Question Paper

Exam Date & Time: 03-May-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

FOURTH SEMESTER B.TECH. (ELECTRONICS AND COMMUNICATION ENGINEERING) DEGREE EXAMINATIONS - APRIL / MAY 2024
SUBJECT: ECE 2222/ECE_2222 - DIGITAL SIGNAL PROCESSING

Marks: 50 **Duration: 180 mins.**

Answer all the questions.

1A) Compute the 6-point DFT of the sequence x(n) = {0, 1, 2, 3, 2, 1} using matrix multiplication method. (5)

1B) State and prove the circular convolution property of DFT of two sequences $x_1(n)$ and $x_2(n)$. (3)

1C) Describe the Goertzel algorithm with expressions. What is it used for? (2)

2A) Compute the 8-point DFT of the sequence x(n) = {1, 0.5, 0, -0.5, -1, -0.5, 0, 0.5} using decimation in frequency FFT algorithm. Illustrate that the computation is faster than the direct computation of DFT. (5)

2B) Analyze the FIR lattice structure whose lattice coefficients are: K_1 = 0.65, K_2 = -0.34 & K_3 = 0.8, and obtain its impulse response coefficients. (3)

2C) Realize the linear phase FIR filter of length M = 7, whose first four filter coefficients are: 1, 1/3, -1/8 and 1/5. (2)

3A) A LPF has the desired frequency response (5)

$$|H_d(e^{j\omega})| = \begin{cases} 1, & 0 \le |\omega| \le 0.5\pi \\ 0, & elsewhere \end{cases}$$

Determine the filter coefficients h(n) using frequency sampling technique. Assume filter length M=9.

3B) Determine the unit sample response h(n) of a 4 length linear phase symmetric FIR filter having frequency response $H_r(0) = 1 \ and \ H_r\left(\frac{\pi}{2}\right) = 0.5$ (3)

3C) From Q3B determine the system function H(z) and the phase $\emptyset(\omega) \ for \ H_r(\omega) > 0.$ (2)

4A) Certain IIR Butterworth LPF has the following specifications (5)

$$-1.5dB \le 20log_{10}(|H(e^{j\omega})|) \le 0dB \ , \ 0 \le \omega \le \pi/3$$

$$20log_{10}(|H(e^{j\omega})|) \le -10dB, \quad 0.5\pi \le \omega \le \pi$$

Assume T=1 second. Obtain the prewarped analog edge frequency specifications , order of filter,3-dB cut-off frequency and poles of the filter.

4B) For the filter specification given in Question 4A, determine the analog transfer function H(s). (3)

4C) For the filter specification given in Question 4A, determine the system function H(z). Use bilinear transformation. (2)

5A) Given the system function $H(z) = \frac{1+z^{-1}+0.5z^{-2}}{1+0.2z^{-1}-0.15z^{-2}}$. Obtain the lattice ladder structure. (5)

5B)	Convert the analog filter into its equivalent digital filter using impulse invariance method whose transfer function is given by $H(s) = \frac{s+1}{s^2+2s+17}$. Assume T=1 second.	(3)
5C)	Illustrate the concept of spectral leakage and spectral resolution problems occurring in spectral estimation from finite duration signals.	(2)

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