

SOLUTIONS TO DSP TEST 1

2020

$$1(a) \quad y[n] = 2x[n] - 3x[n-1] + x[n-3]$$

$$(b) \quad x[0] = 1 \quad x[1] = 0.5 \quad x[2] = 0$$

$$(i) \quad x[3] = -0.5$$

$n =$	0	1	2	3	4	5	6
$x[n] =$	1	0.5	0	-0.5	0	0	0
$h[n] =$	2	-3	0	1	0	0	0

$1 \cdot h[n] =$	2	-3	0	1	0	0	0
$0.5 \cdot h[n-1] =$	0	1	-1.5	0	0.5	0	0
$-0.5 \cdot h[n-3] =$	0	0	0	-1	1.5	0	-0.5

$$y[n] = 2 \quad -2 \quad -1.5 \quad 0 \quad 2 \quad 0 \quad -0.5$$

$$(ii) \quad \begin{aligned} y[0] &= 2 \cdot (1) - 3(0) + 0 = 2 \\ y[1] &= 2 \cdot (0.5) - 3(1) + 0 = -2 \\ y[2] &= 2 \cdot (0) - 3(0.5) + 0 = -1.5 \\ y[3] &= 2 \cdot (-0.5) - 3(0) + 1 = 0 \\ y[4] &= 2 \cdot (0) - 3(-0.5) + 0.5 = 2 \\ y[5] &= 2 \cdot (0) - 3(0) + 0 = 0 \\ y[6] &= 2 \cdot (0) - 3(0) + (-0.5) = -0.5 \end{aligned}$$

$$\begin{aligned}
 (c) \quad h_1[0] &= 1 & h_2[0] &= 1 \\
 h_1[1] &= 0 & h_2[1] &= 0.741 \\
 h_1[2] &= -0.2 & h_2[2] &= 0.549
 \end{aligned}$$

TOTAL

$$h[0] = 2$$

$$h[1] = 0.741$$

$$h[2] = 0.349$$

2.

$$y[n] - 0.5y[n-1] = -0.5x[n] + x[n-1]$$

$$Y(\omega) [1 - 0.5e^{-j\omega}] = X(\omega) [-0.5 + e^{-j\omega}]$$

$$H(\omega) = \frac{Y(\omega)}{X(\omega)} = \frac{-0.5 + e^{-j\omega}}{1 - 0.5e^{-j\omega}}$$

$$H(\omega) = \frac{Y(\omega)}{X(\omega)} = \frac{-0.5 + e^{-j\omega}}{1 - 0.5e^{-j\omega}}$$

$$\frac{(-0.5 \angle 0) + (1 \angle -\omega)}{(1 \angle 0) - (0.5 \angle -\omega)}$$

$$\text{FOR } \omega = 1.2\pi$$

$$\text{MAGNITUDE} = 1$$

$$\text{PHASE } \angle = 2.926 \text{ RADS}$$

$$\text{FOR } \omega = \frac{\pi}{2}$$

$$\text{MAGNITUDE} = 1$$

$$\text{PHASE } \angle = -2.498 \text{ RADS}$$

2. THE MAGNITUDE IS
UNITY FOR BOTH
EXAMPLES

STEADY STATE RESPONSE

$$y[n] - 0.5y[n-1] = -0.5x[n] + x[n-1]$$

$$s[n] - 0.5s[n-1] = -0.5u[n] + u[n-1]$$

$$y_{ss} - 0.5y_{ss} = -0.5 + 1$$

$$y_{ss} = \frac{-0.5 + 1}{1 - 0.5} = \frac{0.5}{0.5} = 1$$