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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Electronics and Communication Engineering
Semester End Examination; May / June - 2019
Digital Signal Processing

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Compute the 4-point DFT of the following sequences :

i) $x_n = \cos(\frac{n\pi}{4});\ 0 \le n \le 3$ ii) $x_n = \{1, 0, 1, 0\}$ 10

Draw its magnitude and phase spectrum.

b. State and prove time reversal properly as applicable to DFT. 4

c. Compute the circular convolution between two sequences given, 6

$x(n) = n\ \ for\ 0 \le n \le 4\ and\ \ y(n) = u(n) - u(n-2)$

2 a. Show that multiplication of DFT's $X_1(k)$ and $X_2(k)$, corresponds to circular convolution of $x_1(n)$ and $x_2(n)$. 8

b. An input $x_n = \{0, 1, 2, 1, 2, 3, 4, 5, 2, 1, 4, 5\}$ has to be filtered through a linear filters of impulse response $h_n = \{1, -1, 1\}$ use overlap-save method to determine *y(n)* taking input block length *L* = 4. 12

UNIT - II

3 a. Determine the number of complex multiplications, complex additions and trigonometric functions required for computation of N-point DFT. 10

b. Draw the neat flow graph of 8-point Decimation– In –Time (DIT) FFT algorithm and using the same determine 8-point DFT of $x(n) = \{1, -1, 1, 0, 2, -1, 2, 1\}$. 10

4 a. First 5-point of 8-point DFT of a real valued sequence is given by $x(k) = \{0, 2+j2, -j4, 2-2j, 0\}$. Determine the remaining points .Hence find sequence *x(n)* using DIT-FFT algorithm. 10

b. A complex sequence *z(n)* with DFT *z(k)* is formed as $z\ (n) = x(n) + jy(n),$ where *x(n)* and *y(n)* are real sequences with corresponding DFT's *x(k)* and *y(k)* respectively . Express *x(k)* and *y(k)* in terms of DFT *z(k)* given , 10

$Z(k) = \{\ 12 + j12, 1.414 + j3.414, 0, -0.5858 + j1.414, 0, -1.414 + j0.5858, 0, -3.414 - j1.414\}$

Compute *x(k)* and *y(k)* using above relation without computing any DFT.

UNIT - III

5 a. Justify the need for windows in FIR filter design. Write the time domain relationships and important characteristics of Hamming, Hanning and Bartlett windows. 10

b. The desired frequency response of low pass filter is given by,

$$H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j3w}; & |w| < \frac{3\pi}{4} \\ 0; & \frac{3\pi}{4} < |w| < \pi \end{cases}$$ 10

Determine frequency response of FIR filter if Hamming window is used with $N = 7$.

6 a. Discuss the steps used in design of FIR filter using frequency sampling method. 5

b. Compare FIR and IIR filters for its various performance parameters. 5

c. Design an ideal low pass FIR filter whose desired frequency response is,

$H_d(e^{jw}) = \begin{cases} 1; & \frac{\pi}{3} \geq w \geq -\frac{\pi}{3} \\ 0; & \pi \geq |w| \geq \frac{\pi}{3} \end{cases}$ using Hamming window for $N = 9$. Determine $h(n)$ and $H(z)$. 10

UNIT - IV

7 a. An analog filter has a transfer function $H(s) = \frac{10}{s^2 + 7s + 10}$. Design a digital filter equivalent to this using Impulse Invariant method. 8

b. Design an analog filter with maximally flat response in the pass band and an acceptable attenuation of – 2 dB at 20 rad/s. The attenuation in the stop band should be more than 10 dB beyond 30 rad/s. 12

8 a. Design an IIR Chebyshev digital filter using Bilinear transformation meeting the following specifications: 14

$$0.8 \leq |H(e^{jw})| \leq 1 \quad for \; 0 \leq w \leq 0.2\pi$$
$$|H(e^{jw})| \leq 0.2 \quad for \; 0.32\pi \leq w \leq \pi \quad and \; T = 1\,s.$$

b. Given $|H(e^{j\Omega})|^2 = \frac{1}{1+64\Omega^6}$. Determine the analog Butterworth low pass filter transfer function. 6

UNIT - V

9 a. Obtian cascade and parallel realilzaiton form for,

$$H(Z) = \frac{(1 + \frac{1}{4}Z^{-1})}{(1 + \frac{1}{2}Z^{-1})(1 + \frac{1}{2}Z^{-1} + \frac{1}{4}Z^{-2})}.$$ 10

b. Describe speech coding process using an ADPCM speech encoder. 10

10 a. Given $H(z) = 1 + 2Z^{-1} + 1/3Z^{-2}$. Obtain second order Lattice structure of the system. 10

b. Given Impulse response, $h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4)$ check whether system has linear phase characteristics, if yes; realize the system with minimum multiplies. 10

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