First exam — Instrumetion & measurment — Fall 2014

power unit

Q)1 :

A) Define the following terms :-

1) Skin effect :
2) Limmiting error

B) what is methods that used To measure the internal Risistance of ameter ?? Draw the circuit's ?? explain

C) Sketch shunt type ohmmeter circuit and series type ohmmeter circuit then explain ??

Q)2 : ~~Design~~

using the Ayrton shunt method. design amulti-range Ammeter Knowing that

- $R_m = 100\,\Omega$
- the full scale deflection of the pmmc = $50\,\mu A$

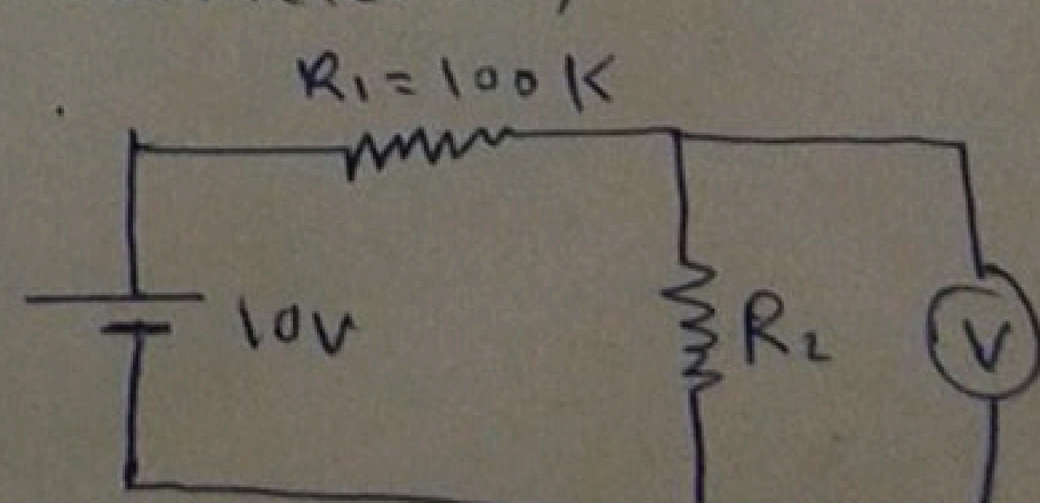
→ the needed ranges :-

(0 — 1mA), (0 — 10mA), (0 — 50mA), (0 — 100mA)

Q3) :

consider the Following circuit with the Following information Determine the sensitivity of the voltmeter (2)

* the voltage on the Resistance R_2 is measured by voltmeter (1) with sensitivity of $5\,K\Omega/V$ the reading was 1.49V with range (0 — 10V)



* the voltmeter (2) is inserted instead of voltmeter ① the reading was 1.75V with (0 — 5) Range

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Q1) I

a)

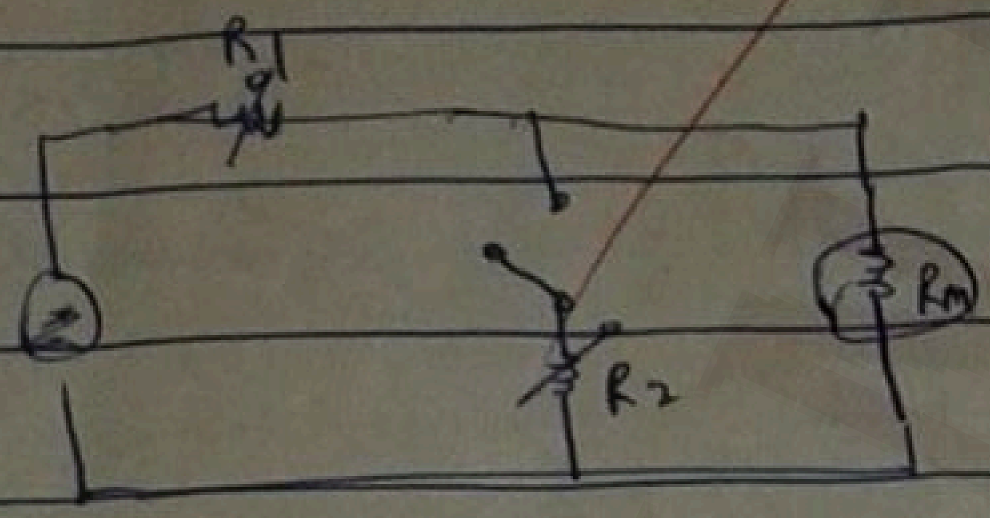
1) Skin Effect : one type of instrument ~~infu~~ infuilnce and ~~some tim~~ sometimes it's very large and maybe erotic and will change the reading of measured value to improve it we must adjcent device to regular adsuement

2) Limmiting error's : The ammeter must be grantued to be with in certain range of error's called limmiting errors and it's equal accuracy multiply Fule scal deflection of ammeter

Limmiting error = Fule scale * accuracy

b)

1) half scale method

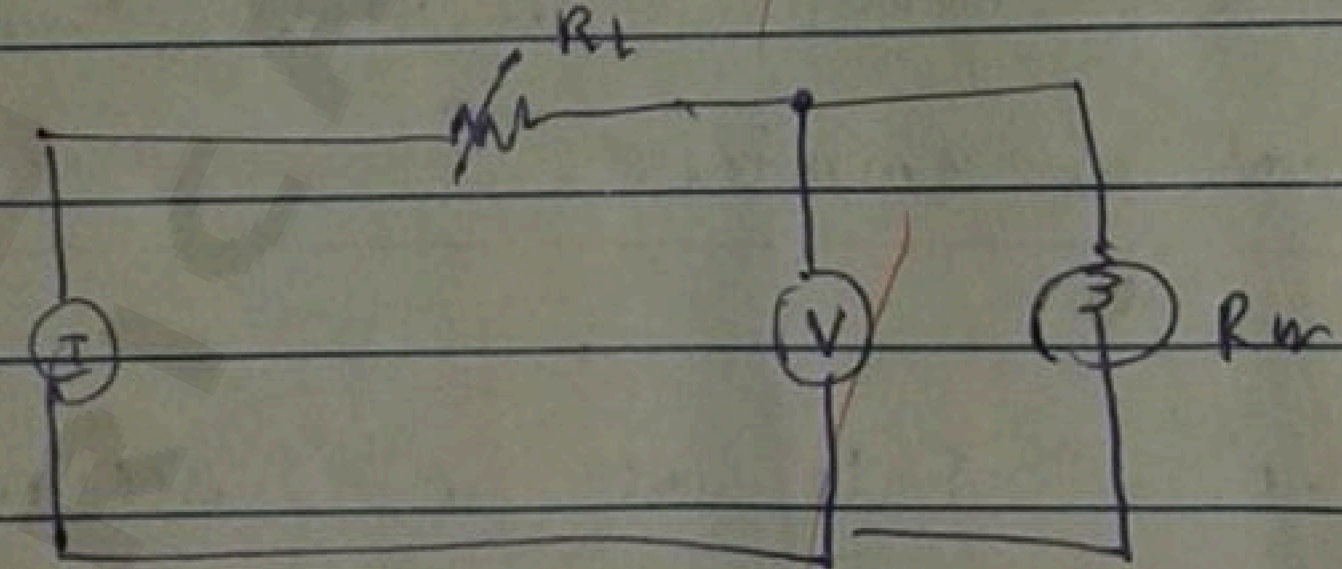


~~half scale method~~

First we adjucent R_1 (untile ammeter) give Fulle scale deflection (I_{fs}) then we close the switch and adjucent R_2 to give half value of Full scale then the value of R_m will be equal value of R_2

$$R_m = R_2$$

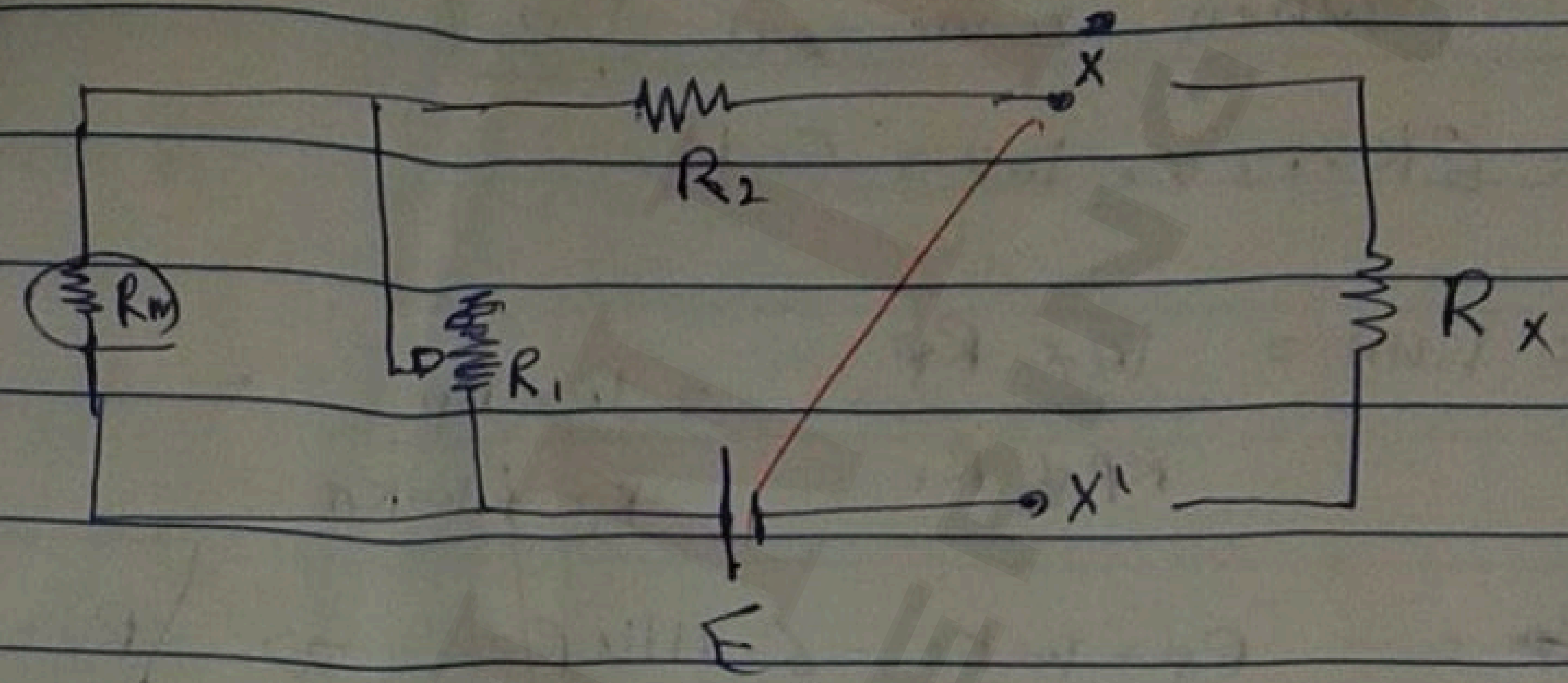
2) currunt - voltage method



First we adjucent R_1 to untile {pmmc} ammeter give Full scale deflection then we calculat R_m by using following method

$$R_m = \frac{V}{I_{Fs}}$$ V → reading of voltmeter

(c) 1)



2) shunt type contain from R_1 which represent changing resister (shunt) to select suitble scale we adjacent R_1 to give demand value.

R_2: it is series resister called multiplier.

~~(Rm) represent~~ . Note that R_1 connect in ~~series~~ parrallel with Rmmc and R_2 connect in series with R_x

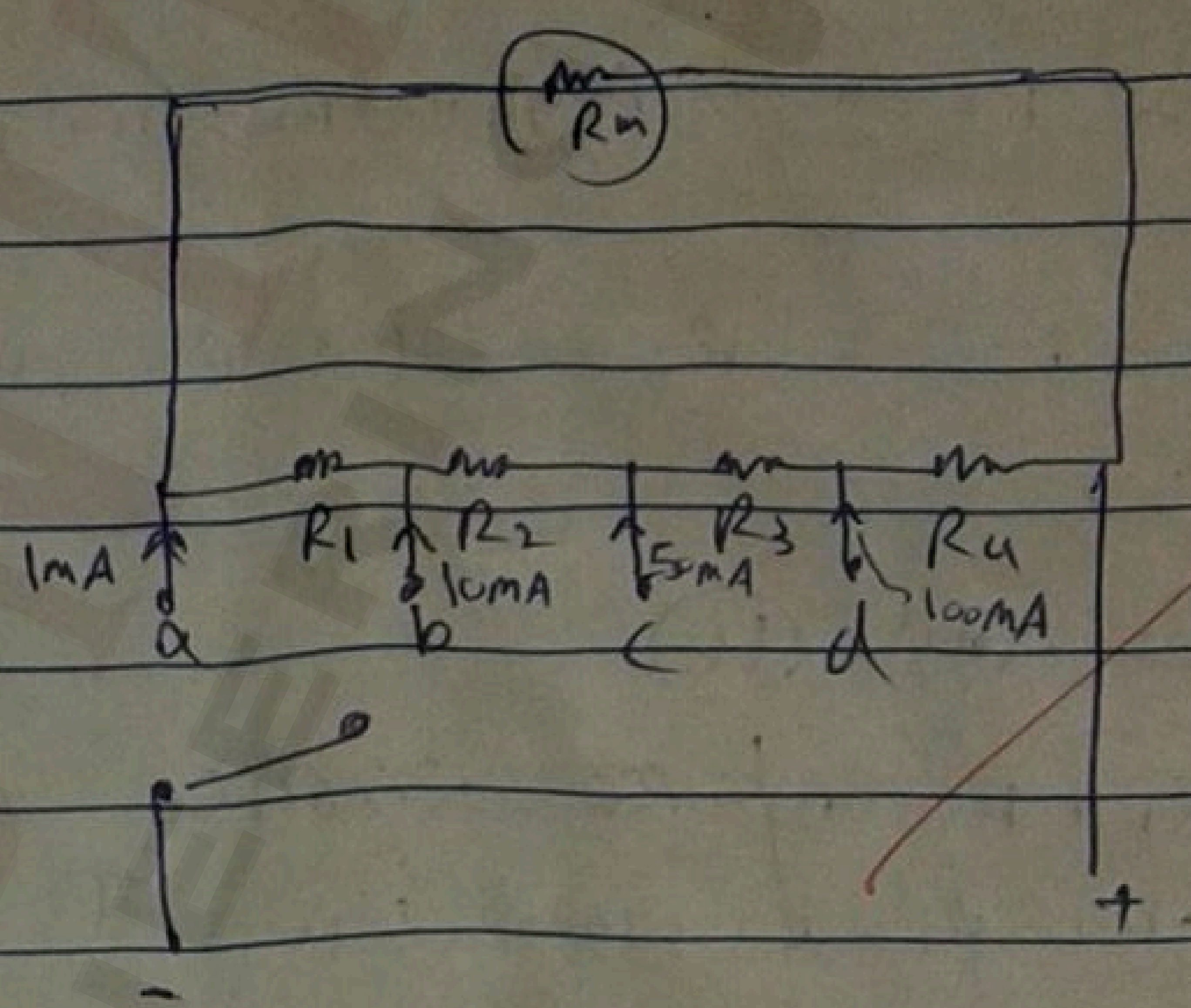
Keep in mind R_x: represent unknown Resister

the diffrent between series type and shunt type ohmmeter is:

series type use in measure high resister

shunt - type " " " low resiste.

Question (2)



when switch at position (a)

~~Rm~~ R_1

$$R_1+R_2+R_3+R_4 = \frac{R_m}{\frac{I_T}{I_{fs}} - 1}$$

$$R_1+R_2+R_3+R_4 = \frac{100}{\frac{1mA}{50\mu A} - 1} = \frac{100}{19}$$

$$19R_1 + 19R_2 + 19R_3 + 19R_4 = 100$$

$$R_1 + R_2 + R_3 + R_4 = 5.26315 \quad \text{--- (1)}$$

when switch @ position (b)

$$R_2+R_3+R_4 = \frac{R_m + R_1}{\frac{I_T}{I_{fs}} - 1} = \frac{R_1 + R_m}{199}$$

$$-R_1 + 199R_2 + 199R_3 + 199R_4 = 100 \quad \text{--- (2)}$$

when switch @ position (c)

$$R_3+R_4 = \frac{R_1+R_2+R_m}{\frac{50mA}{50\mu A} - 1} = \frac{R_1+R_2+R_m}{999}$$

$$-R_1 - R_2 + 999R_3 + 999R_4 = 100 \quad \text{--- (3)}$$

$$R_4 = \frac{R_1+R_2+R_3+R_m}{\frac{100mA}{50\mu A} - 1} = \frac{R_1+R_2+R_3+R_m}{1999}$$

$$-R_1 - R_2 - R_3 + 1999R_4 = 100 \quad \text{--- (4)}$$

$R_1 + R_2 + R_3 + R_4 = 5.26315$ --- (1)

$-R_1 + 199R_2 + 199R_3 + 199R_4 = 100$ --- (2)

$-R_1 - R_2 + 999R_3 + 999R_4 = 100$ --- (3)

$-R_1 - R_2 - R_3 + 1999R_4 = 100$ --- (4)

(1) and (4)

$R_1 + R_2 + R_3 + R_4 = 5.26315$

$-R_1 - R_2 - R_3 + 1999R_4 = 100$ +

$2000R_4 = 105.26315$

$R_4 = 0.052631575$

(1) and (3)

$-R_1 - R_2 + 999R_3 + 999R_4 = 100$

$R_1 + R_2 + R_3 + R_4 = 5.26312$

$1000R_3 + 1000R_4 = 105.26312$

$R_3 = 0.05263152$

(1) and (2)

$R_1 + R_2 + R_3 + R_4 = 5.26315$

$-R_1 + 199R_2 + 199R_3 + 199R_4 = 100$

$$R_2 = \frac{105.2631 - 200 \times (0.05263152) - 200 \times (0.052631)}{200}$$

$R_2 = 0.421$

$R_1 = 4.73683451$

Q) 3 When connected $\boxed{V_1}$

~~$R_v = 5K\Omega/V \times 10V = 50K\Omega$~~

$V = 1.49 = \frac{10 \times R_p}{R_p + R_1} = \frac{10 \times R_p}{R_p + 100K\Omega} =$

$R_p + 100K\Omega = 6.7114\, R_p \Rightarrow \boxed{R_p = 17.5088K}$

$R_p = \frac{R_v \times R_2}{R_v + R_2} = 17.5088K$

$\frac{50K \times R_2}{17.5088K} = 50K + R_2$

$\boxed{R_2 = 26.9439K\Omega}$

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When connected $\boxed{V_2}$

$1.75 = \frac{10 \times R_p}{R_p + R_1} = \frac{10 R_p}{R_p + 100K}$

$\boxed{R_p = 21.2121K}$

$R_p = \frac{R_2 \times R_v}{R_2 + R_v} = \frac{26.9439K \times R_v}{26.9439K + R_v} = 21.2121K$

$\boxed{R_v = 99.70997}$

S = sensitivity $= \frac{R_{Total}}{V_{FS}} = \frac{99.70997}{5} = 19.94199$

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