GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

Course EE 2250

Electric Circuit Analysis

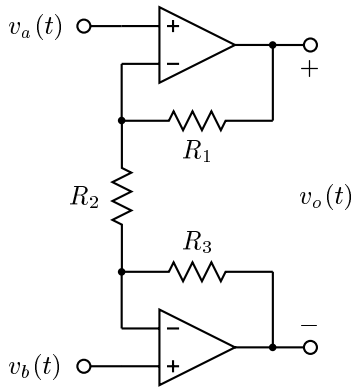
Assigned: January 28, 1999

Due: February 4, 1999

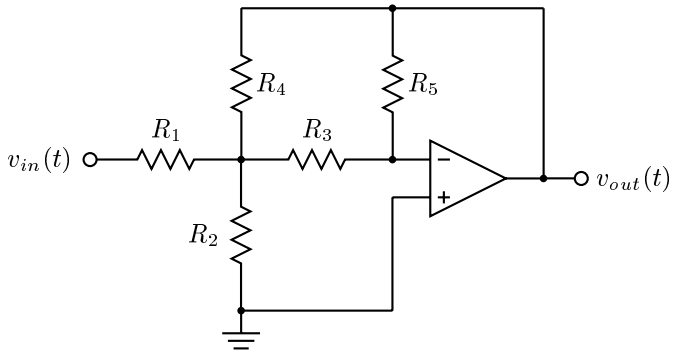
Problem Set #4

Reading: Read the following sections from Dorf and Svoboda:
Chapter 10, Sections 10.3–10.9; (sinusoidal steady-state analysis)

Problem 4.1: Find $v_o(t)$ for the circuit below in terms of the input voltages $v_a(t)$ and $v_b(t)$.



Problem 4.2: Determine the output voltage $v_{out}(t)$ in terms of the input voltage $v_{in}(t)$ for the circuit below.

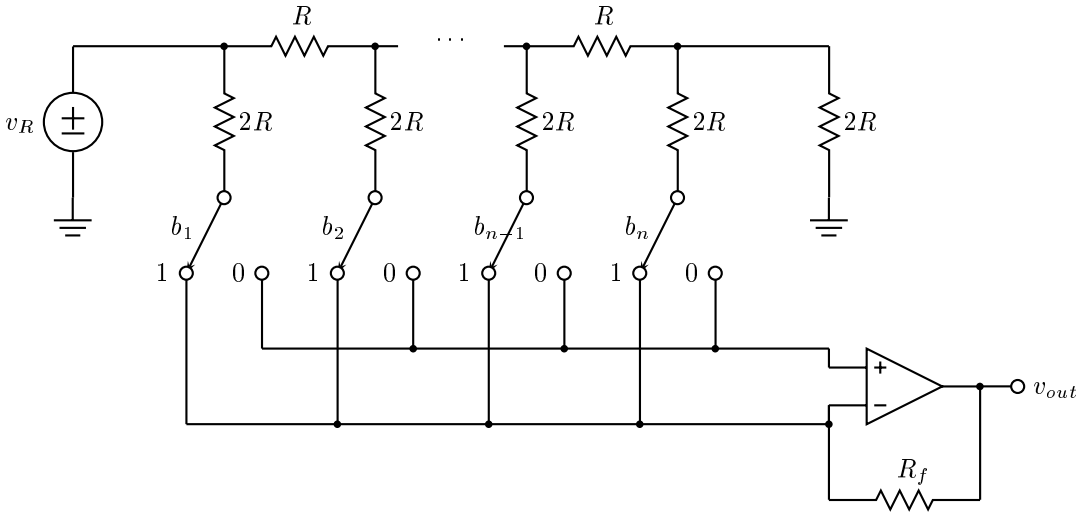


Problem 4.3: This is Problem 6.6-16 from Dorf and Svoboda. The circuit shown below is called the inverted $R-2R$ ladder digital-to-analog converter (DAC). The input to this circuit is a binary code represented by b_1, b_2, ..., b_n, where b_i is either 1 or 0. Each switch shown in the figure is controlled by one of the bits in the binary code. If $b_i = 1$, that switch will be in the '1' position; if $b_i = 0$, that switch will be in the '0' position. Depending on the position of the switch, each current i_k is diverted either to true ground (adding to the + terminal of the opamp) or to the virtual ground (adding to the − terminal.)

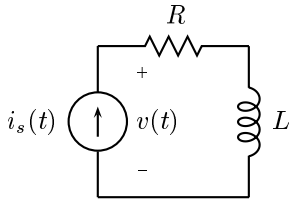
(a) Show that $i = v_R/R$ regardless of the digital input code.

(b) Show that the output voltage can be expressed as

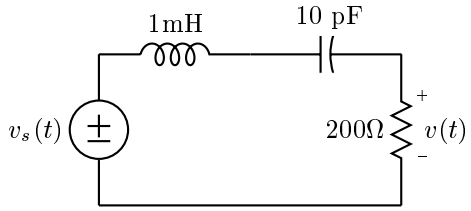
$$v_{out}(t) = -\frac{R_f}{R} v_R (b_1 2^{-1} + b_2 2^{-2} + \ldots + b_{n-1} 2^{-n+1} + b_n 2^{-n})$$



Problem 4.4: Find the value of the current $v(t)$ when the current is the complex exponential time function $i_s(t) = e^{j\omega t}$.



Problem 4.5: For the circuit below find $v(t)$ when $v_s(t) = \cos(\omega t)$.



Problem 4.6: For the following circuit find $i(t)$ when $v_s(t) = \sin(\omega t)$.