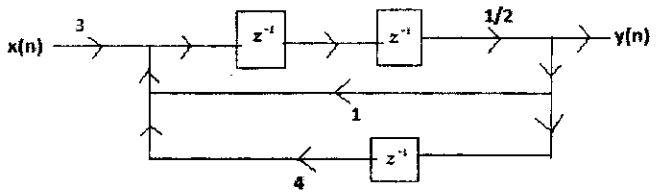
$$N = \log_{10} \frac{[10^{-kp/10} - 1]/[10^{-ks/10} - 1]}{2\log_{10}(\Omega p/\Omega s)}$$

b) Distinguish between Butterworth and chebychev IIR filter. (06)

c) Apply bilinear transformation to obtain digital low pass filter to approximate $H(S) = 2/(s+1)(s+2)$. Assume cutoff frequency of 100Hz and sampling frequency of 1kHz. For the analog transfer function determine H(z) using impulse invariant method? (08)

UNIT – V

9. a) An LTI system is shown in figure below. Write the input- output relationship and (12)



Realize the system in the following forms:
(i) Direct form I realization.
(ii) Direct form II realization.
(iii) Draw the transpose of the direct form II structure.

b) Realize the following system in: (08)
i) Direct form ii) Cascade form
$H(z) = 1 + \frac{3}{4} z^{-1} + \frac{1}{8} z^{-2} + \frac{3}{4} z^{-3} + z^{-4}$,

10. a) Obtain the cascade and parallel realization and also find the transpose of the parallel form realization for the system function given below. (12)

$$H(z) = \frac{2(1-z^{-1})(1+\sqrt{2}z^{-1}+z^{-2})}{(1+0.5z^{-1})(1-0.9z^{-1}+0.81z^{-2})}$$, use 1st order and 2nd order system

b) Realize a Linear phase FIR filter with the following impulse response. (08)
$h(n) = \delta(n) + \frac{1}{2}\delta(n-1) - \frac{1}{4}\delta(n-2) + \delta(n-4) + \frac{1}{2}\delta(n-3)$. Give necessary equations.

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