Homework # 1
EE201 (032)
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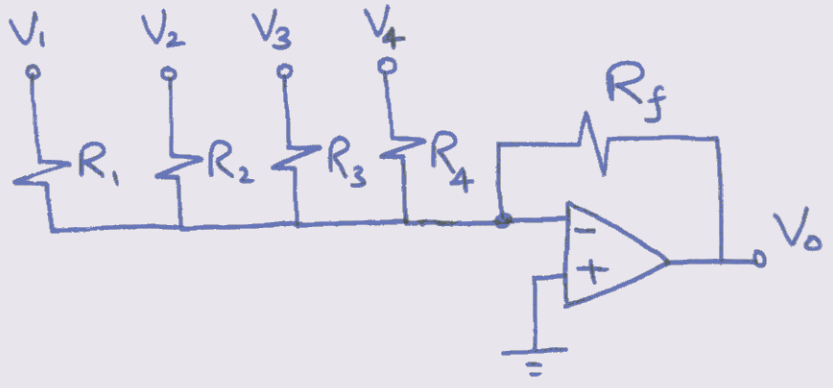
Q1. In the op amp circuit shown in the figure below,

(a) find an expression for the output voltage 'Vo'

(b) Let R_f=10kΩ, R_1=10kΩ, R_2=20kΩ, R_3=40kΩ and R_4=80kΩ. Inputs V_1 to V_4 could have only two values, either 0 or 1 (binary input). If V_1 is the most significant bit (MSB) and V_4 is the least significant bit (LSB) draw a table with three columns, with the first column showing the binary input [$V_1V_2V_3V_4$], the second column showing the decimal equivalent value and the third column showing the value of output voltage (Vo) from equation of part (a). Obtain the output voltage for all the combination of binary inputs [0000],[0001],[0010],……,[1111]

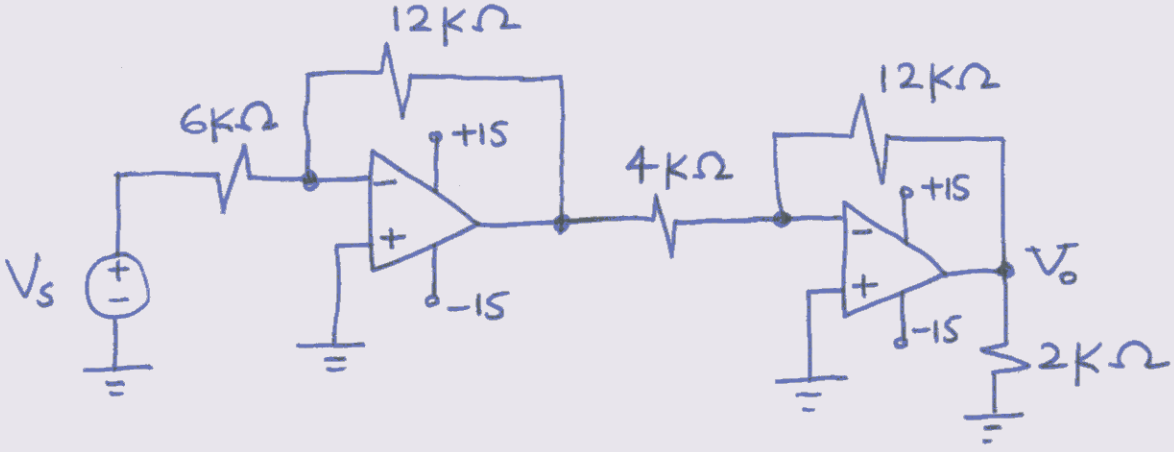
(c) Can you guess from the table of part (b) what is the function performed by this op amp circuit.

(Notice that the resistor values are $R_4=2R_3=4R_2=8R_1$. This is called binary weighted ladder.)



Q2. Your laboratory has available a large number of 10μF capacitors rated at 300V. To design a circuit you need a 40μF capacitor rated at 600V. How many 10μF capacitors rated at 300V are needed from the laboratory and how would you connect them to get a 40μF capacitor rated at 600V. Show the connection of capacitors clearly.

Q3. Find Vo, if Vs=12mV.



Q4. A 10V dc voltage is applied to an op amp integrator with R=50kΩ, C=100mF at t=0. How long will it take for the op amp to saturate (non linear region) if the supply voltages are ±12V? Assume that the initial capacitor voltage was zero.

Q5. The gap in the circuit will arc over whenever the voltage across the gap reaches 36kV (36000V). The initial current in the inductor is zero. The value of β is adjusted so that the Thevenin resistance seen by the inductor becomes (-3kΩ).
(a) What is the value of β?
(b) How many microseconds after the switch has been closed will the gap arc over?

[What is Arcing: When electricity flows through the air from one pole of an electric circuit to another, or jumps from its source to ground without flowing through a desired circuit, it is said to arc. This phenomenon is often accompanied by visible flashes of light and a crackling noise. Lightning and static electricity shocks are well-known examples of arcing. In electrical generation, arcing is usually undesirable because an arc sends all electricity to ground without putting it to a practical use. However, deliberately-created high-intensity arcs of electricity have many practical applications ranging from welding to high-intensity lighting.]