Time (3 Hours) **Marks: 80**

Note: (1) Question no. 1 compulsory
(2) Attempt any 3 question out of remaining five questions.
(3) Draw neat diagram wherever necessary.

Q 1. Attempt any Four out of Six questions (5 marks each) **(20)**

a. Check whether the given system y(n) = | x(n) | is linear/non-linear, time variant/time invariant, static/dynamic, stable/unstable, causal/non causal systems.
b. Explain Sampling theorem in detail.
c. Discuss Rectangular, Hamming windows used to design FIR filters.
d. Find the 4-point DFT of the sequence x(n)= {1 , -2 , 3 , 2}.
e. Explain ROC and its properties.
f. Explain minimum phase, maximum phase and mixed phase systems with examples.

Q 2. a. Obtain the Z-transform of **(10)**
(1) x(n) = n(n+1) u(n)
(2) x(n) = u(-n).

b. Determine the periodicity of the following **(10)**
(1) x(t) = 2 cos 3t + 3 sin 7t
(2) x(t) = 5 cos 4πt + 3 sin 8πt

Q3. a. A LTI is described by the equation 2y(n) + 3y(n-1) + y(n-2) = u(n) + u(n-1) – u(n-2). Find response of the system when the initial conditions are given by y(-1) = 2 and y(-2) = -1 and when unit step is applied as the input. **(10)**

b. Design a digital low pass FIR filter for a following specification **(10)**

$$H_d(\omega) = \begin{cases} e^{-j\omega\tau} & \text{for } \omega \le \omega_C \\ 0 & \text{otherwise} \end{cases}$$

Using rectangular window of length =7 & Wc=1rad/sample.

Q4. a. Determine inverse Z-transform of $X(z) = \frac{1}{1-1.5z^{-1}+0.5z^{-2}}$ **(10)**
for ROC (1) | z | > 1 (2) | z | < 0.5 (3) 0.5 < | z | < 1

b. Discuss the method of Bilinear transformation for design of IIR filter. **(10)**

Q5. a. Explain any five properties of DFT (**10**)

b. Compute DFT for the sequence x(n) = {0.5,0.5,0.5,0.5,0,0,0,0) using radix -2 DIT-FFT algorithm. (**10**)

Q6. a) An LTI system is described by the equation: (**10**)

$Y(n) = x(n) + 0.8\, x(n-1) + 0.8\, x(n-2) - 0.49\, y(n-2)$

Determine the transfer function of the system, sketch poles and zeroes on the z-plane.

b) Find y(n) by using convolution if x(n) = [1,3,5,3] and h(n) = [2,3,1,1]. (**10**)
