CBCS SCHEME

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15EC52

Fifth Semester B.E. Degree Examination, Aug./Sept. 2020
Digital Signal Processing

Time: 3 hrs. Max. Marks: 80

Note: ***1. Answer any FIVE full questions, choosing ONE full question from each module.***
2. Use of Normalized filters tables is permitted.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Compute the circular convolution of the following sequences using DFT and IDFT method $x(n) = \{1, 2, 3, 4\}$ and $h(n) = \{4, 3, 2, 1\}$. **(08 Marks)**

b. Given $x(n) = \{1, -2, -2, 5, 8, 2\}$, evaluate the given expression $\sum_{K=0}^{5} e^{-j2\pi k/3} X(K)$ without computing DFT. **(04 Marks)**

c. Obtain the relationship of DFT with z-transforms. **(04 Marks)**

OR

2 a. Explain frequency domain sampling and reconstruction of signals. **(09 Marks)**

b. Consider the finite length sequence $x(n) = \delta(x) + 2\delta(n-5)$

i) Find the 10 point DFT of x(n)

ii) Find the sequence that has a DFT $y(k) = e^{\frac{j2k2\pi}{10}} x(k)$. **(07 Marks)**

Module-2

3 a. Evaluate the linear convolution of the following sequences using DFT and IDFT method. $x(n)=\{1, 2, 3\}$ and $h(n) = \{1, 2, 2, 1\}$. **(08 Marks)**

b. A long sequence x(n) is filtered through a filter with impulse response h(n) to yield the output y(n). If $x(n) = \{1, 1, 1, 1, 1, 3, 1, 1, 4, 2, 1, 1, 3, 1\}$ and $h(n) = \{1, -1\}$. Compute y(n) using overlap save technique. Use only a 5-point circular convolution. **(08 Marks)**

OR

4 a. State and prove the following properties of DFT i) Parseval's theorem **(06 Marks)**
ii) Time shifting property. **(04 Marks)**

b. Determine the response of an LTI system with $h(n) = \{1, -1, 2\}$ for an input $x(n) = \{1, 0, 1, -2, 1, 2, 3, -1, 0, 2\}$ use overlap add method with block length L = 4. **(06 Marks)**

Module-3

5 a. Find the DFT of the sequence using decimation in time FFT algorithm and draw the flow graph indicating the intermediate values in the flow graph.
$x(n) = \{1, -1, -1, -1, 1, 1, 1, -1\}$. **(08 Marks)**

b. Derive the computational arrangement of 8-point DFT using radix – 2 DIF-FFT algorithm. **(08 Marks)**

OR

6 a. What is Goertzel algorithm? Obtain direct form–II realization of second order goertzel filter. **(08 Marks)**

b. Find the IDFT of the sequence using DIF-FFT algorithm :
$X(k) = \{0, 2\sqrt{2}(1-j), 0, 0, 0, 0, 2\sqrt{2}(1+j)$. **(08 Marks)**

Module-4

7 a. Draw the block diagrams of direct form – I and direct form – II realizations for a digital IIR filter described by the system function :

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{(z - \frac{1}{4})(z^2 - z + \frac{1}{2})}.$$ **(08 Marks)**

b. Show that the bilinear transformation maps the s-plane to z-plane efficiently in the transformation of analog to digital filter. **(08 Marks)**

OR

8 a. Design a two pass Butterworth analog filter to meet the following specifications :
   i) Attenuation of –1db at 20rad/sec
   ii) Attenuation is greater than 20db beyond 40rad/sec. **(09 Marks)**

b. The transfer function of analog filter is $H(s) = \frac{2}{(s+1)(s+2)}$. Find H(z) using impulse invariance method. Show H(z) when $T_S = 1$sec. **(07 Marks)**

Module-5

9 a. A low pass filter is to be designed with the following desired frequency response

$$H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j2\omega}; & |\omega| < \pi/4 \\ 0; & \pi/4 < |\omega| < \pi \end{cases}$$

Determine the filter coefficients $h_d(n)$ and h(n) if ω(n) is a rectangular window defined as follows : $\omega_R(n) = \begin{cases} 1; & 0 \le n \le 4 \\ 0; & \text{otherwise} \end{cases}$. **(08 Marks)**

b. Realize the direct from the linear phase FIR filters for the following impulse response

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

OR

10 a. The frequency response of an FIR filter is given by :

$$H(\omega) = e^{-j3\omega}(1 + 1.8\cos 3\omega + 1.2\cos 2\omega + 0.5\cos\omega).$$

Determine the coefficients of the impulse response h(n) of the FIR filter. **(06 Marks)**

b. Obtain the coefficients of FIR filter to meet the specification given below using the window method :
   i) Pass band edge frequency $f_p = 1.5$KHz
   ii) Stop band edge frequency $f_s = 2$KHz
   iii) Minimum stop band attenuation = 50db (Hamming)
   iv) Sampling frequency $F_S = 8$KHz. **(10 Marks)**

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