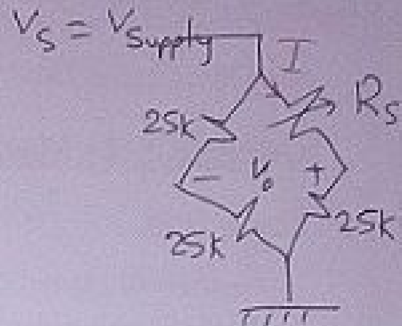
Method 1: Use a bridge circuit to convert the change in resistance into voltage.



* __Power dissipation:__

$$I^2 R_S \leqslant 2.5\ mW$$

$$I^2 (25K\Omega) \leq 2.5\ mW$$

$$I \leqslant 0.32\ mA$$

let $I = 0.3\ mA = \dfrac{V_{supply}}{25K + 25K} \Rightarrow \boxed{V_S = 15V}$

- Check at $R_S = 5K\Omega$ $\quad I = \dfrac{15V}{5K + 25K} = 0.5\ mA$

$$P = I^2 R = (0.5)^2 (5K) = 1.25\ mW < 2.5\ mW$$

R_S	V_o	V_{out}
25K	0V	−2V
5K	12.5V	2V

$V_{out} = aV_o + b$

$-2 = a(0) + b$

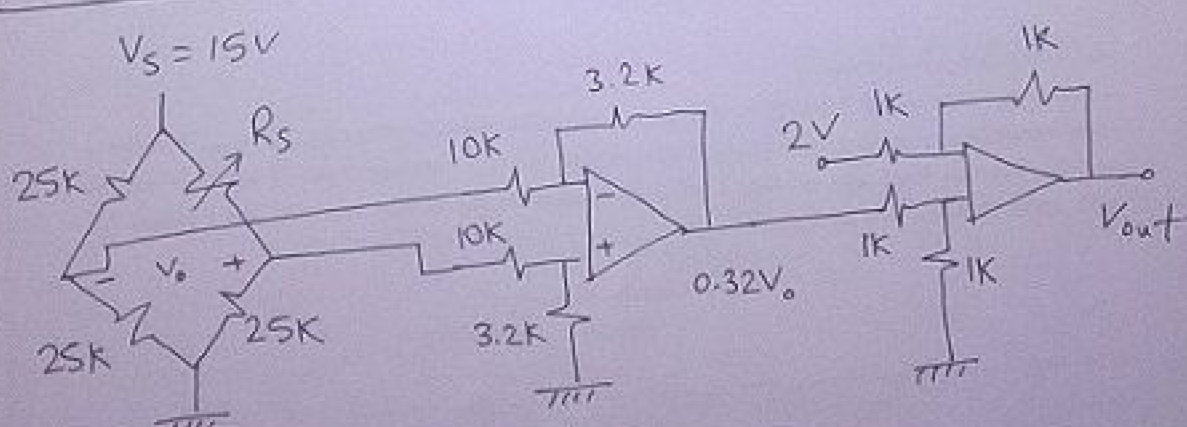
$2 = a(12.5) + b$

$b = -2$

$a = 0.32$

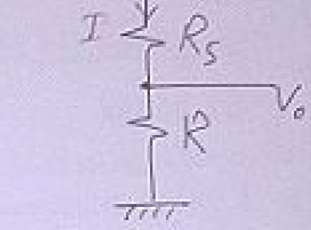
$$\boxed{V_{out} = 0.32 V_o - 2}$$

The designed circuit



Method 2: Use a voltage divider to convert the change in resistance into voltage.

$V_s = V_{supply}$



Power dissipation

$$I^2 R_s \leq 2.5\,mW$$

$$I^2 (25K\Omega) \leq 2.5\,mW$$

$$I \leq 0.32\,mW$$

let $I = 0.3\,mA = \dfrac{V_{supply}}{25K + 25K} \Rightarrow \boxed{V_s = 15V}$

- Check at $R_s = 5K\Omega$

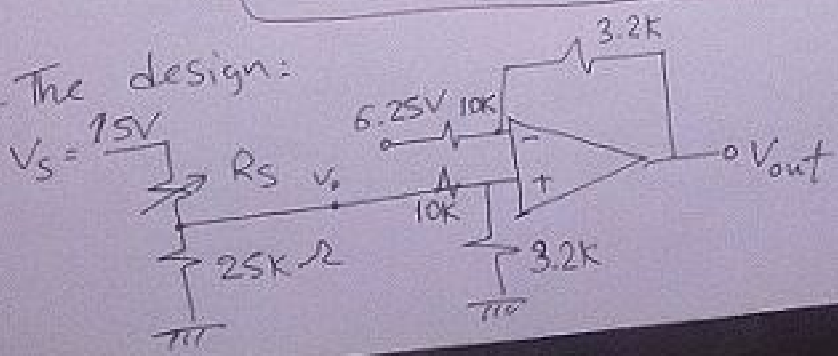
$$I = \frac{15}{5K + 25K} = 0.5\,mA$$

$$P = I^2 R = (0.5\,mA)^2 (5K\Omega) = 1.25\,mW$$
$$< 2.5\,mW$$

- we want (من الحل الطريقة الأولى)

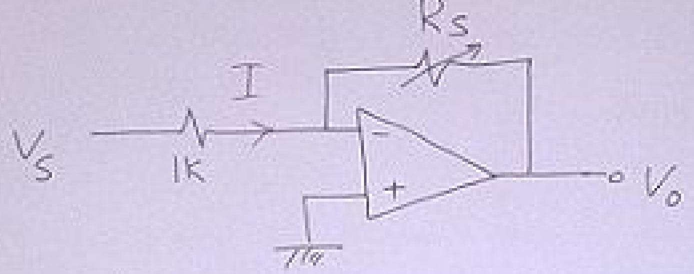
$$V_{out} = 0.32 V_o - 2$$
$$= \boxed{0.32 (V_o - 6.25)}$$

- The design:



Method 3: Use an op-amp circuit

(ميزة هذه الطريقة أن العلاقة تكون خطية)



Power dissipation

$$I = \frac{V_S}{1K} \quad , \quad P_{R_S} = I^2 R_S = I^2 (25K) \leq 2.5mW$$

$$\Rightarrow I \leq 0.32 \text{ mA} \Rightarrow V_S \leq 0.32V$$

let $V_S = 0.3V$ ∴ $I = 0.3mA$

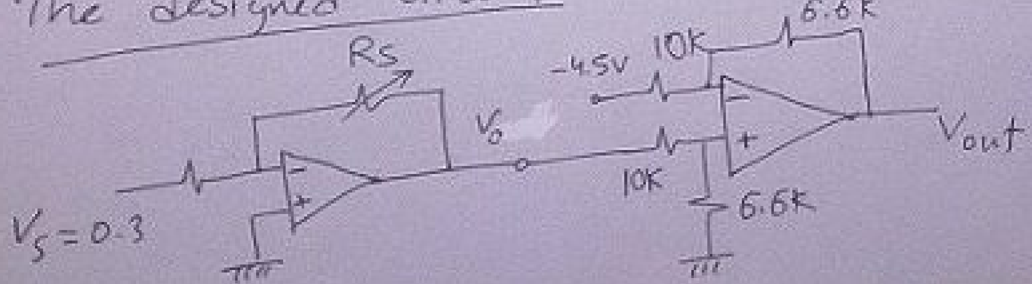
R_S	V_o	V_{out}
25KΩ	−7.5V	−2V
5KΩ	−1.5V	2V

$$V_{out} = a V_o + b$$

$$-2 = a(-7.5) + b$$
$$2 = a(-1.5) + b$$

$$V_{out} = 0.667 V_o + 3 = 0.667(V_o + 4.5) = 0.667(V_o - (-4.5))$$

The designed circuit



Zagazig University
Faculty of Engineering
Computers and Systems Department

Course: CSE 323a - Measurements and Testing (1)
3rd Year Computers and Systems Engineering
Mid-term Exam – November 09, 2017

No of pages: 1	Time allowed: 45 min	Total marks: 20

Name: .... **B.N.** (   )

Question 1 (14 Marks)

True or false:

1. The larger the physical size of a resistor, the higher the power rating.
2. Electrolytic capacitors are polarized; you must observe their polarity.
3. If a system has a time constant of one second, its step response will reach steady state in approximately 2 seconds.
4. The main idea of bridge circuits is to provide an output voltage with zero dc offset.
5. A dummy gauge is used to compensate for temperature effects.
6. The use of current, rather than voltage, in data transmission is better for noise reduction.
7. A gain of 60 dB means that the amplitude of the output will be 60 times that of the input.
8. At steady state, the output of a linear time-invariant system fed by a sinusoidal input will have the same amplitude as the input.
9. Active filters can be designed with gains other than unity.
10. In AC measurement with DMM, the reading is the average of the signal.
11. Clamp meters can be used to measure small currents in the range of milli-amperes.
12. The higher is the bandwidth of an oscilloscope the smaller is the rise time of the pulse which can be displayed using this oscilloscope.
13. If a Lissajous figure is a straight line with positive-slope, then the phase difference is 180°.
14. If the phase difference between two sinusoids is constant during successive cycles, we can conclude that they have the same frequency.

Question 2 (6 Marks)

Sensor resistance varies from 25 to 5 kΩ as a variable changes from c_{min} to c_{max}. Design a signal-conditioning system that provides an output voltage varying from -2 to +2 V as the variable changes from min to max. Power dissipation in the sensor must be kept below 2.5 mW. Draw the complete designed circuit.

---- All the best ----