

(3 Hours)

[Total Marks: 80]

N.B. :

- 1) Question No.1 is compulsory.
- 2) Attempt any three from remaining questions.
- 3) Figures to right indicate full marks.
- 4) Assume suitable data if necessary.

Q1 Solve any **Five** Questions.

20

- (a) Define periodic and non periodic signals and check the periodicity of signal

5

$x(n) = \left(\sin \frac{2\pi n}{3} + \cos \frac{2\pi n}{5} \right)$. Find its fundamental period if the signal is periodic.

- (b) Check whether the system $y(n) = a^n x(n)$ is static/dynamic, linear/nonlinear and Time variant/ Time Invariant.

5

- (c) The transfer function of LTI system is $H(Z) = \frac{z-1}{(z-2)(z+3)}$ Determine the impulse response.

5

- (d) Find the 4-point DFT of $x(n) = \{1, -2, 3, 2\}$ using matrix method.

5

- (e) Compare analog and digital filters and state requirement of digital filter to be stable and causal.

- (f) Determine whether the system $H(Z) = \frac{1+2z^{-1}}{1+\frac{6}{5}z^{-1}+\frac{9}{25}z^{-2}}$ is both Causal and Stable.

5

Q 2(a) Sketch the signal $x(n) = 2u(n+2) - 2u(n-3)$

5

- (b) Find even and odd components of signal $x(n) = \{5, 4, 3, 2, 1\}$

5

- (c) Find Z-transform of following signals.

10

i. $x(n) = 2^n u(n-2)$

ii. $x(n) = \left(\frac{1}{2}\right)^n u(n) * \left(\frac{1}{4}\right)^n u(n)$

- 3.(a) If DFT of $\{x(n)\} = X(k) = \{4, -j2, 0, j2\}$, using properties of DFT, find

10

i. DFT $x(n-2)$

ii. DFT $x(-n)$

iii. DFT $x^*(n)$

iv. DFT $x^2(n)$

v. DFT $x(n) * x(n)$

- (b) Find the inverse Z-transform of $X(Z) = \frac{3z^{-1}}{(1-z^{-1})(1-2z^{-1})}$ if 10
- ROC $|Z| > 2$
 - ROC $|Z| < 1$
 - ROC $1 < |Z| < 2$
- 4.(a) Find the 8-point DFT by radix-2, DIT FFT algorithm. 10
 $x(n) = \{2, 1, 2, 1, 2, 1, 2, 1\}$
- (b) Determine the response of LTI system governed by the equation, 10
 $y(n) - 0.5y(n-1) = x(n)$ for the input $x(n) = 5^n u(n)$, and initial condition $y(-1) = 2$.
- 5.(a) A low pass filter is to be designed with the following desired frequency response: 10

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

Determine the filter coefficients $h(n)$ if the window function is defined as:

$$w(n) = \begin{cases} 1, & 0 \leq n \leq 4 \\ 0, & \text{otherwise} \end{cases}$$

- (b) A linear shift invariant system is described by the difference equation 10
 $y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + x(n-1)$ with $y(-1) = 0$ and $y(-2) = -1$. Find the natural response of the system.
- 6.(a) Find DTFT of sequence $x(n) = n \left(\frac{1}{2}\right)^n u(n)$ 5
- (b) Find the energy of signal $x(n) = \left(\frac{1}{2}\right)^n n \geq 0$ 5
 $= (3)^n n < 0$
- (c) Discuss the method of Bilinear transformation for Design of IIR filter. 10