Samuel Lenius EE315 FM HW 4

1) a) F

b) T

c) T

2) a) ① $Q_{in2,CT}(t) = \int_{t-D\cdot T_s}^{t} I_{out,1d}(t')\,dt'$

$D =$ Duty Cycle $T_s = 1/f_s \rightarrow$ (SC clock period)

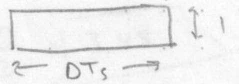
$I_{out\,1d}$ = Differential output current from A_1

Q_{in2CT} = Running windowed integral of $I_{out\,d1}$

↑

$I_{out\,d1}$ Convolved with rectangle height 1, width $D \cdot T_s$

rectangle →



$rect(x) = h \cdot \Pi\left(\frac{x-c}{b}\right)$ c = center = $\frac{D\cdot T_s}{2}$ b = width = $D \cdot T_s$

h = height = 1 $x = t - t'$

$$Q_{in2CT}(t) = \int_{-\infty}^{\infty} \Pi\left(\frac{t - \frac{D\cdot T_s}{2} - t'}{D\cdot T_s}\right) \cdot I_{out1d}(t')\,dt'$$

$$\int_{-\infty}^{\infty} x(t')\,dt' = x(t)$$

$$Q_{in_2CT}(t) = I_{out\,1d}(t) \cdot \Pi\left(\frac{t - \frac{DT_s}{2}}{DT_s}\right)$$

$$|Q_{in_2CT}(\omega)| = \left|\mathcal{F}\left(I_{out\,1d}(t) \cdot \Pi\left(\frac{t - DT_s/2}{DT_s}\right)\right)\right|$$

$$= |I_{out1d}(\omega)| \cdot \left|\int_{-\infty}^{\infty} e^{-j\omega t} \cdot \Pi\left(\frac{t - \frac{DT_s}{2}}{DT_s}\right) dt\right|$$

$$= |I_{out\,1d}(\omega)| \cdot \left|\int_{-DT_s}^{DT_s} e^{-j\omega t}\,dt\right| \Rightarrow \frac{-1}{j\omega}\left(e^{-j\omega DT_s} - e^{j\omega DT_s}\right).$$

$$\sin(\omega) = \frac{1}{2j}\left(e^{j\omega} - e^{-j\omega}\right)$$

$$= \left|\frac{1}{j\omega}\left(e^{j\omega DT_s} - e^{-j\omega DT_s}\right)\right| = \left|\frac{2\cdot\sin(\omega DT_s)}{\omega}\right| \cdot |I_{out\,1d}(\omega)|$$

② $$\frac{|Q_{in2d}(\omega)|}{|I_{out1d}(\omega)|} = \left|\frac{2\cdot\sin(\omega DT_s)}{\omega}\right|$$