$$w(n)\begin{cases} 0.42 - 0.5\cos\left(\frac{2\pi n}{N-1}\right) + 0.08\cos\left(\frac{4\pi n}{N-1}\right), & 0 \le n \le N-1 \\ 0 \quad \text{otherwise} \end{cases}$$

Determine the frequency response of filter. 13

11. Compute 8-point DFT of the sequence

{1, 2, 3, 4, 3, 2, 1, 0}

using DIT FFT algorithm. Show the steps with a suitable diagram. 14

OR

12. Find and draw the radix-2, 16 point DIT FFT algorithm for the following sequence :

$x(n) = u(n) - u(n-16]$ 14

Faculty of Engineering & Technology
Seventh Semester B.E. (Infor. Tech) (C.B.S.)
Examination
Elective—II : DIGITAL SIGNAL PROCESSING

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Solve Question No. **1 OR** Question No. **2**.

(3) Solve Question No. **3 OR** Question No. **4**.

(4) Solve Question No. **5 OR** Question No. **6**.

(5) Solve Question No. **7 OR** Question No. **8**.

(6) Solve Question No. **9 OR** Question No. **10**.

(7) Solve Question No. **11 OR** Question No. **12**.

(8) Due credit will be given to neatness and adequate dimensions.

(9) Assume suitable data wherever necessary.

1. (a) Impulse response of an LTI system is given by

$h(n) = (1/2)^n u(n) + (-1/2)^n u(n)$

(i) Is the system casual ? Justify

(ii) Is the system BIBO stable ? Justify

4. (a) Prove the differentiation property and the convolution property related with z-transform. 8

(b) Determine the signal x(n) whose z-transform is given by :

$$X(z) = \log (1 + az^{-1}) \quad |z| > |a|$$ 5

5. (a) Consider the signal :

$$x(n) = \{1, 0, -1, \underset{\uparrow}{2}, 3\}$$

with Fourier transform

$$X(w) = X_R(w) + j\, X_I(w).$$

Determine and sketch the signal y(n) with Fourier transform :

$$Y(w) = X_I(w) + X_R(W)\, e^{j2w}.$$ 7

(b) Given $h(n) = 1 \quad 0 \le n \le N - 1$

$= 0 \quad$ otherwise

(i) Find H(w)

(ii) For N = 5

Plot the magnitude and phase of H(w). 7

OR

6. (a) Perform circular convolution using DFT-IDFT method for

$$x_1(n) = \{2, 1, 2, 2\}$$

$$x_2(n) = \{1, 2, 3, -3\}.$$ 7

(b) Consider a complex sequence

$$x(n) = e^{jw_0 n} \quad ; 0 \le n \le N - 1$$

$$= 0 \quad ; \text{elsewhere}$$

(i) Find the Fourier transform X(w) of x(n).

(ii) Find N-point DFT, X(K) of x(n) and show that $X(K) = X(W)\Big/ W = \frac{2\pi K}{N}$. 7

7. Design a digital IIR Butterworth low pass filter using Bilinear transformation with following specifications :

(i) Pass band ripple 1.5 dB upto 4 rad/sec.

(ii) Stop band attenuation 20 dB beyond 8π rad/sec.

(iii) Sampling frequency 25 Hz.

Also draw the structure of filter which you have designed. 13

OR

8. (a) Convert the analog filter with system function

$$H_a(s) = \frac{s + 0.2}{(s + 0.2)^2 + 16}$$

into a digital IIR filter by means of impulse invariance method. 7

(iii) Find the energy in the sequence h(n).

(iv) Give difference equation realization of the system. 8

(b) Show that a Linear Time Invariant system is stable if and only if

$$\sum_{k=-\infty}^{\infty} |h(k)| < \infty$$ 5

OR

2. (a) Determine linear convolution of signals

$x_1(n) = (1/2)^n u(n)$

$x_2(n) = (1/4)^n u(n)$. 6

(b) Compute the auto correlation of the signal

$x(n) = \{1, 2, 3, 4\}$ 7

3. (a) Find the z-transform of :

(i) $x(n) = a^n u(n)$

(ii) $x(n) = a^n \cos(\omega n) u(n)$, $0 < a < 1$

Also plot its ROC. 8

(b) Find the inverse z-transform of the following :

$$X(Z) = \frac{1}{1 + 1.5z^{-1} - 0.5z^{-2}}$$ 5

OR

(b) Convert the analog filter with system function

$$H_a(s) = \frac{2}{(s+2) + (s+1)}$$

into a digital IIR filter using Bilinear transformation; assume T = 0.1 s. 6

9. Design an ideal high pass FIR digital filter with a frequency response

$H_d(e^{jw}) = 1, \pi/4 \le w \le \pi$

$= 0, |w| < \pi/4$

(i) Find the values of h(n) for N = 11

(ii) Find H(z)

(iii) Plot the magnitude response using :

(a) Hamming window

(b) Hanning window. 13

OR

10. Design a linear phase FIR filter for following specifications :

$$H_d(e^{jw}) = \begin{cases} e^{-j4w} & 0 \le |w| \le 1;\ 2 \le |w| \le \pi \\ 0 & 1 < |w| < 2 \end{cases}$$

Find the impulse response of FIR filter using blackman window given by :