EC516 HW9

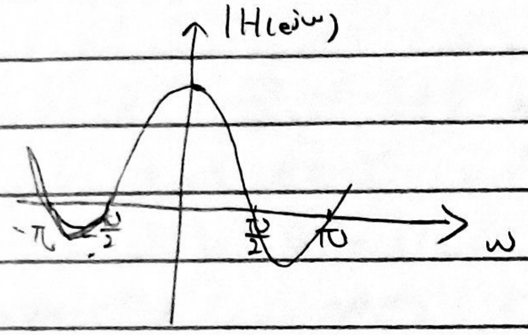
1

$x[n] = u[n] - u[n-4]$

a) Since $x[n]$ is a very typical length 3 box, so as we know

$$X(e^{jw}) = \sum_{n=-\infty}^{\infty} x[n] e^{-jwn}$$

$$= \frac{\sin(2w)}{\sin(\frac{w}{2})}$$



b) For $X[k]$ to be zero, $X(e^{jw})$ has to be zero

$X(e^{jw}) = 0$ whenever $\sin(2w) = 0$

$w = m\pi$ when it is this way

$$w_k = \frac{2\pi k}{N} = m\pi$$

$$k = \frac{mN}{2}$$ and since $0 \le k < N$ and $N = 4$

So $k = 0, 2$

c) similar to previous question but with $N = 8$

So $k = 0, 2, 4, 6$.

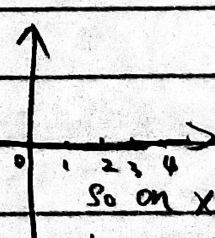
d) $y[n] = (-1)^n x[n]$

$$Y[k] = \sum_{n=0}^{3} y[n] e^{-j\frac{2\pi}{4}kn} = \sum_{n=0}^{3} (-1)^n e^{-j\frac{\pi}{2}kn}$$

$Y[0] = \sum_{n=0}^{3} (-1)^n = 0$ $\quad Y[1] = \sum_{n=0}^{3} (-1)^n e^{-j\frac{\pi}{2}n} = 0$

$Y[2] = \sum_{n=0}^{3} (-1)^n e^{-j\pi n} = 0$ $\quad Y[3] = 0$

so $Y[k] = 0$ and so $y[n] = 0$



So on x-axis 4 zero point.

9.2

a) $w_k = \frac{2\pi k}{256}$ $k = 0, 1, \dots, 255$

$Q[k_0]^{256} = Q(e^{-\frac{j\pi}{2}})$ $w_{k_0} = -\frac{\pi}{2}$ in DTFT

$\frac{2\pi k}{256} = -\frac{\pi}{2} \mod 2\pi$

$k_0 = \frac{-\frac{\pi}{2}}{2\pi} \cdot 256 \mod 256$

$k_0 = -\frac{1}{4} \cdot 256 \mod 256 = -64 \mod 256$

So $k_0 = 192$

$k_0 = 192$ $w_{192} = -\frac{\pi}{2} \mod 2\pi$

So Yes when $k_0 = 192$, we have $Q[k_0]^{256} = Q(e^{-\frac{j\pi}{2}})$

b) Let $r[n] = q[n-16]$ $R[k]^{256}$ be 256-point DFT of $r[n]$.

$R[k]^{256} = Q[k]^{256} e^{-j\frac{2\pi k}{256} n_0}$

$n_0 = 16$ and $k = 0, 1, \dots, 256$.

$|R[k]^{256}| = |Q[k]^{256} e^{-j\frac{2\pi k}{256} n_0}|$

$|R[k]^{256}| = |Q[k]^{256}|$ as $|e^{-j\theta}|$ is always 1

So $R[k]^{256}$ and $Q[k]^{256}$ are equal except they have time shift which don't affect magnitude