BTS(C) – VI – (S) – 10 – 044 – J

B. Tech Degree VI Semester (Supplementary) Examination September 2010

CS/EE 602 DIGITAL SIGNAL PROCESSING

(2006 Scheme)

Time : 3 Hours | Maximum Marks : 100

PART – A

(Answer ***ALL*** questions)

(8 x 5 = 40)

I. (a) Find the circular convolution of the sequences $x[n]=[1,2,3]$ and $h[n]=[1,0,2]$. Derive the matrix H that represents the circular convolution operator.

(b) Given $y[n]-0.5y[n-1]=2x[n]$, find its causal impulse response and anticausal impulse response.

(c) Compute the total number of additions and multiplications required for computing the 16 pt DFT of a sequence. How will the multiplication and addition be reduced if a 16 pt radix 4 FFT algorithm is used? Ignore all trivial multiplications. (multiplication by $\pm 1, \mp j$ etc.).

(d) Draw the signal flow graph for 8 point DIT FFT. Hence calculate the DFT of $x[n]=[1\ 2\ 3\ 4\ 5\ 6\ 7\ 8]$.

(e) Explain the window method for FIR filter realization. What is the disadvantage of rectangular window?

(f) Realize the filter $H(Z)=\dfrac{1+3Z^{-1}+4Z^{-2}}{1+4Z^{-1}+6Z^{-2}+8Z^{-3}}$ in Direct Form 1 and Direct Form 2.

(g) Explain Limit cycle oscillations.

(h) Compare and contrast General Purpose microprocessors and DSPs.

PART – B

(4 x 15 = 60)

II. (a) Using long division method, find the inverse Z transform of $X(Z)=\dfrac{1}{1+Z^{-1}+Z^{-2}}$ for causal and anticausal $x[n]$. (5)

(b) Find the inverse Z transform of $X(Z)=\log\left(1+aZ^{-1}\right)$ (5)

(c) For the sequence

$x[n]=\left(\dfrac{-1}{3}\right)^n u[n]-\left(\dfrac{1}{2}\right)^n u[-n-1]$, compute $X(Z)$ and plot ROC. Will $x[n]$ have a Fourier Transform? (5)

OR

III. (a) Check the linearity, causality and stability of the following systems.

(i) $y[n]=5x[n]+3$

(ii) $y[n]=x^2[n]$

(iii) $y[n]=3y[n+1]+x[n]+x[n-1]$ (6)

(b) Compute the linear convolution of $x[n]=[1,3,1]$ and $h[n]=[1,4,3]$ using circular convolution method. (4)

(c) Define Systems Transfer function. Hence for a system given by $y[n]=y[n-1]+x[n]$, write down the system transfer function and then compute the impulse response. (5)

(P.T.O)

IV. (a) Derive the 8 point D.I.F FFT. Hence compute the DFT of the sequence $x[n]=[1,4,6,8,8,6,4,1]$ using the DIF FFT algorithm. (10)

(b) Show that $DFT\left(x^{*}[n]\right)=X^{*}[N-k]$ where N is the length of the sequence and $X[k]$ is the DFT of $x[n]$. (5)

OR

V. Compute the DFT of the sequence $x[n]=[1,8,4,2,2,4,8,1]$ given a 4 point FFT transformer (it can compute FFT of a 4 point sequence only). The FFT transformer may be used only once. (15)

VI. (a) Compare FIR and IIR filters. (5)

(b) Design using rectangular windowing method, a LPF FIR filter with following specifications.

Cut off frequency = 500 Hz
Sampling frequency = 2kHz
Order of the filter = 10 (10)

OR

VII. (a) Realize the filter

$$H(z)=\frac{1+2z^{-1}+z^{-2}}{\left(1-z^{-1}\right)\left(1-z^{-2}\right)}$$

(i) Direct Form 1
(ii) Direct Form 2
(iii) Cascade Form, where each stage is implemented as a second order system. (8)

(b) Realize the filter

$H(z)=1+3z^{-1}+4z^{-2}+5z^{-3}+4z^{-4}+3z^{-5}+z^{-6}$ in Direct Form.

Is a linear phase response possible? Thereafter, realize the filter so as to minimize the number of multiplications. (7)

VIII. (a) Derive the expression for mean square quantization error. (6)

(b) Draw the block diagram of a typical fixed point DSP processor. (9)

OR

IX. (a) Draw the block diagram of a typical floating point DSP processor. (8)

(b) Explain in detail an application of DSP to image processing. (7)

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