EE 3054 · Quiz 1 · FALL 2008

1) Make a sketch of each of the following discrete-time signals

a) $x(n) = 2\delta(n) - \delta(n-3) + 3\delta(n+2)$

b) $x(n) = 2\cos\left(\frac{\pi}{4}n\right)u(n)$

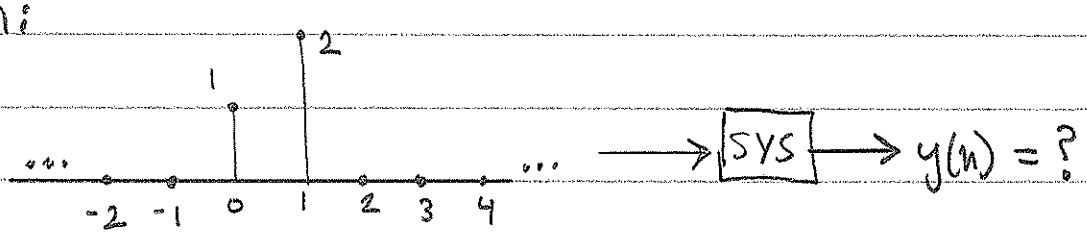
c) $x(n) = \sum_{k=0}^{\infty} (-1)^k \delta(n-5k)$

2) A discrete-time system is described by

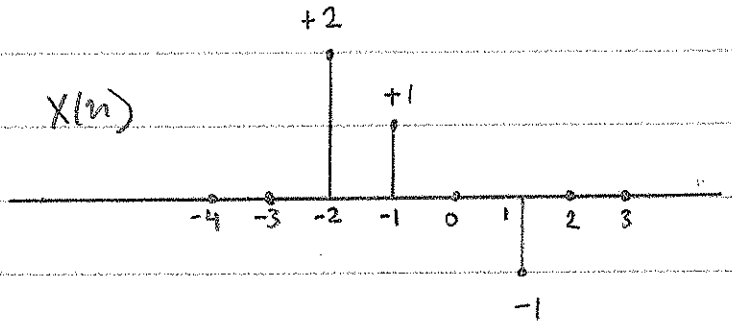
$$y(n) = x(n) + [x(n+1)]^2$$

$y(n)$ represents the output signal.
$x(n)$ " " input ".

a) find the output signal produced by the input shown:



b) Is the system : linear or nonlinear?
c) " " time invariant or time-varying?
d) " " causal or non-causal?

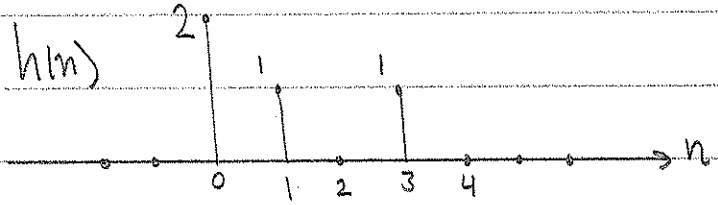
3) 

a) sketch the signal $f(n)$ defined $F(z) = z^{-3} X(z)$

b) " " $g(n)$ " $G(z) = X(1/z)$

c) " " $v(n)$ " $V(z) = X(-z)$

4) If the impulse response of an LTI system is



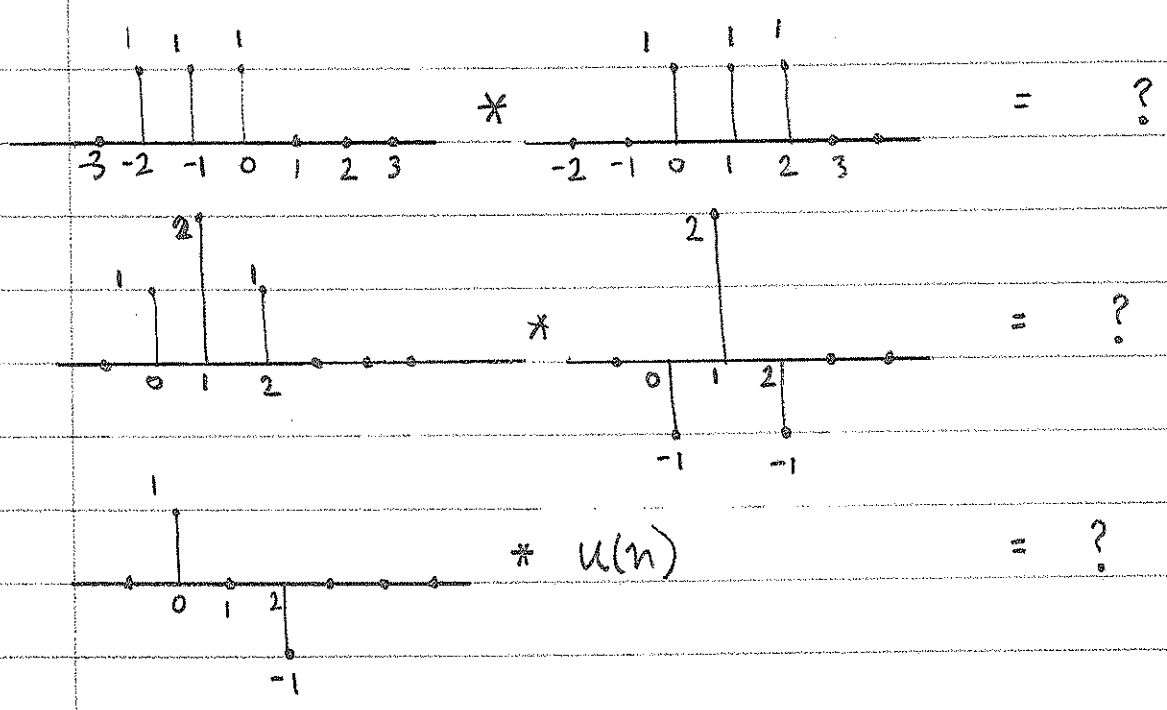
then a) find the transfer function $H(z)$.
b) find a difference equation that implements the system.

5) If the difference equation of an CAUSAL LTI system is

$$y(n) = 2x(n) + x(n-2) - 0.2y(n-1)$$

a) what is the transfer function of the system?
b) sketch the pole/zero diagram of the system.
c) What is the dc gain of the system?
d) What output $y(n)$ is produced by the input $x(n) = 2$.
(sketch the input & out signals.)

⑥ Sketch the convolution of the signals



7) If an LTI system has impulse response

$$h(n) = \left(\frac{1}{3}\right)^n u(n)$$

then a) Find the difference equation to implement the system.

b) find the output signal when the input signal is

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

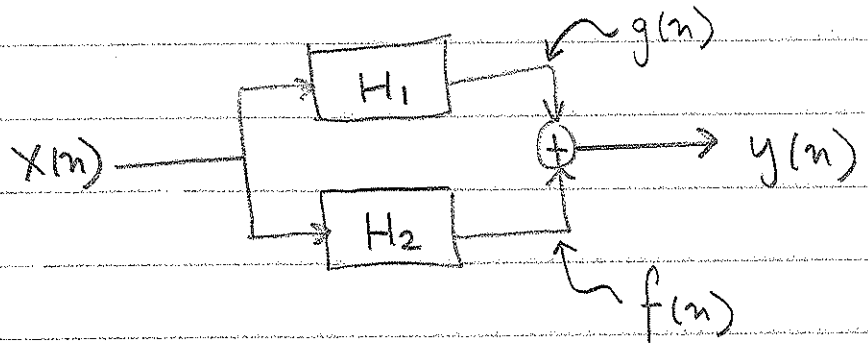
(find an explicit formula for output $y(n)$.)

8) An LTI system has the impulse response

$$h(n) = 5\left(\tfrac{2}{3}\right)^n \cos\left(\tfrac{\pi}{6} n\right) u(n)$$

What are the poles of the system?

9) Two LTI systems are connected



System H_1 is described by the difference equation

$$g(n) = X(n) + \tfrac{1}{2} g(n-1).$$

System H_2 is described by the difference equation

$$f(n) = X(n) + \tfrac{1}{3} f(n-1).$$

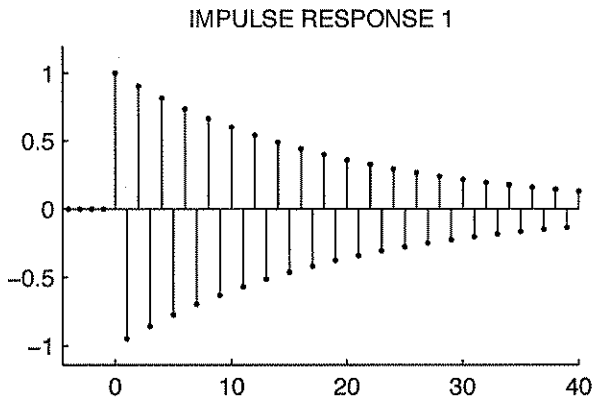
Find the difference equation for the total system

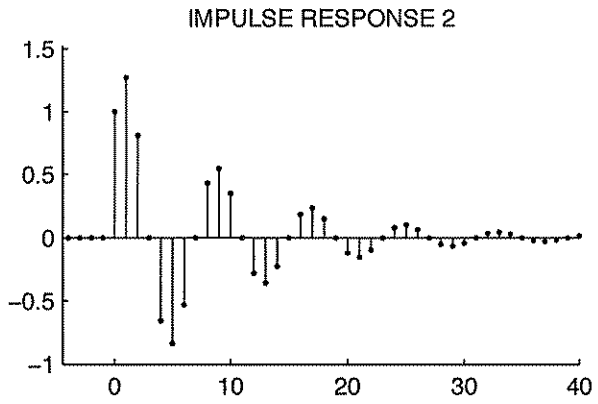
$$y(n) = \sim ? \sim$$

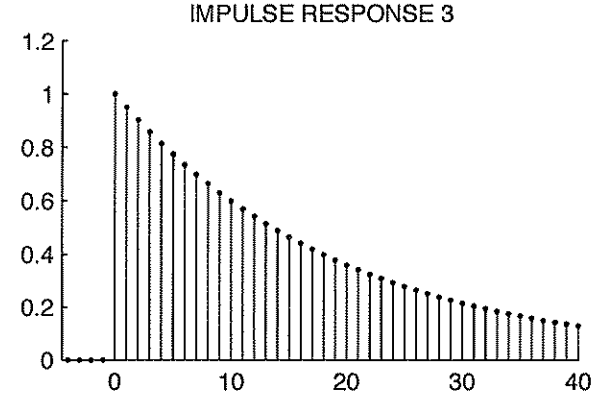
RHS should use X( ) & y( ).

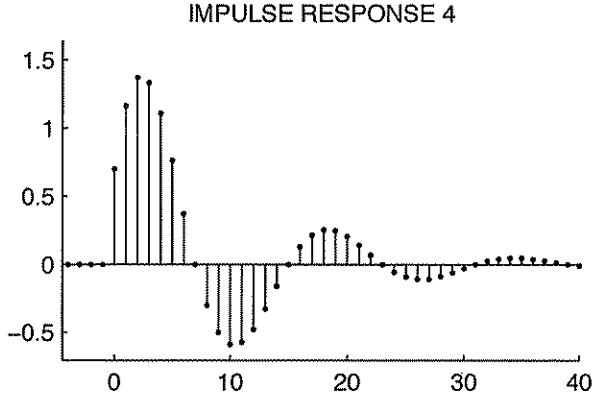
10. Match the pole/zero diagram, impulse response, & frequency response of each LTI system by completing the table. (copy the table onto your answer sheet.)

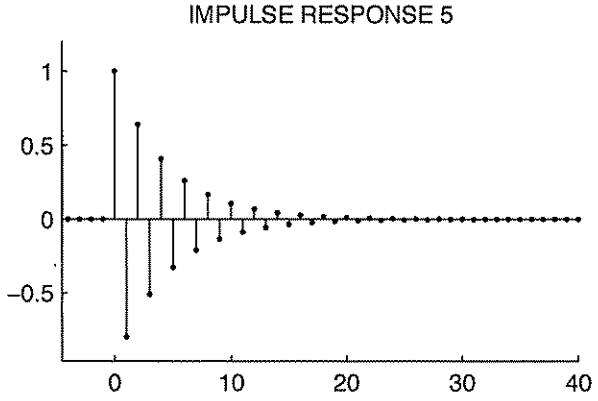
	$h(n)$	$H(\omega)$	p/z diagram
1			
2			
3			
4			
5			
6			
7			
8			

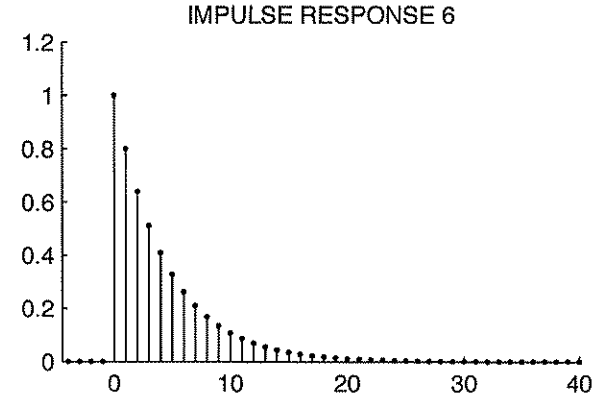

IMPULSE RESPONSE 1
1
0.5
0
−0.5
−1
0
10
20
30
40

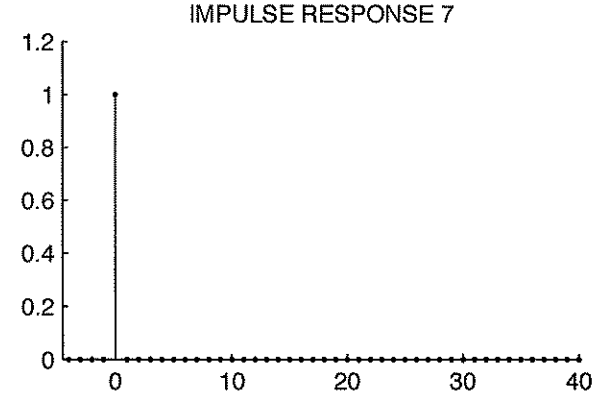

IMPULSE RESPONSE 2
1.5
1
0.5
0
−0.5
−1
0
10
20
30
40

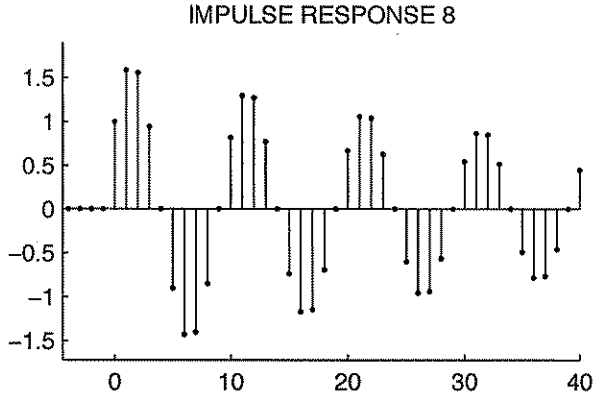

IMPULSE RESPONSE 3
1.2
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40

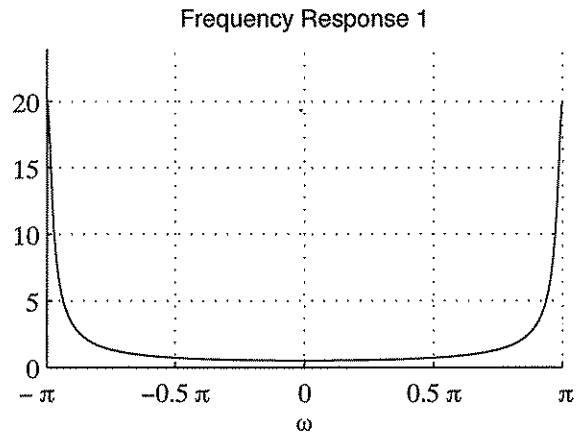

IMPULSE RESPONSE 4
1.5
1
0.5
0
−0.5
0
10
20
30
40

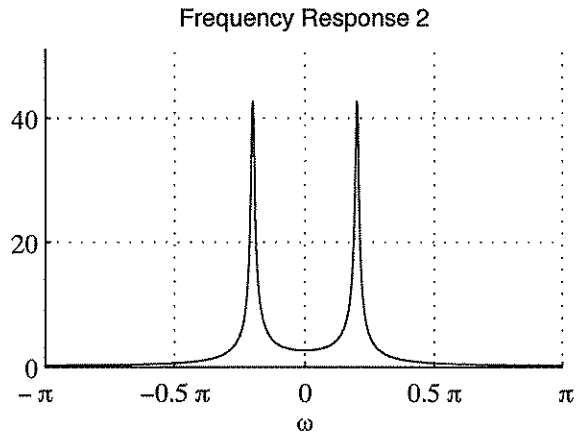

IMPULSE RESPONSE 5
1
0.5
0
−0.5
0
10
20
30
40

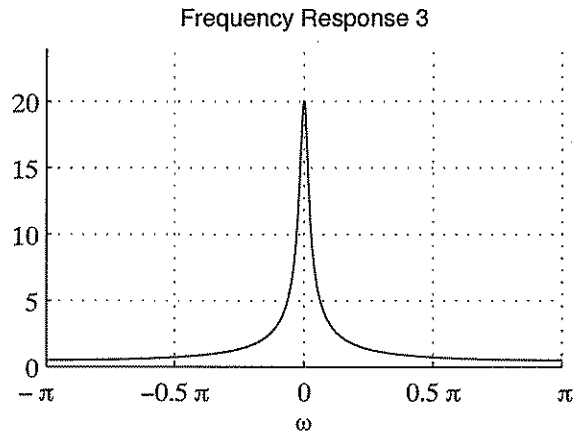

IMPULSE RESPONSE 6
1.2
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40

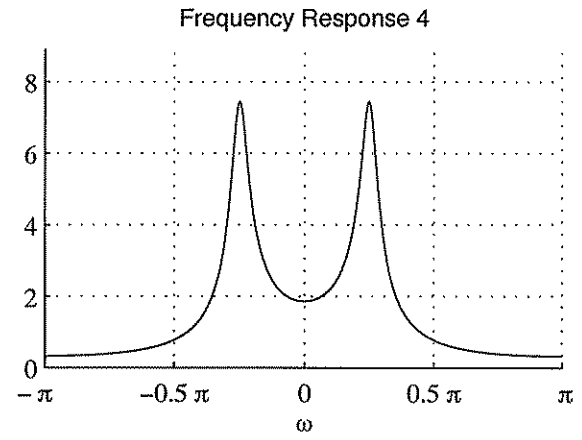

IMPULSE RESPONSE 7
1.2
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40

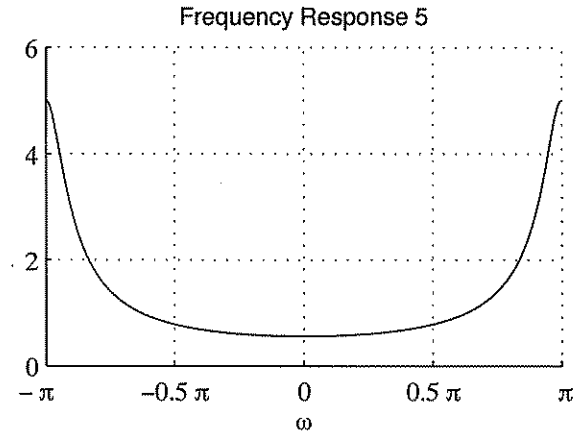

IMPULSE RESPONSE 8
1.5
1
0.5
0
−0.5
−1
−1.5
0
10
20
30
40

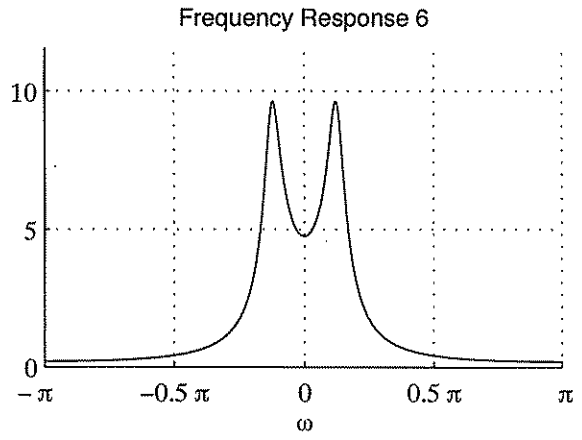

Frequency Response 1
20
15
10
5
0
− π
−0.5 π
0
0.5 π
π
ω

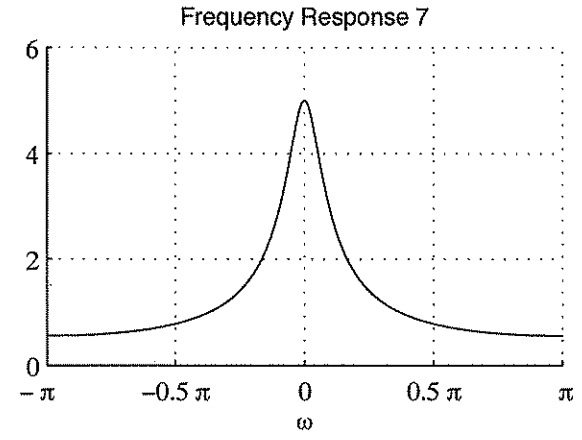

Frequency Response 2
40
20
0
− π
−0.5 π
0
0.5 π
π
ω

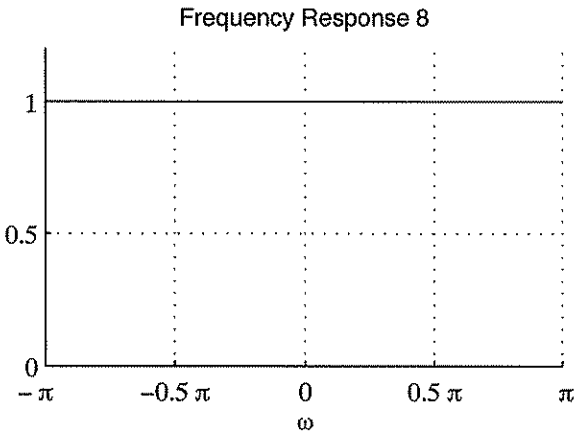

Frequency Response 3
20
15
10
5
0
− π
−0.5 π
0
0.5 π
π
ω


Frequency Response 4
8
6
4
2
0
− π
−0.5 π
0
0.5 π
π
ω

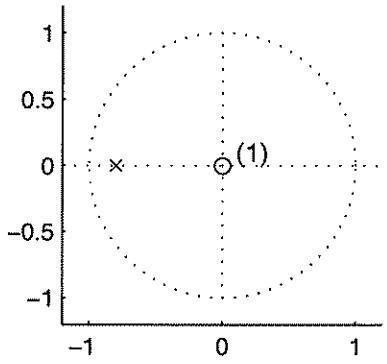

Frequency Response 5
6
4
2
0
− π
−0.5 π
0
0.5 π
π
ω


Frequency Response 6
10
5
0
− π
−0.5 π
0
0.5 π
π
ω

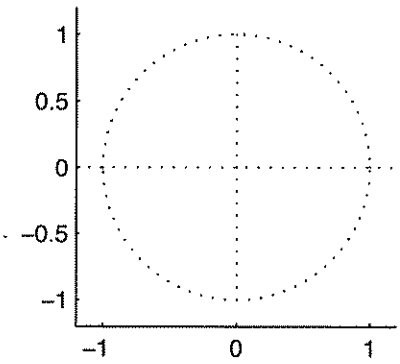

Frequency Response 7
6
4
2
0
− π
−0.5 π
0
0.5 π
π
ω


Frequency Response 8
1
0.5
0
− π
−0.5 π
0
0.5 π
π
ω

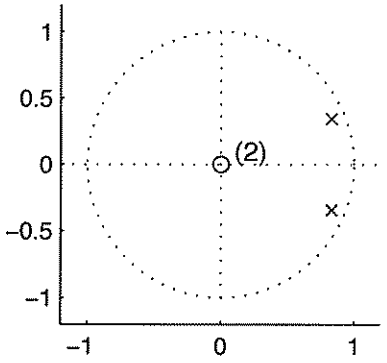
ZERO–POLE DIAGRAM 1



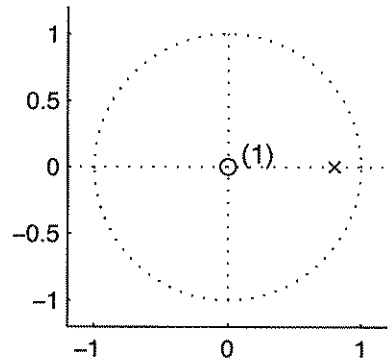
ZERO–POLE DIAGRAM 2



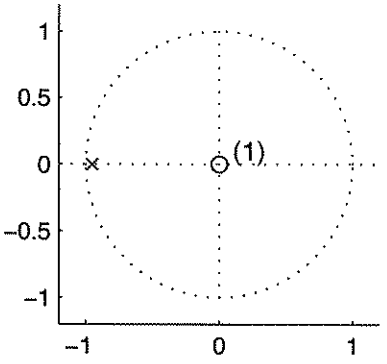
ZERO–POLE DIAGRAM 3



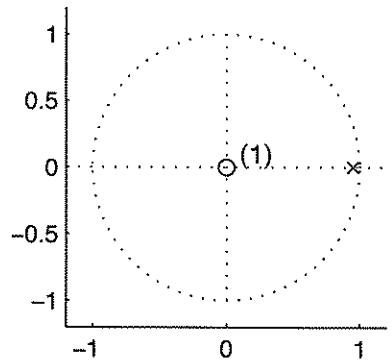
ZERO–POLE DIAGRAM 4



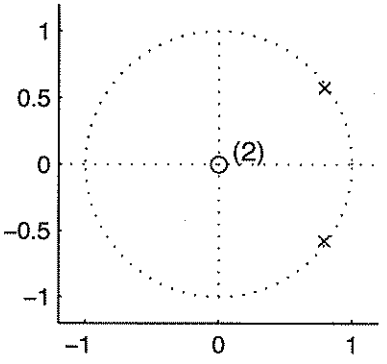
ZERO–POLE DIAGRAM 5



ZERO–POLE DIAGRAM 6



ZERO–POLE DIAGRAM 7



ZERO–POLE DIAGRAM 8