HW1 Junsheng Huang NETID: jh103

[1] (a) $2\cdot e^{\frac{\pi}{3}j} + e^{-\frac{\pi}{2}j}$ $r = \sqrt{1+(\sqrt{3}-1)^2} = \sqrt{5-2\sqrt{3}} \approx 1.24$

$= 1+\sqrt{3}j - j$ polar form: $\sqrt{5-2\sqrt{3}}\, e^{j\theta}$, $\arctan\theta = \frac{1}{\sqrt{3}-1} = \frac{\sqrt{3}+1}{2}$, $\theta = 36.21°$

$= 1+(\sqrt{3}-1)j$

(b) $\frac{1+j}{1-2j} = \frac{(1+j)(1+2j)}{(1-2j)(1+2j)} = \frac{-1+3j}{5}$

$r = \sqrt{(\frac{1}{5})^2+(\frac{3}{5})^2} = \frac{\sqrt{10}}{5}$ $\theta = \arctan(\frac{3}{-1})$

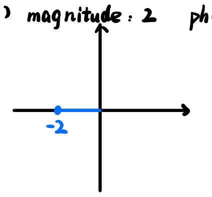
polar form: $\frac{\sqrt{10}}{5}e^{j\theta}$, $\theta = -71.56°$

[2] $16z^3+2=0$, $z^3 = -\frac{1}{8}$

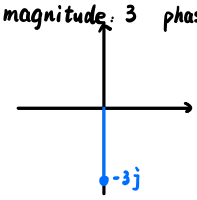
$z_1 = -0.5$ $z_2 = 0.25+0.433j$ $z_3 = 0.25-0.433j$

$= \frac{1}{4}+\frac{\sqrt{3}}{4}j$ $= \frac{1}{4}-\frac{\sqrt{3}}{4}j$

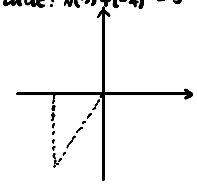
[3] (a) magnitude: 2 phase: π



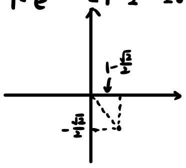
(b) magnitude: 3 phase: $\frac{3}{2}\pi$



(c) magnitude: $\sqrt{(-3)^2+(-4)^2} = 5$ phase: 4.067



(d) $1-e^{-\frac{\pi}{4}j} = 1-\frac{\sqrt{2}}{2}-\frac{\sqrt{2}}{2}j$

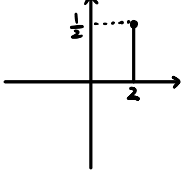


magnitude: 0.765

phase: -1.178

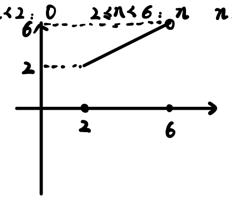
[4]. (a) $\sin^2(\frac{\pi}{8}n)\delta[n-2]$

$= \frac{1}{2}[1-\cos(\frac{\pi}{4}n)]\delta[n-2]$

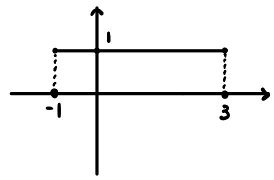


(b) $n(u[n-2]-u[n-6])$

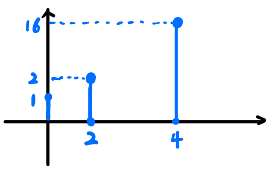
$n<2$: 0 $2\le n<6$: n $n\ge 6$: 0



(c) $u[-n+3] = \begin{cases} 0 & n>3 \\ 1 & n\le 3 \end{cases}$ $u[n+1] = \begin{cases} 0 & n<-1 \\ 1 & n\ge -1 \end{cases}$



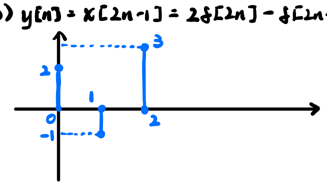
(d) $2^n \sum_{k=0}^{2}\delta[n-2k] = 2^n(\delta[n]+\delta[n-2]+\delta[n-4])$



[5] (a) $x[n] = \{\cdots 0, 2, \underset{\uparrow}{0}, -1, 1, 3, 0, \cdots\}$

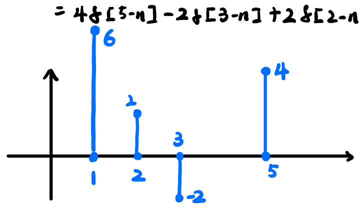
$= 2\delta[n+1]-\delta[n-1]+\delta[n-2]+3\delta[n-3]$

(b) $y[n] = x[2n-1] = 2\delta[2n]-\delta[2n-2]+\delta[2n-3]+3\delta[2n-4]$



(c) $v[n] = 2x[4-n]$

$= 4\delta[5-n]-2\delta[3-n]+2\delta[2-n]+6\delta[1-n]$



[6] (a) $y[n] = 3x[n]-x[n-1]$

Linear: let $z[n] = ax_1[n]+bx_2[n]$

$T(ax_1[n]+bx_2[n]) = 3z[n]-z[n-1]$

$= aT(x_1[n])+bT(x_2[n])$

the system is linear

time-invirant: $y[n-n_0] = 3x[n-n_0]-x[n-n_0-1]$

the system is time-invirant

causal: output not depend on future value

⇒ the system is linear, time-invirant and causal

(b) $y[n] = x[n+2]+2$

linear, $z[n] = ax_1[n]+bx_2[n]$

$T(z[n]) = z[n+2]+2$

$= ax_1[n]+bx_2[n]+2$

$\ne ax_1[n]+2a+bx_2[n]+2b$

not linear

time-invirant: $y[n-n_0] = x[n-n_0+2]+2$ ✓

causal: depend on future value $x[n+2]$ ✗

the system is not linear, time-invirant, not causal.

(c) $y[n] = (n+1)x[n-1]$

linear, $z[n] = ax_1[n]+bx_2[n]$

$T(z[n]) = (n+1)z[n-1]$

$= (n+1)[ax_1[n]+bx_2[n]]$

$= a(n+1)x_1[n]+b(n+1)x_2[n]$

$= aT(x_1[n])+bT(x_2[n])$ ✓

time-invirant: $y[n-n_0] = (n-n_0+1)x[n-n_0-1]$ ✗

causal: not depend on future value ✓

the system is linear, not time-invirant, causal.

(d) $y[n] = |x[n^4]|$

linear: $z[n] = a x_1[n] + b x_2[n]$

$|z[n^4]| = |a x_1[n^4] + b x_2[n^4]|$

$\neq |a x_1[n^4]| + |b x_2[n^4]|$ X

time-invirant: $y[n-n_0] = |x[(n-n_0)^4]|$ X

causal: let $n=2$, $y[2] = |x[16]|$

depending on future value X

the system is not linear, not time-inviriant, not causal.