39/40

37+2

(40 marks)

FACULTY OF ENGINEERING & TECHNOLOGY

MEASUREMENTS AND CONTROL LAB.0908448

MID-TERM EXAM

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Second Semester

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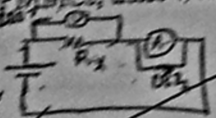
PART ONE: (12)

Resistance measuring using voltmeter & ammeter method

1. One of the experiments in the measurements lab was to measure the value of resistances using two PMMCs, there were two cases in that experiment name, identify and draw them.

Case 1

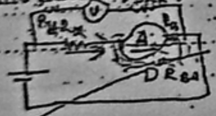


$R_x = \frac{R_x}{R_x + R_v} \times 100\%$

$R_x = \frac{R_x R_v}{R_x + R_v}$

Case 1: Voltmeter Galvanometer: in this case the voltmeter parallel to R_x only $DRB_v = \frac{V - R_v I_{FSD}}{I_{FSD}}$

Case 2



$R_x = R_x + R_a$, $e = \frac{R_a}{R_x}$

$DRB_a = \frac{R_a I_{FSD}}{I - I_{FSD}}$ $I_t - I_a$

Case 2: Ammeter Galvanometer: in this case the Ammeter will be in series with R_x and the voltmeter parallel with them

- After doing this experiment the results were as follows

Rx(KΩ)	7	-	20
Expected Ix (mA)	1.714		0.5
Measured Ix' (mA)	1.95		0.65
Measured voltage across resistance Vx (V)	12		12
Measured value of Rx (Rx')(kΩ)	6.154		18.462
Measured percentage Error (e%)	12.08 %		7.69 %

Table 1.

2. Fill in Table1 the ***expected current** Ix* in mA, and the ***measured value of** Rx* in ohms, show one sample of your calculations for both Ix and measured Rx.

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$I_x = \frac{V}{R_x} = \frac{12}{7\,k\Omega} = 1.714\ mA$

$R_{x\,meas} = \frac{V_{meas}}{I_{meas}} = \frac{12}{1.95} = 6.154$

3. If you were given:

7

Galvanometer with *internal resistance=600 ohms, max current=0.5mA.*

Decade resistance box:

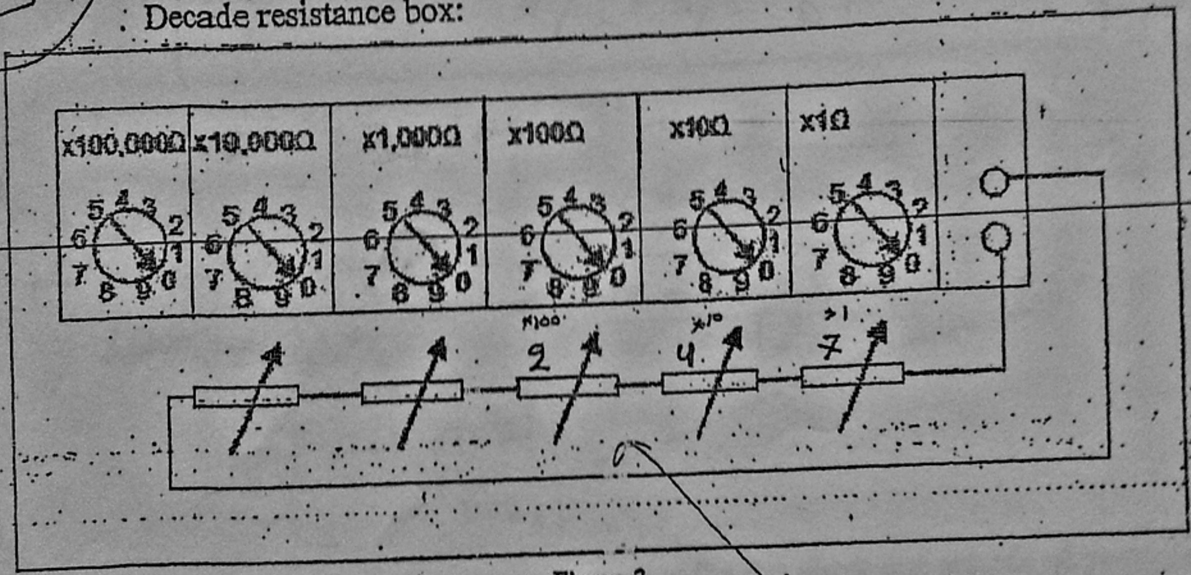
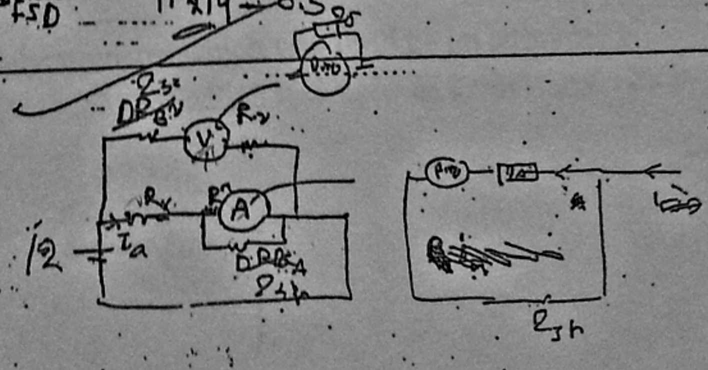


Figure 2.

Considering your results in 2 above, design ammeter to measure the current Ix *show your calculations, the circuit and the settings of DRB on Figure 2.*

$DRB_A = \frac{R_a I_{FSD}}{I_a - I_{FSD}} = \frac{600 \times 0.5}{1.714 - 0.5} = 247\ \Omega$



4. If you were given:

- Galvanometer with *internal resistance=2000 ohms, max current=0.4mA)*
- Decade resistance box:

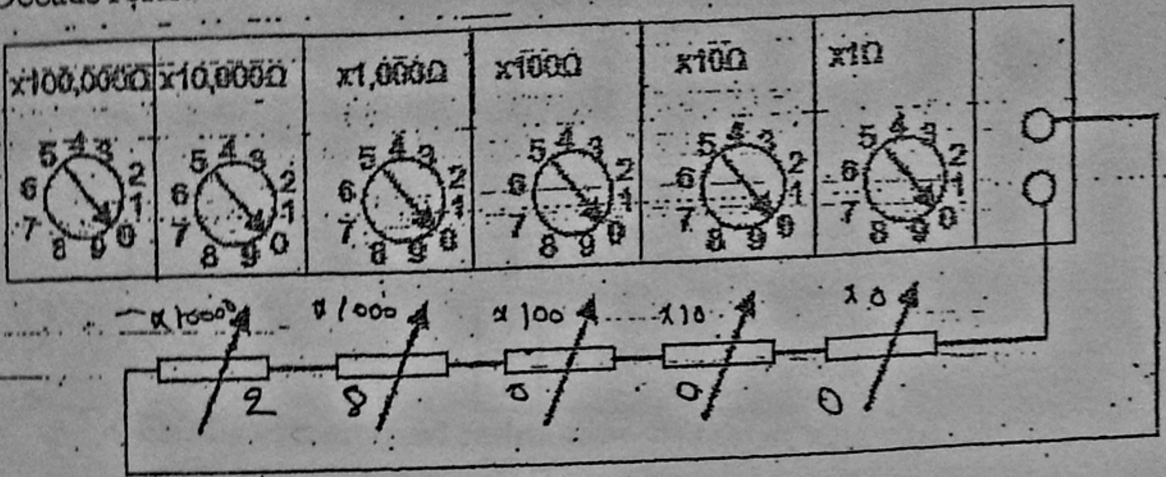
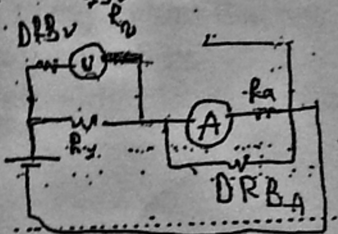


Figure 3.

8 = 12

Design *voltmeter* to measure the voltage across Rx, ***show your calculations, the circuit and the setting of DRB on figure3.***

$$DRB_v = \frac{v - R_v I_{fsD}}{I_{fsD}} = \frac{12 - 2000 \times 0.4_{mA}}{0.4\,mA} = 28000\ \Omega$$



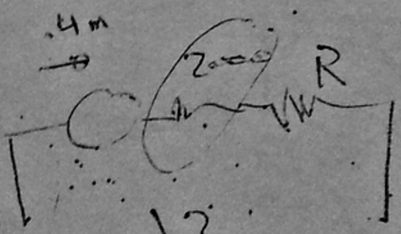
5. Fill in table 1 the ***measured percentage error for Rx***, show one sample of your calculations.

$$e = \frac{R_x - R_x'}{R_x} \times 100\% = \frac{7 - 6.1154}{7} \times 100\% = 12.087\%$$

$\frac{1}{I_{fsD}}$

6. The ***sensitivity*** of the galvanometer which was used as an ammeter is: 2000 ohm/volt

7. The ***sensitivity*** of the galvanometer which was used as a voltmeter is: 2500 Ohm/volt



$\frac{12}{.4m} - 2000 = R$

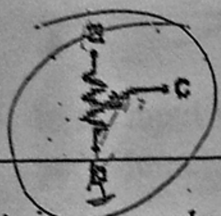
PART TWO: (12)

To design a DC milli-voltmeter, you will use:

- Operational Amplifier LM741, and here is the pin connection for this OP-AMP:

1	Offset Null
2	Inverting Input
3	Non-inverting Input
4	Vs-
5	Offset Null
6	Output
7	Vs+
8	N/C

- A PMMC with internal resistance= 700 Ohms, max current= 0.1 mA.
- 20kΩ Potentiometers. 15k Ω potentiometer



When rotated fully clockwise, a is connected to c.

When rotated fully counter-clockwise, b is connected to c.

- A power supply with +10 V, -10 V and +6 V.
- Resistors of any values that you might need.
- Decade resistance box.

Here is shown part of the electrical circuit that measure milli-voltages:

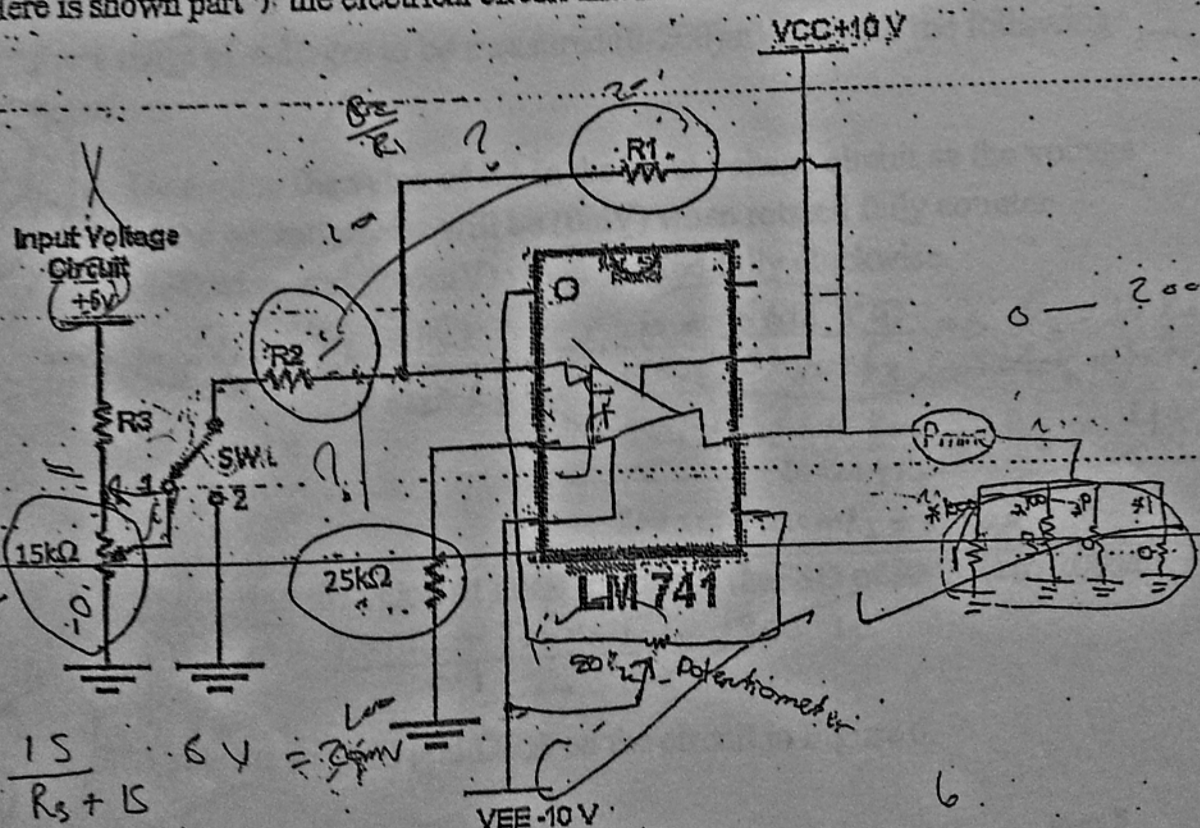


Figure 6.

1. In order to perform the offset null adjustment,the switch SW1 should be connected to terminal---2---------.

2. Draw the connection of the 20kΩ potentiometer on the circuit in Figure 6,in order to do the offset null adjustment.

3. What is the importance of the Offset Null Adjustment for the OP-AMP ?

to remove any drift from the output and to ensure that the output will be zero when we apply zero input

4. What are the values of:

+R1:---50 kΩ---------

+R2:---50 kΩ---------

$25\ k\Omega = \frac{R_1 * R_2}{R_1 + R_2}$, $\frac{R_1}{R_2} = 1 \Rightarrow R_1 = R_2$

$\frac{R_1^2}{2R_1} = 25\ k\Omega$

$R_1 = 2 \times 25\ k\Omega = 50\ k\Omega$, $R_2 = 50\ k\Omega$

5. In the input voltage circuit, why R3 is connected in series with the potentiometer?

to increase sensitivity & accuracy , and to prevent a short circuit when we apply zero input, and to safe the op-amp when we apply high voltage, so there will be voltage division on it

For a range of voltages to be measured:(0-200)mV, answer the following questions:

6. Determine the value of R3 in the input voltage circuit,so the voltage of the potentiometer will be (0mV) when rotated fully counter-clockwise, and (200mV) when rotated fully clockwise.

$\Rightarrow V_x = \frac{V_{in} * 15\ k\Omega}{15\ k\Omega + R_3} \Rightarrow 0 = \frac{6 * 15\ k\Omega}{15\ k\Omega + R_3} \Rightarrow R_3 = 15\ k\Omega$ when rotated CCW

$200\ mV = \frac{6 * 15\ k\Omega}{15\ k\Omega + R_3} \Rightarrow R_3 = 435\ k\Omega$

$200 \times 15 + 200\ m R_3 = 6 \times 15\ k\Omega$

7. Determine the value of DRB to change theFSD of PMMC to 200Mv.

$DRB = \frac{200\ mV - 700 \times 0.1}{0.1} = 1300\ \Omega$

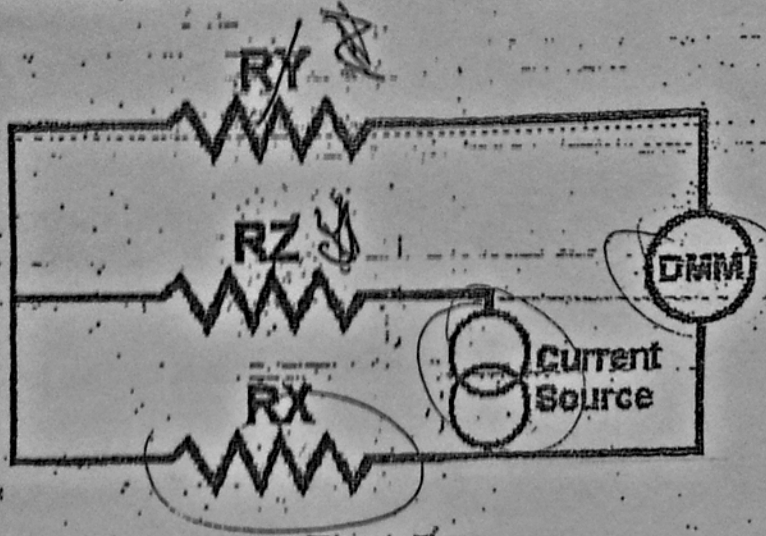
8. Draw the PMMC and DRB on the circuit in Figure 6.

Digtial earth Resistance Tester

Digtal earth Resistance

PART THREE: (8)

*The circuit shown in figure7 is the circuit that you have used to measure the earth resistance; three earthing rods X,Y and Z were used, there resistances are RX ,RY and RZ



(Figure7)

(1.5) 1. The name of the method which was used to measure the earth resistance in the circuit above is Fall of Potential method

(1.5) 2. Which resistance performs the earth resistance RX, RY, or RZ? Rx

(1) 3. The sitting for the DMM in figure 7 is Voltmeter

Choose one (voltmeter, Ammeter, or Ohmmeter)

(1) 4. What is the equation that show s the relationship between the diameter of the earth rod and the resistance of it? $R = \frac{\rho L}{A}$, $A = \frac{\pi D^2}{4}$ when we increase D R will Decrease

(1) 5. Soil conductivity and resistivity depend on: fertilize and wet soil

(1.5) 6. What is the maximum allowable value of earth resistance according to the Jordanian Engineers Association specifications?

5 Ω

fertilize

PART FOUR: (8)

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A. Choose the correct answer:

1. LabVIEW is a programming language that uses:
   a) Ladder diagram   (b)) Icons   c) Lines of text   d) nodes

2. In LabVIEW, you build a user interface that known as:
   a) block diagram   (b)) Front panel
   b) functions pallete   d) Controls pallete

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3. The following pallete should be visible when the front panel window is active:
   a) Controls pallete only   (b)) Tools pallete and Controls pallete
   c) Tools pallete only   d) Tools pallete and Functions pallete

4. The following pallete should be visible when the block diagram window is active:
   a) Controls pallete only   b) Tools pallete and Controls pallete
   c) Tools pallete only   (d)) Tools pallete and Functions pallete

5. When you need to build a function generator you will assign DAQ as:
   a) Input
   (b)) Output

B. Give a brief description for the following code.

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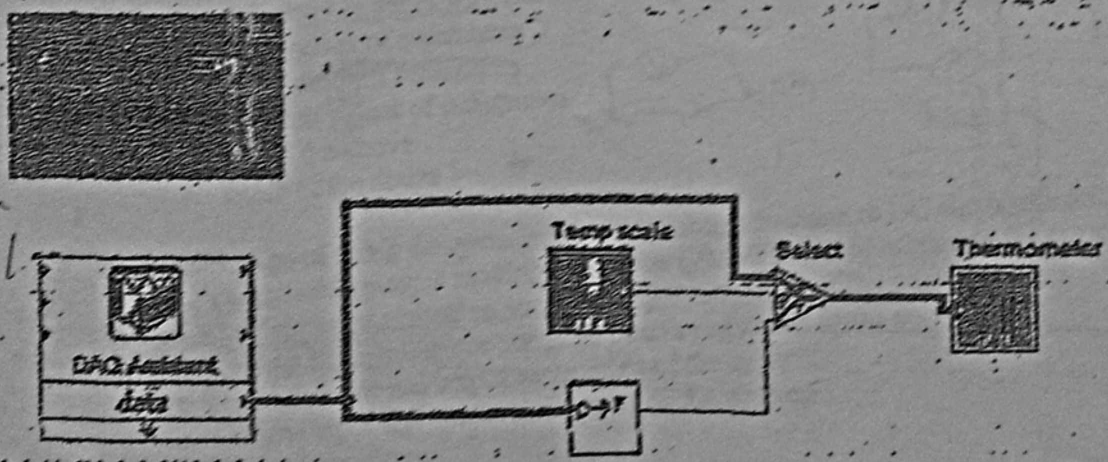

In the front panel we put a vertical slide switch & thermometer (0-125)
In the Block diagram we add a DAQ Assistant to get the signal from the thermometer on the Board and move it to the PC → it will separate in 2 lines
first line when the vertical slide switch up → will display the temperature in celcuis
the second line will pass through the convertor and convert the celecuis Temp. into a Fehrenhite, Now to choose one of the 2 lines we put a comparasor and select one of them and move it to the Thermometer.