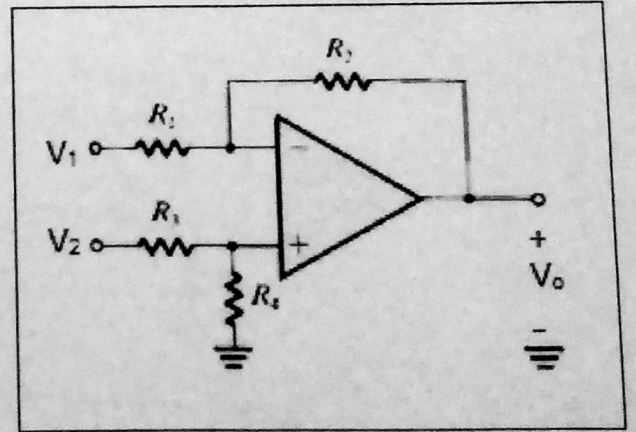




- 1) Design the best circuit to convert digital data to analog by using ideal Op Amp.
  - a) Draw the circuit with all amount of component. [4 points]
  - b) Convert (d<sub>8</sub> d<sub>7</sub> d<sub>6</sub> d<sub>5</sub> d<sub>4</sub> d<sub>3</sub> d<sub>2</sub> d<sub>1</sub>:01001100) to analog signal if  $V_{ref} = -5V$  [4 points]
- 2) Design a high pass active filter by using ideal Op Amp, it has a cut-off frequency 2kHz and the maximum gain 4 v/v. (use only 10kΩ resistor)
  - a) Draw the circuit with all amount of component of the circuit if it is second order. [6 points]
  - b) Find the  $V_o$  when  $V_i$  is sine wave have 0.5v peak and 1ms period time. [2 points]
- 3) Design the square waveform oscillator has frequency 2 kHz and the gain of Schmitt trigger circuit is 5v/v. (C=5mF) draw the circuit [8 points]
- 4) Find the values of resistors in the difference amplifier circuit to realize a differential gain of 100, a differential input resistance of 10 kΩ, and a minimum CMRR of 60 dB. Assume the op amp to be ideal. [10 points]

Note: 
$$A_c = \left( \frac{R_4}{R_4 + R_3} \right) \left( 1 - \frac{R_2 R_3}{R_1 R_4} \right)$$



- 5) Design by using only one ideal op amps and resistors to provide  $V_o$ , draw the circuit.

$$V_o = -2V_1 + V_2 + 2V_3 \quad [6 \text{ points}]$$