4.21: Determine the duty cycle ~~argum~~ argument & setting_value for a PWM signal @ 62.5 kHz & a 30% duty cycle if the MCU has a 16 MHz clock.

setting_value 0x01 per table 4.7

30% of 255 is → 76.5 → input should be 77

5.2: minimum sampling frequency to prevent aliasing for the following?

a) $f(t) = \cos(5\pi t)$

Frequency $= \frac{5}{2}$ Hz → sampling frequency should be 5 Hz

b) $f(t) = 3\sin(2\pi t) + 3\cos(2\pi t)$

frequency = 1 Hz → sampling frequency should be 2 Hz

c) $f(t) = 3\sin(2\pi t) + 3\cos(3\pi t)$

highest frequency $= \frac{3}{2}$ Hz → sampling frequency should be 3 Hz

5.4 determine the aliasing frequency if the signal $\cos(2\pi 10 t)$ was sampled @ 8 Hz.

$$f_a = |f - f_s| = 10 - 8 = 2\text{ Hz}$$

5.7 determine the digital output of a 10 bit A/D converter with a range of 0-5V for 1V input.

$$\text{output} = (2^{10} - 1) \cdot \frac{1}{5} = 204.6 \rightarrow \boxed{205}$$

5.9 determine the minimum number of bits for an A/D converter with a ±10V range to have a resolution of 0.02V.

$$\text{resolution} = \frac{\text{range}}{2^n - 1} = 0.02 = \frac{20}{2^n - 1} \rightarrow n = 9.96 \rightarrow \boxed{10} \text{ bits}$$

5.13. A temp. sensor was connected to a 16 bit A/D w/ a range of 0-5V. The sensitivity is 10 mV/°C & has 0V out @ 0°C.

Determine:

a) The temp. if the A/D output is 1000.

$$\text{output} = 1000 = \frac{V_{in}}{V_{max}}(2^N-1) = \frac{V_{in}}{5}(2^{16}-1)$$

$$\rightarrow V_{in} = 76.3 \cdot 10^{-3}\,V$$

$$\text{Temp} = \frac{V_{in}}{\text{sensitivity}} = \frac{76.3 \cdot 10^{-3}}{10 \cdot 10^{-3}} = 7.6\,°C$$

b) The uncertainty due to the quantization error.

$$\text{uncertainty} = \frac{\text{range}}{(2^N-1)} \cdot \frac{1}{\text{sensitivity}} \overset{0.5}{=} \left(\frac{5}{2^{16}-1}\right)\left(\frac{1}{10 \cdot 10^{-3}}\right)\left(\frac{1}{2}\right)$$

$$= \pm \cancel{7.6 \cdot 10^{-3}\,°C}$$

$$= \pm 3.8 \cdot 10^{-3}\,°C$$