Roy Kalv DSP Quiz #1

1. (a) $V(t) = 2.5\cos(2\pi ft - \pi/4)$

$V(t) = 2.5\cos(\varphi)$

$V(t) = 2.5\,R\{e^{j\varphi}\}$

$\boxed{V(t) = R\{2.5e^{j\varphi}\}}$

(b) $\sin(x) = \Im(e^{jx})$

$\cos(x) = \sin(x + \pi/2)$

$V(t) = 2.5\sin(\varphi + \pi/2)$

$= \sin(x) = \Im(e^{jx})$

$V(t) = 2.5\,\Im(e^{j(\varphi + \pi/2)})$

$\boxed{V(t) = \Im(2.5e^{j(\varphi - \pi/2)})}$

2. $T = \frac{1}{f}$

$= \frac{1}{1000} = 0.001$ secs

$\boxed{= 0.001 \text{ seconds}}$

(b) $5ns = 5 \cdot 10^{-9}$ secs

$$\frac{1}{5 \cdot 10^{-9}}$$

$\boxed{= 200\,MHz}$

(c) $\frac{1}{5000} = 0.0002$ sec $= 200\,\mu s$

$\frac{1}{50000} = 20\,\mu s$

Samples per Period $= \frac{200}{20} = \boxed{10 \text{ samples per period}}$

(d) $\frac{1}{2 \cdot 10^{-6}} = 500\ Hz$

$f = 5\ kHz$

$\frac{200\ \mu s}{2\ \mu s} = 100$

There are 100 samples per period

3. $\Delta V = \frac{V\ range}{Num\ of\ steps}$

$= \frac{2.56}{256}$

$= 0.01\ V$

(b) $\log_2(256) = ?$

$n = 8$

(c) $8 + 1 = 9$ bits

$2^9 = 512$

$\Delta v = \frac{2.56\ V}{512} = 0.005\ V$

If we double the number of bits, the new

$\Delta V = 0.005\ V$

Ray Wan - DSP Quiz # 2

(d.) Sampled freq = |(array) signal - N · f_s |

= |20 kHz - 10 kHz |

[= 10 kHz, is the sampled frequency]

5. (a) $|jwT| = 2\pi f \cdot RC$

$|1 + jwT| = 1 + j \cdot 2\pi f \cdot RC$

$|R(f)| = \frac{wT}{\sqrt{1+(wT)^2}}$

$= \frac{2\pi fRC}{\sqrt{1+(2\pi fRC)^2}}$

(b) Phase Shift = $\pi/2$

$\phi(f) = \pi/2 - \arctan(wT)$

$= \pi/2 - \arctan(2\pi fRC)$

(d) $\tau = 1000\,\Omega \cdot 1 \cdot 10^{-6} F$

$= 1 \cdot 10^{-3} s$

$w = 2\pi \cdot 500$

$= 3141.59$

$|R(f)| = \frac{3141.59 \cdot (1 \cdot 10^{-3})}{\sqrt{1 + (3141.59 \cdot (1 \cdot 10^{-3}))}}$

≈ 0.949

6. (a) $f_{signal} = 2.5\,kHz$ $\quad \frac{10}{2} = 5 > 2.5$

$f_s = 10\,kHz$

Since f_s is more than twice the signal frequency, it will not alias. The sampled frequency is 2.5 kHz.

(b) $f_{signal} = 5\,kHz$ $\quad \frac{10}{2} = 5 = 5$

$f_s = 10\,kHz$

The signal will fold and the sampled frequency is 0 Hz

(c) $\frac{10}{2} = 5 < 7$

sampled $= |7 - 1 \cdot 10| = 3\,khz$

sampled freq = 3 kHz