ESc201A Home Assignment 7 Oct. 12, 2019.

Solutions of the HA#7 will be on Brihaspati on 20/10/19.

Consider all voltage and current sources to be ideal.

1. In fig. 7.1, the OpAmp is ideal. For v_i=2Cos(10^6t) V, find the small signal voltage gain v_O/v_i.

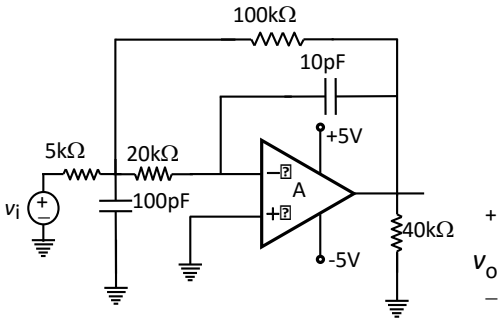

Figure 7.1

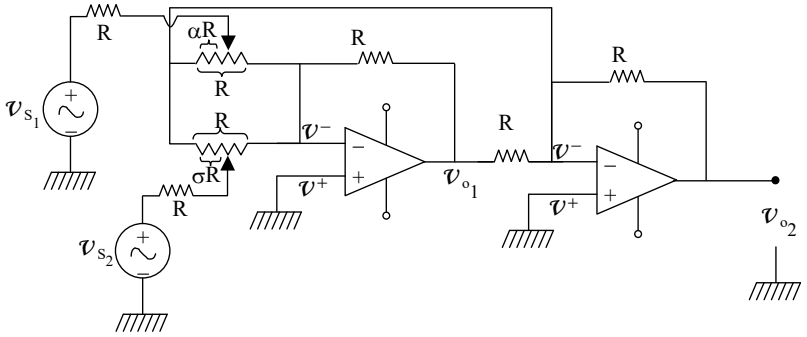

Figure 7.2

2. In fig. 7.2 the operational amplifiers are ideal..

(a) Find v_o as a function of α, σ, v_{S_1}, and v_{S_2}, when the OpAmps operate in their linear regions..

(b) Describe the behavior of the circuit when α=σ =1.0..

(c) Repeat the calculation for when α = σ = 0.

3. In fig. 7.3, considering the OpAmp to be ideal, the resistances are slightly mismatched due to their tolerances. Find the output voltage for v_1=3.98 V and v_2=4.02 V. How much is the error in the measurement.

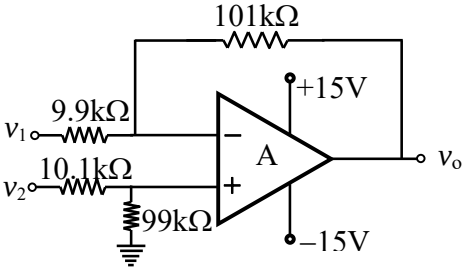

Figure 7.3

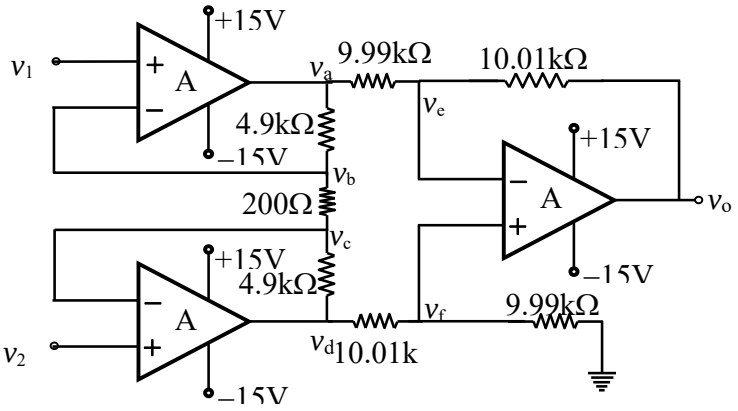

Figure 7.4

4. In the ideal-OpAmp Instrumentation amplifier of fig. 7.4, the input voltages are v_1=4.99 V and v_2=5.01 V. Find all the voltages v_a, v_b, v_c, …… v_f, and v_o. What are the values of A_{dm}, A_{cm}, and CMRR.

5. In the circuit of fig. 7.5(a) the input signal is shown in fig. 7.5(b) and the diodes D_1 and D_2 have V_{on}=0.6V and R_F=0. Sketch the output waveform.

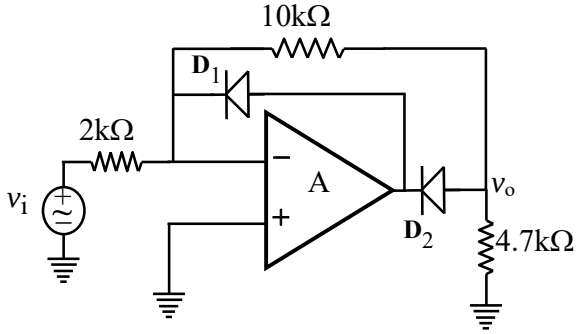

Figure 7.5(a)

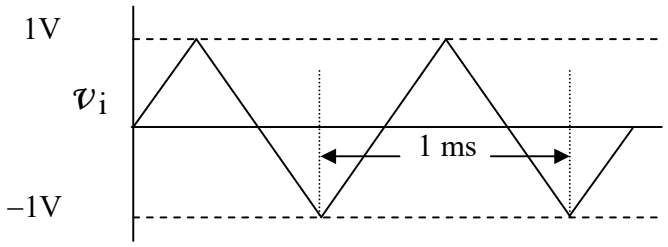

Figure 7.5(b)

6. What are the switching thresholds and the hysteresis of the Schmitt Trigger in fig. 7.6 ? For both D_{Z1} and D_{Z2}, V_z=4.3V.

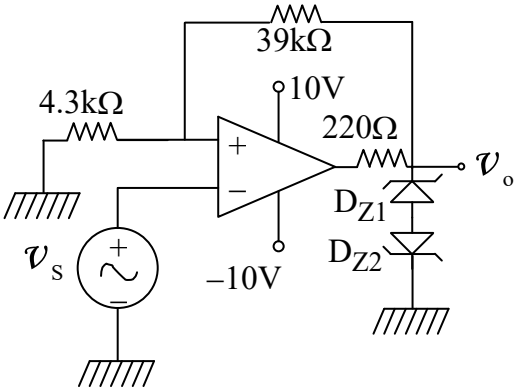

Figure 7.6

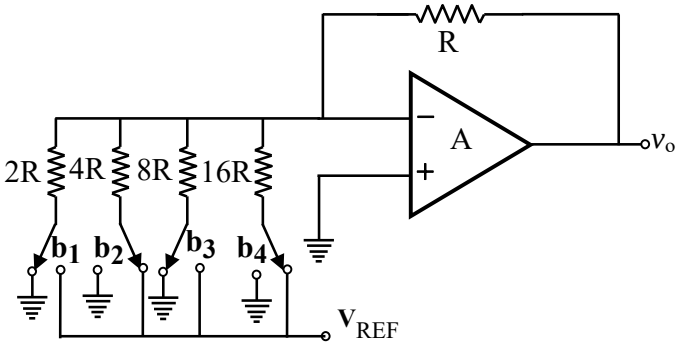

figure 7.7

7. A 4-bit (b_1, b_2, b_3, b_4) Digital-to-Analog Converter (DAC) is shown in fig. 7.7. The 4-bits control the switches **b_1, b_2, b_3, b_4** for the OpAmp inverting inputs. When the bit is 1, the switch connects to V_{REF}, otherwise it connects to ground. The configuration in fig. 7.7 is for bits 0101. Find the output voltage v_o for these bits for V_{REF}=3V. Repeat for all 16 combinations of 1's and 0's for the 4-bit input. What is the value of the digital quantization?

8. Considering the OpAmp in fig. 7.8 to be ideal, find the oscillation frequency of the astable (has no stable state) multivibrator circuit of fig. 7.8(a). Do the same for fig. 7.8(b) but you need to be more careful to see the trick question.

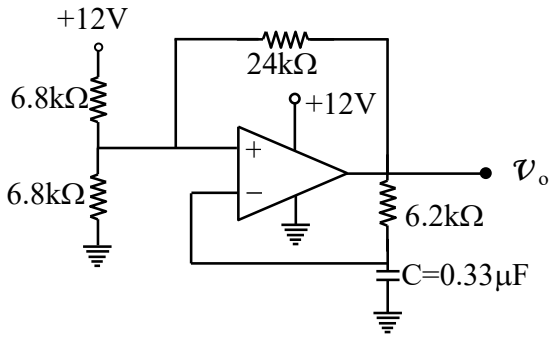

Figure 7.8(a)

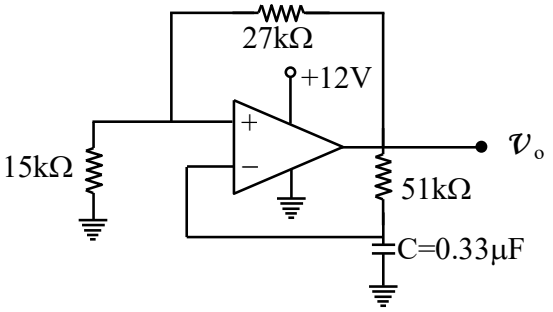

Figure 7.8(b)

9. For the oscillator shown in fig. 7.9, find the frequency of oscillation and the minimum value of σ for oscillation to sustain.

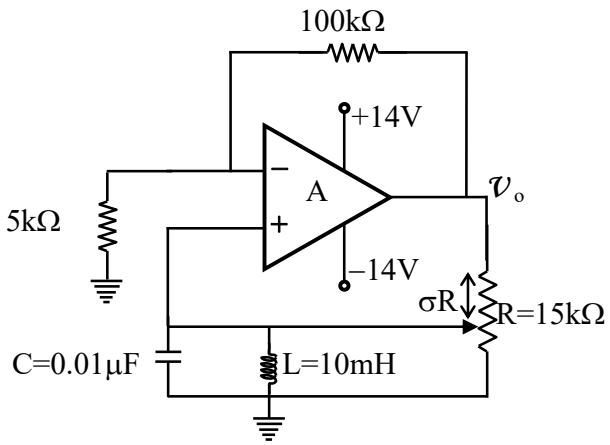

Figure 7.9