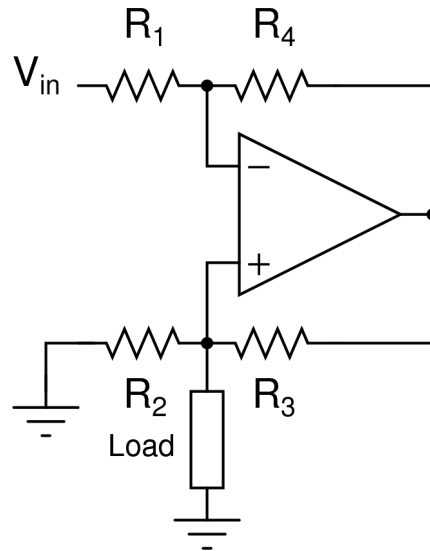


## Week #8 Homework

- This is a “Howland Current Source”. Show that if the resistors are chosen such that  $R_3/R_2=R_4/R_1$ , then  $I_{load} = -V_{in}/R_2$ .



- Show how to make a two-digit digital-to-analog converter by appropriately scaling the input resistors in a summing amplifier (Fig.7.5 in your book is a summing amp with two inputs: one happens to be a DC voltage from a pot and the other an AC voltage from a current source). The “digital” input represents two digits, each consisting of four lines that represent the values 1,2,4 and 8 for the respective digits. An input line is either +1 V or ground, *i.e.*, the eight input lines represent 1,2,4,8,10,20, and 80. Because op-amp outputs generally cannot swing beyond  $\pm 13$  V, you will have to settle for an output in volts equal to one-tenth the value of the input number.
- Draw a DC-coupled inverting amplifier with gain of 100 and  $Z_{in}=10k$ . Include compensation for input bias current, and show offset voltage trimming network (10k pot between pins 1 and 5, wiper tied to V<sub>-</sub>). Now add circuitry so that  $Z_{in} \geq 10^8 \Omega$ .