

**ISTANBUL TECHNICAL UNIVERSITY**  
**COMPUTER ENGINEERING DEPARTMENT**

**BLG 354E**  
**SIGNALS AND SYSTEMS**  
**FOR COMPUTER ENGINEERING**  
**ASSIGNMENT 1**

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**STUDENT:**

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## Question 1

### a) Impulse Response

$$y = 2\left(x - \frac{1}{2}z^{-1}y\right) - \frac{1}{2}z^{-1}y$$

$$y = 2x - \frac{3}{2}z^{-1}y$$

$$\left(1 + \frac{3}{2}z^{-1}\right)y = 2x$$

$$y = \frac{2x}{1 + \frac{3}{2}z^{-1}}$$

$$T(z) = \frac{Y(z)}{X(z)} = \frac{2}{1 + \frac{3}{2}z^{-1}}$$

$$x[n] = \delta[n] = \{1\} \Rightarrow X(z) = 1$$

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

$$y(k) = Z^{-1} \left\{ \frac{2}{1 + \frac{3}{2}z^{-1}} \right\}$$

$$y(k) = 2 \left( -\frac{3}{2} \right)^k u(k)$$

### b) Output as a Difference Equation

$$y[n] = 2\left(x[n] - \frac{1}{2}y[n-1]\right) - \frac{1}{2}y[n-1]$$

$$y[n] = 2x[n] - \frac{3}{2}y[n-1]$$

$$y[n] + \frac{3}{2}y[n-1] = 2x[n]$$

### c) System Output for Given $x[n]$

$$x[n] = (n-1)(u(n-1) - u(n-4) - \delta(n))$$

$$x[n] = \{1, 0, 1, 2\}$$

n	x[n]	y[n-1]	y[n]
0	1	0	2
1	0	2	-3
2	1	-3	6.5
3	2	6.5	-5.75
4	0	-5.75	8.625
5	0	8.625	-12.9375

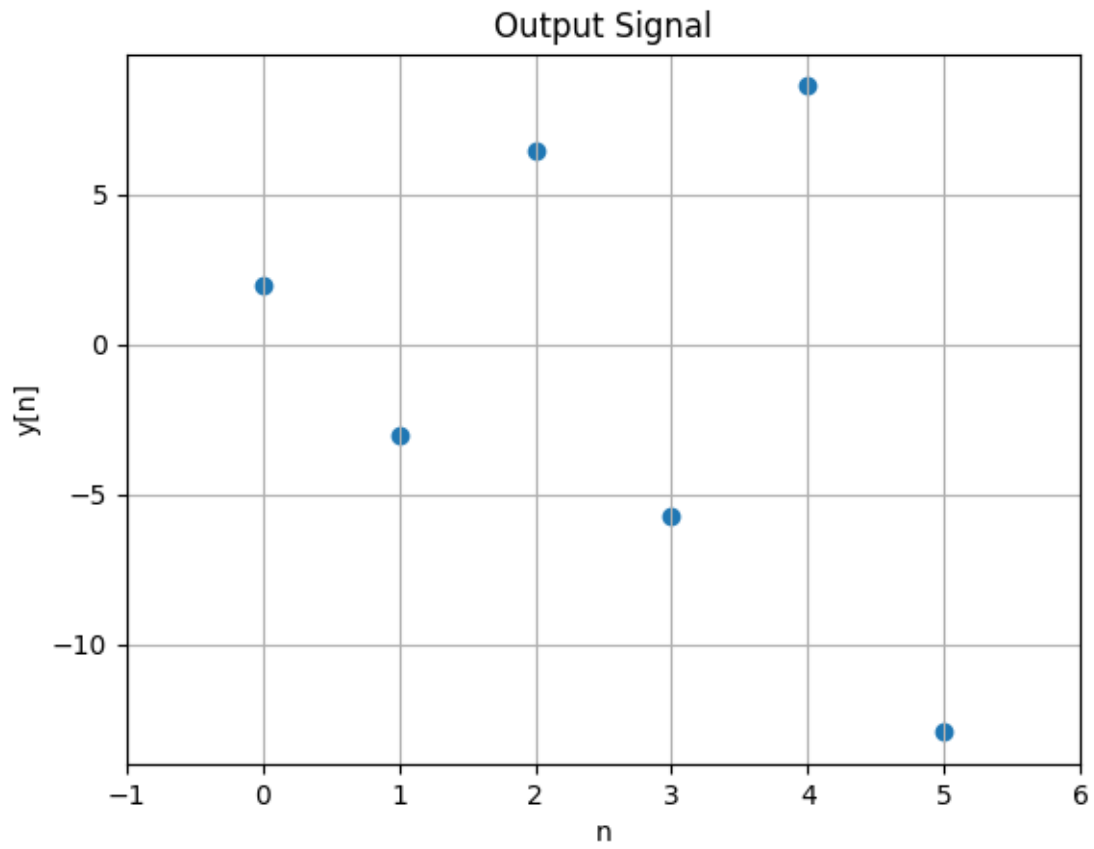


Figure 1: Plot of output signal

#### d) Finding The Transfer Function

Transfer Function  $T(z)$  was found in part a) as:

$$T(z) = \frac{Y(z)}{X(z)} = \frac{2}{1 + \frac{3}{2}z^{-1}}$$