CBCS SCHEME

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18EE63

Sixth Semester B.E. Degree Examination, Jan./Feb. 2023
Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Given x[n] = [1, 1, 1], obtain the five point DFT X[K]. **(06 Marks)**

b. State and prove the following property of DFT:
(i) Periodicity property (ii) Frequency shift **(06 Marks)**

c. Compute circular convolution using DFT-IDFT for following sequence :
$x_1[n] = [\underset{\uparrow}{2}, 3, 1, 1]$; $x_2[n] = [\underset{\uparrow}{1}, 3, 5, 3]$ **(08 Marks)**

OR

2 a. Differentiate between linear and circular convolution. **(04 Marks)**

b. Find the output of the LTI system whose impulse h[n] = [1, 1, 1] and input signal is x[n] = [3, −1, 0, 1, 3, 2, 0, 1, 2, 1] using the overlap save method. Use 6 point circular convolution. **(10 Marks)**

c. g[n] and h[n] are the two sequence of length 6, with 6 pt DFT's G(k) and H(k) respectively. The sequence g[n] = [4, 3, 1, 5, 2, 6]. The DFT's are related by circular frequency shift as $H(k) = G((k-3))_6$. Determine h[n] without computing DFT and IDFT. **(06 Marks)**

Module-2

3 a. Find the DFT of x[n] = [1, 2, 3, 4, 4, 3, 2, 1] using the DIT-FFT algorithm. **(10 Marks)**

b. Develop an 8 point DIF-FFT algorithm, starting from DFT. State clearly all the steps. Explain how it reduces the number of computations. **(10 Marks)**

OR

4 a. Develop DIT-FFT algorithm for composite value of N = 6. Draw the corresponding signal flow graph. **(08 Marks)**

b. Find the 4-pt circular convolution of x[n] and h[n] given using radix – 2 DIF-FFT algorithm.

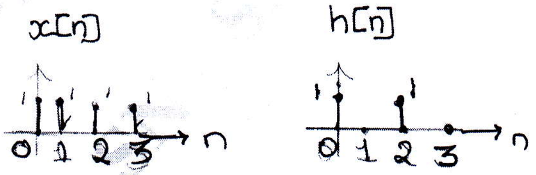

Fig.Q4(b) **(12 Marks)**

Module-3

5 a. Find a Butterworth analog high pass filter with the specifications: Pass band gain of $K_p = 2$ dB at pass band edge frequency $\Omega_P = 200$ rad/sec and stop band gain of $K_S = 20$ dB at stop band edge frequency Ω_S, $\Omega_S = 100$ rad/sec **(12 Marks)**

b. Convert the analog filter with system transfer function

$$H(s) = \frac{(s+0.1)}{(s+0.1)^2 + 3^2}$$

Into a digital IIR filter by mean of the impulse invariant method. **(08 Marks)**

OR

6 a. Design a Chebyshev analog low pass filter that has a –3dB cut of frequency of 100 rad/sec and a stop band attenuation 25 dB or greater for all radian frequencies past 250 rad/sec. **(12 Marks)**

b. Establish the bilinear transformation between the 's' domain and the 'z' domain. Hence show that the region outside the unit circle in the domain corresponds to the right half of 's' plane. **(08 Marks)**

Module-4

7 a. Design a digital Chebyshev J filter that satisfies the following constrains.

$$0.8 \le |H(j\omega)| \le \qquad 0 \le \omega \le 0.2\,\pi$$
$$|H(j\omega)| \le 0.2 \qquad 0.6\,\pi \le \omega \le \pi$$

Use impulse invariant transformation. **(14 Marks)**

b. Write the difference between IIR and FIR filter. **(06 Marks)**

OR

8 a. Obtain the direct from – II, cascade/series and parallel form realization of the following function:

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{(z - 0.25)(z^2 - z + 0.5)}$$ **(12 Marks)**

b. Realize the following difference equation using digital structures in all forms:

$$y[n] - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x[n] + \frac{1}{3}x(n-1)$$ **(08 Marks)**

Module-5

9 a. Design a lowpass digital filter to be used in A/D – H(z) – D/A structure that will have –3dB cutoff at 30π rad/sec and attenuation factor of 5 dB at 45 π rad/sec. The filter is required to have a linear phase and the system will use sampling frequency of 100 samples/sec. **(10 Marks)**

b. Define the following windows along with their impulse response:
(i) Rectangle window (ii) Hamming window
(iii) Hanning window (iv) Bartlett window **(10 Marks)**

OR

10 a. Determine the filter coefficient h[n] obtained by sampling $H_d(\omega)$ given by,

$$H_d(\omega) = \begin{cases} e^{-j3\omega}, & 0 < \omega \le \frac{\pi}{2} \\ 0, & \frac{\pi}{2} < \omega < \pi \end{cases}$$ **(12 Marks)**

b. Realize the linear FIR filter having the following:

$$h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4)$$ **(08 Marks)**

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