

- N.B. (1) Question No. 1 is compulsory.
 (2) Attempt any four from Question No. 2 to 7.

1. (a) Explain even and odd symmetric signals with graphical representation for $N = 5$. Express $x(n)$ in terms of its even and odd components, prove your answer for $x(n) = \{ 4, -2, 4, -6 \}$ 5
- (b) Test the following signals for linearity and time variance/invariance. 5
- (i) $y(n) = x(n) \cdot x(n)$
 - (ii) $y(n) = n x(n)$
 - (iii) $y(n) = x(2n)$
 - (iv) $y(n) = x(n - 2)$
 - (v) $y(n) = e^{x(n)} \cdot x(n)$.
- (c) By giving analysis and synthesis equations for DTFT, DFT and z-transform describe it with the help of physical interpretation. 5
- (d) Determine the z-transform $Y(z)$ for ROC $|z| > |\alpha|$ for 5
- $$y(n) = (n + 1) \alpha^n u(n)$$
- make use of suitable z-transform property.

2. (a) Determine the inverse z-transform for the following $x(z)$ by partial fraction expansion method. 10

$$x(z) = \frac{z + 2}{2z^2 - 7z + 3}$$

if ROCs are (i) $|z| > 3$ (ii) $|z| < 1/2$ and (iii) $1/2 < |z| < 3$.

- (b) Show graphically finite and infinite duration 10
- (i) Causal signal
 - (ii) Anticausal signal
 - (iii) 2-sided signal.
- in discrete time domain with their respective ROCs.

3. (a) A second order discrete time system is characterised by the difference equation 10
- $$Y(n) - 0.1y(n-1) - 0.02y(n-2) = 2x(n) - x(n-1)$$
- Determine $y(n)$ for $n \geq 0$ when $x(n) = u(n)$ and initial conditions are $y(-1) = -10$ and $y(-2) = 5$.

- (b) A system has unit sample response $h(n)$ given by 10
- $$h(n) = -\frac{1}{4} \delta(n+1) + \frac{1}{2} \delta(n) - \frac{1}{4} \delta(n-1).$$
- (i) Is the system BIBO stable ?
 - (ii) Is the filter causal ?
 - (iii) Find the frequency response.

4. (a) Explain convolution and correlation property of z-transform. Determine the cross correlation sequence $r_{x_1 x_2}(l)$ of 10

$$x_1(n) = \{ 1, 2, 3, 4 \}$$

$$x_2(n) = \{ 4, 3, 2, 1 \}.$$

- (b) For the following two sided signal determine ROC, find respective z-transform, state whether fourier transform exist, give reason. 10

$$x(n) = \left(-\frac{1}{3}\right)^n u(n) - \left(\frac{1}{2}\right)^n u(-n-1).$$

5. (a) Given $x(n) = \{ 1, 2, 3, 4, 4, 3, 2, 1 \}$, find $x(k)$ using DIT-FFT algorithm. 10
- (b) Given $x(n) = 2^n$ and $N = 8$ find $x(k)$ using DIF-FFT algorithm. 10

6. (a) Show cascade and parallel realization for

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$$H(z) = \frac{1 - \frac{1}{2} z^{-1}}{1 - z^{-1} + \frac{3}{16} z^{-2}}$$

- (b) Identify the following filter based on its pass band by sketching its frequency response.
 $h(n) = \{ 1, -1/2 \}$.

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7. Attempt any **four** of the following :—

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- (a) System classification
- (b) DSP processors
- (c) Linear phase system

- (d) Minimum phase system
 - (e) Comparison between IIR and FIR system.
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