CBCS SCHEME

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18EE63

Sixth Semester B.E. Degree Examination, July/August 2022
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. Compute 4-point DFT of casual three sample sequence given by

$$x(n) = \frac{1}{3}\,;\ 0 \le n \le 2$$
$$= 0\ ;\ \text{else.}$$ **(06 Marks)**

b. State and prove linearity property of DFT. **(06 Marks)**

c. Find the circular convolution of two finite duration sequences $x_1(n)$ and $x_2(n)$ using concentric circle method. Where $x_1(n)$ and $x_2(n)$ are given by
$x_1(n) = \{1, -1, -2, 3, -1\}$
$x_2(n) = \{1, 2, 3\}$. **(08 Marks)**

OR

2 a. Compute circular convolution using Stockham's method for following sequences:
$x_1(n) = \{2, 3, 1, 1\}$ and $x_2(n) = \{1, 3, 5, 3\}$. **(10 Marks)**

b. Find the output y(n) of a filter whose impulse response h(n) = (1, 2) and input signal x(n) = {1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1} using overlap save method. Use block length of N = 4. **(10 Marks)**

Module-2

3 a. Develop decimation in time algorithm for finding FFT. Draw signal flow graph for N = 8 for DIT algorithm. **(10 Marks)**

b. Find the 8 point DFT of sequence x(n) = {1, 1, 0, 0, -1, -1, 0, 0} using DIT FFT algorithm. Draw signal flow graph. **(10 Marks)**

OR

4 a. Develop a decimation in frequency FFT algorithm for N = 8. Draw signal flow graph. **(10 Marks)**

b. The DFT X(k) of sequence is given as, $X(k) = \{0, 2\sqrt{2}(1-j), 0, 0, 0, 0, 0, 2\sqrt{2}(1+j)\}$. Determine the corresponding time sequence x(n) using DIF-FFT algorithm. Write its signal flow graph. **(10 Marks)**

Module-3

5 a. A system function of the normalized lowpass filter is given below:
$$H(s) = \frac{1}{s^2 + \sqrt{2}s + 1}.$$ Determine H(z) using impulse invariant transformation. Consider T = 1sec. **(08 Marks)**

b. Design an analog filter with maximally flat response in the passband and an acceptable attenuation of -2dB at 20radians/second. The attenuation in the stop band should be more than 10dB beyond 30 radian/second. **(12 Marks)**

OR

6 a. Transform the analog filter $H(s) = \frac{s+0.1}{(s+0.1)^2+9}$ into a digital filter using bilinear transformation. The digital filter should have resonant frequency $w_r = \pi/4$. **(05 Marks)**

b. Design an analog Chebyshev filter with the following specifications:
Passband ripple: 1dB for $0 \le \Omega \le$ rad/sec.
Stopband attenuation : -60dB for $\Omega \ge 50$ rad/sec. **(10 Marks)**

c. Let $H(s) = \frac{1}{s^2+\sqrt{2s}+1}$ represent the transfer function of a lowpass filter with a passband of 1 rad/sec. Use frequency transformation to find the transfer functions of the following analog filters.
i) A lowpass filter with pass band of 10rad/sec
ii) A high pass filter with cut-off frequency of rad/sec. **(05 Marks)**

Module-4

7 a. Compare Butterworth and Chebyshev filter approximations. **(05 Marks)**

b. Design a digital low pass filter to satisfy the following pass band ripple $1 \le H(j\Omega) \le 0$, for $0 \le \Omega \le 1404\pi$ rad/sec and stop band attenuation $|H(\Omega)| > 60\,dB$ for $\Omega \ge 8268\ \pi$ rad/sec sampling interval $T_s = \frac{1}{10^4}$ sec. Use BLT for designing. **(15 Marks)**

OR

8 A discrete time system H(z) is expressed as

$$H(z) = \frac{10\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{2}{3}z^{-1}\right)\left(1+2z^{-1}\right)}{\left(1-\frac{3}{4}z^{-1}\right)\left(1-\frac{1}{8}z^{-1}\right)\left[1-\left(\frac{1}{2}+j\frac{1}{2}\right)z^{-1}\right]\left[1-\left(\frac{1}{2}-j\frac{1}{2}\right)z^{-1}\right]}.$$

a. For the discrete time system defined by H(z), find the difference equation of the system. **(02 Marks)**

b. For the discrete time system, H(z) realize the system in direct form-I and II. **(08 Marks)**

c. For the discrete time system H(z), realize parallel and cascade forms using second order sections. **(10 Marks)**

Module-5

9 a. The desired frequency response of the low pass filter is given by

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

Determine the frequency response of FIR filter if the hamming window is used, with N = 7. **(08 Marks)**

b. Design an ideal band pass filter with frequency response.
$H_d(e^{jw}) = 1$, for $\frac{\pi}{4} \le |w| \le \frac{3\pi}{4}$. Use rectangular window with N = 11 in the design. **(12 Marks)**

OR

10 a. Determine the impulse response h(n) of a filter having desired frequency response.

$$H_d(e^{jw}) = \begin{cases} e^{-j(N-1)w/2} & \text{for } 0 \le |w| \le \pi/2 \\ 0 & \text{for } \frac{\pi}{2} \le |w| \le \pi \end{cases}$$

N = 7, use frequency sampling approach. **(10 Marks)**

b. Realize the following system function $H(z) = 1+\frac{3}{4}z^{-1}+\frac{17}{8}z^{-2}+\frac{3}{4}z^{-3}+z^{-4}$ in
i) Direct form ii) Cascaded form. **(10 Marks)**