

- N.B. (1) Question No. 1 is compulsory.
 (2) Attempt any four questions out of the remaining six questions.
 (3) Figure to the right indicate full marks.
 (4) Assume suitable data if necessary.

1. (a) Obtain Linear convolution by using circular convolution for — 20
 $x(n) = \{ 1, 0, 3, 2 \}$, $h(n) = \{ 4, 3, 2, 1 \}$

(b) Find wheather the following signals are Linear, Time variant :—
 (i) $y(n) = x(n^2)$ (ii) $y(n) = x^2(n)$.

(c) Find $x(n)$ if $X(Z) = \frac{1 + \frac{1}{2}Z^{-1}}{1 - \frac{1}{2}Z^{-1}}$.

(d) For the DFT of real sequence. Find boxed quantities :—
 (i) $X[K] = \{ 0, \square, 2 + j, -1, \square, j \}$
 (ii) $X[K] = \{ 1, 2, \square, \square, 0, 1 - j, -2, \square \}$

2. (a) Give the classification of Discrete Time Signal. Explain with example. 8
 (b) Find the impulse response, frequency response, magnitude response and phase response of the following system :— 12

$$y(n) - y(n-1) + \frac{3}{16}y(n-2) = x(n) - \frac{1}{2}x(n-1)$$

3. (a) If $x(n) = \{ 1, 2, 3, 4, 4, 3, 2, 1 \}$. Find $X(K)$ using DIT-FET algorithm. 10
 (b) Let $x(n) = \{ 1, 2, 3, 4 \}$ 10
 (i) Find $X(K)$ using DFT equation.
 (ii) If $x_1(n) = \{ 1, 2, 3, 4, 1, 2, 3, 4 \}$ find $X_1(K)$ using above result.

4. (a) Find initial and final value of the function :— 10

$$X(Z) = \frac{1 + Z^{-1}}{1 - 0.25Z^{-2}}$$

(b) If $X(Z) = \frac{2 + 3Z^{-1}}{(1 + Z^{-1})(1 + \frac{1}{2}Z^{-1})(1 - \frac{1}{4}Z^{-1})}$ 10

Find $x(n)$ by Partial Fraction Method.

5. (a) Obtain Direct Form-I, Direct Form-II and Cascade realization for — 10

$$H(Z) = \frac{1 + \frac{1}{4}Z^{-1} + \frac{1}{2}Z^{-2}}{1 + Z^{-1} + \frac{1}{2}Z^{-2} + \frac{1}{4}Z^{-3} + \frac{1}{2}Z^{-4}}$$

(b) Design a Butterworth filter using BLT method with following specification :— 10
 $A_p = 3 \text{ dB}$
 $W_p = 0.5 \pi$
 $A_s = 15 \text{ dB}$
 $W_s = 0.75 \pi$.

6. (a) The difference equation of the system is given by — 10

$$y(n) = 3y(n-2) + 2y(n-1) + x(n) - \frac{1}{2}x(n-1) \text{ to system to l/p } x(n) + \left(\frac{1}{2}\right)^n u(n), y(-1) = 1, y(-2) = 0$$

Find : (i) Zero l/p response
 (ii) Zero state response
 (iii) Total response.

(b) Explain Hillbert transform in detail. 10

7. (a) (i) Show that if $\sum x(n)$ is odd signal then $x(n) = 0$. 10
 (ii) Determine Energy of the signal —

$$x(n) = \left(\frac{1}{2}\right)^n \text{ for } n \geq 0$$

$$= 3^n \text{ for } n < 0$$

(b) (i) Write a note on Chirp Algorithm. 10
 (ii) Give the comparision between FIR and IIR filter