Roy Nair DSP HW 2 $\frac{j\omega\tau}{1+j\omega\tau}$

2. The digital signal frequency would be 50 KHz.

(b) The digital signal frequency would be KHz

(c) $750 - 500 = 250$ KHz

(d) $1000 - 500 = 500$ KHz

3. Gain $= \frac{0.33}{3.3} = 0.1$

$$0.1 = \frac{1}{\sqrt{1+(25\cdot10^6/f_c)^2}}$$

$$1+(25\cdot10^6/f_c)^2 = 100$$

$$\frac{25\cdot10^6}{f_c} = \simeq 9.95$$

$$f_c = \frac{25\cdot10^6}{9.95}$$

$$f_c = 2.51 \text{ MHz}.$$

$$f_c = \frac{1}{2\pi RC}, \quad C = \frac{1}{2\pi R f_c}$$

$$C = \frac{1}{2\pi(10,000)(2.51\cdot10^6)}$$

$$= \frac{1}{1.57\cdot10^{11}}$$

$$\boxed{C = 6.37\cdot10^{-12} \text{ F}}$$

3. ADC and DAC

(a) $\Delta V = \frac{\text{voltage}}{\text{Num of levels}}$

$= \frac{2.55}{256}$ $\boxed{\Delta V \approx 0.01V}$

(b) $\Delta V = \frac{4.095}{4096}$

$\boxed{\Delta V \approx 0.001V}$

(c) $\frac{12V}{0.001} = 12,000$

$\log_2(12,000) \approx 13.55 \rightarrow 14$ if rounded up.

$\boxed{14 \text{ bits of precision}}$

(d) 5 v = voltage range

num of levels = 2048

$\frac{5V}{2048} \approx 0.00244V$

$\frac{2.52V}{0.00244V} \approx 1032.79$

Digital amplitude = 1033 counts.

Dac

(a) Sig Amp = 0.0098 V · 256 = 2.5088 V

Signal Amplitude = 2.51 V

(b) signal Amp = 0.505 V
= 2.5 V

The signal Amplitude = 2.5 V

(c) max voltage = $\frac{0.25 \cdot 511}{128}$

= $\frac{127.75}{128}$

≈ 0.997 V

The maximum voltage is 0.997 V

4. $G = \frac{0.33}{3.3} = 0.1$

$f_c = \sqrt{(\frac{f}{0.1})^2 - f^2}$

$f_c = \sqrt{(\frac{10^7}{0.1})^2 - (10^7)^2}$

$= \sqrt{10^{16} - 10^{14}}$

$\approx 10^8$ Hz

$C = \frac{1}{2\pi \cdot 10^4 \cdot 10^8}$

$C = \frac{1}{6.28 \cdot 10^{12}}$

C = 159 pF