

Fifth Semester B.E. Degree Examination, June/July 2018
Digital Signal Processing

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer FIVE full questions, choosing one full question from each module.*
2. *Use of filter table is not permitted.*

Module-1

1 a. Compute N-point DFT of a sequence $x(n)=\frac{1}{2}+\frac{1}{2}\cos\left(\frac{2\pi}{N}\left(n-\frac{N}{2}\right)\right)$. **(08 Marks)**

b. Compute 4-point circular convolution of the sequences using time domain and frequency domain.
$x(n)=\{\underset{\uparrow}{2},1,2,1\}$ and $h(n)=\{\underset{\uparrow}{1},2,3,4\}$ **(08 Marks)**

OR

2 a. Obtain the relationship between DFT and z-transform. **(08 Marks)**

b. Let x(n) be a real sequence of length N and its N-point DFT is X(K), show that
(i) $X(N-K)=X^*(K)$
(ii) $X(0)$ is real.
(iii) If N is even, then $X\left(\frac{N}{2}\right)$ is real. **(08 Marks)**

Module-2

3 a. Let x(n) be a finite length sequence with $X(K)=\{\underset{\uparrow}{10},1-j,4,1+j\}$, using properties of DFT, find the DFT of the followings:
(i) $x_1(n)=e^{j\frac{\pi}{2}n}x(n)$
(ii) $x_2(n)=\left\{\cos\frac{\pi}{2}n\right\}x(n)$ **(08 Marks)**

b. Find the response of an LTI system with an impulse response $h(n)=\{3,2,1\}$ for the input $x(n)=\{2,-1,-1,-2,-3,5,6,-1,2,0,2,1\}$, using overlap add method. Use 8-point circular convolution. **(08 Marks)**

OR

4 a. State and prove the,
(i) Modulation property. (ii) Circular time shift property. **(08 Marks)**

b. Consider a finite duration sequence $x(n)=\{\underset{\uparrow}{0},1,2,3,4,5\}$
(i) Find the sequence, y(n) with 6 point DFT is $y(K)=W_2^K X(K)$.
(ii) Determine the sequence y(n) with 6-point DFT $y(K)=\text{Real}[X(K)]$. **(08 Marks)**

Module-3

5 a. Develop the radix – 2 Decimation in frequency FFT algorithm for N = 8 and draw the signal flow graph. **(10 Marks)**

b. What is Goertzel algorithm and obtain the direct form – II realization? **(06 Marks)**

OR

6 a. Let x(n) be the 8-point sequence of $x(n) = \left\{\frac{1}{\sqrt{2}}, 1, \frac{1}{\sqrt{2}}, 0, \frac{-1}{\sqrt{2}}, -1, \frac{-1}{\sqrt{2}}, 0\right\}$. Compute the DFT of the sequence using DIT FFT algorithm. **(06 Marks)**

b. What is Chirp-Signals and mention the applications of Chirp-Z-transform? **(04 Marks)**

c. A designer is having a number of 8-point FFT chips. Show explicitly how he should interconnect three chips in order to compute a 24-point DFT. **(06 Marks)**

Module-4

7 a. Design a digital low pass Butterworth Filter using bilinear transformation to meet the following specifications:

$$-3\,\text{dB} \le \left|H(e^{j\omega})\right| \le -1\,\text{dB} \text{ for } 0 \le \omega \le 0.5\pi$$

$$\left|H(e^{j\omega})\right| \le -10\,\text{dB} \text{ for } 0.7\pi \le \omega \le \pi$$ **(10 Marks)**

b. Obtain the parallel form of realization of a system difference equation.

$$y(n) = 0.75y(n-1) - 0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)$$ **(06 Marks)**

OR

8 a. Convert the analog filter with system function,

$H_a(s) = \dfrac{s+0.1}{(s+0.1)^2+9}$ into a digital IIR filter by means of the impulse invariance method. **(08 Marks)**

b. Obtain the DF-I and cascade form of realization of the system function.

$$H(z) = \frac{1+\frac{1}{3}z^{-1}}{\left(1-\frac{1}{5}z^{-1}\right)\left(1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}\right)}.$$ **(08 Marks)**

Module-5

9 a. Obtain the linear phase realization of FIR filter with impulse response.

$$h(n) = \delta(n) - \frac{1}{2}\delta(n-1) + \frac{1}{4}\delta(n-2) + \frac{1}{4}\delta(n-3) - \frac{1}{2}\delta(n-4) + \delta(n-5).$$ **(06 Marks)**

b. What are the advantages and disadvantages of the window technique for designing FIR filter? **(04 Marks)**

c. A low pass filter is to be designed with the following desired frequency response:

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

Determine the filter coefficients $h_d(n)$ and h(n) if $\omega(n)$ is a rectangular window defined as.

$$\omega_R(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{Otherwise} \end{cases}.$$ **(06 Marks)**

OR

10 a. The desired frequency response of a low pass filter is given by,

$H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega}, & |\omega| < \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} < |\omega| < \pi \end{cases}$. Determine the frequency response of the FIR filter if Hamming window is used with N = 7. **(10 Marks)**

b. Realize an FIR filter with impulse response h(n) given by,

$h(n) = \left(\frac{1}{2}\right)^n [u(n) - u(n-4)]$ using direct form. **(06 Marks)**