(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 $x(n) = \left(\sin\frac{2\pi n}{3} + \cos\frac{2\pi n}{5}\right)$. Find its fundamental period if the signal is periodic.	5
(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 $x(n) = 2u(t+2) - 2u(t-3)$	5
(b)	Find even and odd components of signal $x(n) = \{5, 4, 3, 2, 1\}$	5
(c)	Find Z-transform of following signals. i. $x(n) = 2^n u(n-2)$ ii. $x(n) = \left(\frac{1}{2}\right)^n u(n) * \left(\frac{1}{4}\right)^n u(n)$	10
3.(a)	If DFT of $\{x(n)\} = X(k) = \{4, -j2, 0, j2\}$, using properties of DFT, find i. DFT x(n-2) ii. DFT x(-n) iii. DFT $x^*(n)$ iv. DFT $x^2(n)$ v. DFT x(n) * x(n)	10

(b) Find the inverse Z-transform of $X(Z) = \frac{3z^{-1}}{(1-z^{-1})(1-2z^{-1})}$ *if* 10

$a. ROC\ |Z| > 2$
$b. ROC\ |Z| < 1$
c. $ROC\ 1 < |Z| < 2$

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

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

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

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

(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 $x(n) = \left(\frac{1}{2}\right)^n \quad n \ge 0$
$= (3)^n \quad n < 0$ 5

(c) Discuss the method of Bilinear transformation for Design of IIR filter. 10