ANALOG SYSTEMS : PROBLEM SET 12

Problem 1

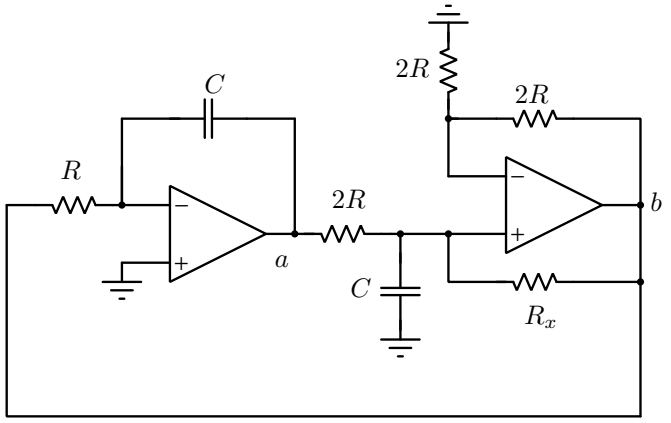

Figure 1: Circuit for Problem 1.

Fig. 1 shows a sinewave oscillator. All opamps are ideal.

- Determine R_x so that the circuit just begins to oscillate.
- Determine the frequency of oscillation, assuming R_x is correctly chosen.
- Determine the transfer function from point a to b, for the R_x you determined in part 1 above.
- Determine the impedance looking across the grounded capacitor for the R_x value that you determined.

Problem 2

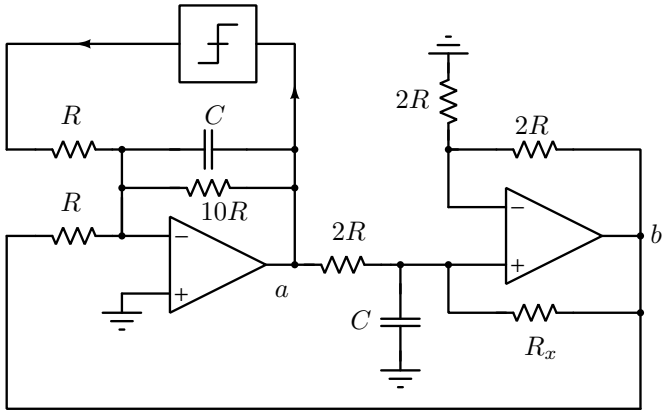

Figure 2: Circuit for Problem 2.

All opamps are ideal in Fig. 2. $R_x = 2R$. The comparator is a nonlinear block which operates as follows. If its input $v_a < 0$, its output is -1 V. If $v_a > 0$, its output is +1 V. Determine the amplitude of oscillation at v_a and v_b. Determine the strength of the 3rd harmonic relative to the fundamental at v_a and v_b. Which of these outputs is "cleaner"?

Problem 3

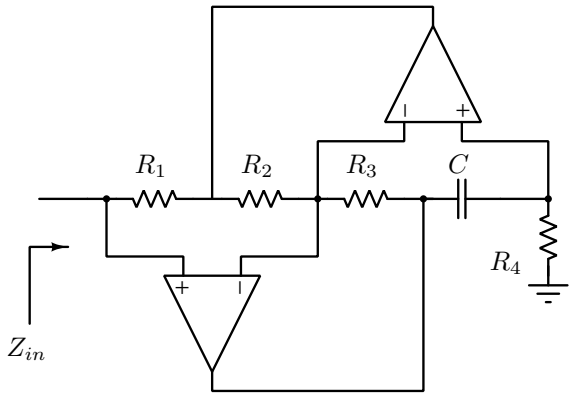

Figure 3: Circuit for Problem 3.

For the circuit of Fig. 3, determine $Z_{in}(s)$.

Problem 4

It turns out that the error due to quantization is often modeled as a uniformly distributed random variable.

Let us denote quantization error by e. Assume it is uniformly distributed between a and b, with $b > a$. Determine the mean and variance of e.

If you have an N-bit ADC, determine the peak Signal to Quantization Noise Ratio in dB for a sinusoidal signal. What would it be for a triangular signal with equal and rising and falling slopes?