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10MT74

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019

Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Compute N-point DFT of $x(n) = \cos\frac{2\pi}{N}K_0 n$. **(05 Marks)**

b. Compute 5-point DFT of x(n) = {1, 1, 1}. **(07 Marks)**

c. Derive the relationship of DFT to (i) DTFT (ii) Z-transform. **(08 Marks)**

2 a. Compute the circular convolution of the sequences $x_1(n)$ = {2, 1, 2, 1} and $x_2(n)$ = {1, 2, 3, 4}. **(10 Marks)**

b. Find the output y(n) of a filter whose impulse response is h(n) = {1, 1, 1} and impulse response x(n), x(n) = {3, -1, 0, 1, 3, 2, 0, 1, 2, 1} using overlap save method. Use 5 point circular convolution. **(10 Marks)**

3 a. Compute how many complex multiplications and additions are required for 64 point DFT and FFT. **(04 Marks)**

b. State and prove properties of phase factor. **(06 Marks)**

c. Determine y(n) = x(n) Ⓝ h(n) if x(n) = n for $0 \le n \le 3$ $h(n) = \cos\frac{n\pi}{2}$ for $0 \le n \le 3$ using DIT-FFT algorithm. **(10 Marks)**

4 a. Develop Radix-2 N-point DIT-FFT algorithm and draw the signal flow graph consider N = 8. **(10 Marks)**

b. Obtain the 8-point DFT of the sequence x(n) = 1 $0 \le n \le 7$ using DIF-FFT algorithm. **(10 Marks)**

PART – B

5 a. Design a lowpass butterworth filter that has a 2 dB passband attenuation at a frequency of 300 π r/s and atleast 60 dB stopband attenuation at 4500 π r/s. **(10 Marks)**

b. Let $H(s) = \frac{1}{s^2 + s + 1}$ represents the transfer function of a lowpass filter with passband of 1 r/s. Use frequency transformation to find the transfer function:

(i) A lowpass filter with a cut-off frequency of 10 r/s.
(ii) A highpass filter with a cut-off frequency 10 r/s.
(iii) A band pass filter with a passband of 10 r/s and a centre frequency 100 r/s. **(10 Marks)**

6 a. The desired frequency response of the lowpass filter is given by

$$H_d(\omega) = e^{-j3\omega} \quad |\omega| < \frac{3\pi}{4}$$
$$= 0 \quad \frac{3\pi}{4} < \omega < \pi$$

Determine the frequency response of the FIR filter if the hamming window is used with N = 7. **(10 Marks)**

b. Determine the FIR filter coefficients h(n) which is symmetric low pass filter with linear phase the desired frequency response is

$$H_d(\omega) = \begin{cases} e^{-J\left(\frac{m-1}{2}\right)\omega} & 0\ |\omega| < \frac{\pi}{4} \\ 0 & \text{otherwise} \end{cases}$$

Employ rectangular window with m = 7. **(10 Marks)**

7 a. Design a digital lowpass butterworth filter using bilinear transformation method to meet the following specifications. Take T = 2 sec passband attenuation 1.25 dB, passband edge frequency 200 Hz, stopband attenuation 15 dB, stopband edge frequency 400 Hz, sampling frequency 2 kHz. **(10 Marks)**

b. A third order Butterworth lowpass filter has the transfer function $H(s) = \frac{1}{(s+1)(s^2+s+1)}$.

Design H(z) using impulse invariant technique. **(10 Marks)**

8 a. Obtain the direct form II and cascade realization of $H(z) = \frac{(z-1)(z^2+5z+6)(z-3)}{(z^2+6z+5)(z^2-6z+8)}$. **(10 Marks)**

b. A FIR filter is given by $y(n) = x(n) + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-3)$. Draw lattice structure. **(10 Marks)**

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