BAYELSA STATE POLYTECHNIC ALEIBIRI

P.M.B 168 EKEREMOR

ELECTRICAL/ELECTRONIC SYSTEMS DESIGN 1
PRACTICAL MANUAL

COURSE CODE: EEC 118

DEPARTMENT OF ELECTRICAL ELECTRONICS ENGINEERING TECHNOLOGY.

STUDENT NAME: BENSON AMAKIRI OKILO

REGISTRATION NO:..

Week 1

Aim

i. Understanding of colour coding in resistors

ii. Measurement of resistance.

A) Resistor colour codes not considering tolerance

S/N	Band 1	Band 2	Band 3	Calculated Value	Measured Value	Compare Calculated and Measured Values
	Red	Red	Red	2.2kΩ ~~560Ω~~	2·182	The Calculated value is less the measured value
	Yellow Green	Blue	Orange	56kΩ ~~560Ω~~	549··	
	White	Orange Brown	Brown	930Ω 910Ω	0·897	The calculated value is higher than the measured value
	Green Blue	Yellow Grey	Black	56Ω 68Ω	067·1	the calculated value is the higher than the measured value
	Brown	Black	Orange	10kΩ	10·10	The calculated value

B) Using the values of the resistors given, complete the table below:

S/N	Calculated Value	Colours			Measured Value	Tolerance ~~Colour~~ Value
		Band 1	Band 2	Band 3		
	10kΩ	Brown	Black	Orange	10-10	
	1kΩ	Brown	Black	Red	01·00	
	~~68kΩ~~ 68Ω	Blue	Grey	~~Orange~~ Black	0·067	
	3.3kΩ	Orange	Orange	Orange	3·278	
	100kΩ	Brown	Black	Yellow		

CamScanner

SERIES CIRCUIT CONNECTION

Objection: Verification of series circuit current and voltages.

Procedure:

1 Connect a number of resistors of different values in series to a 5V voltage source. State the resistor values here:

2 Connect a millimeter just after the voltage source, and just before the first resistor in the series network. What is the magnitude of the current?

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3 Position the millimeter between two resistors in the series network. Again, document the magnitude of the current.--

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· What do you notice about the series current?

·s Resistance

To verify the total resistance of series connected resistors.

Take three (3) individual resistors, and measure their resistances

    1) R_1........................Ω

    2) R_2........................Ω

    3) R_3........................Ω

.. Form a series network with the three (3) resistors, measure the resistance of the series connected resistors by connecting one of the probes of the ohmmeter to Terminal A of the first resistors in the network, and the other probe of the ohmmeter to the terminal B of the last resistor in the series network. Record the resistance value in ohm...

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Sum the values of R_1, R_2 and R_3 in ohms...

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Compare the sum of R_1, R_2 and R_3 in (c) above, and the series resistance in b) above. Comment in the comparison...
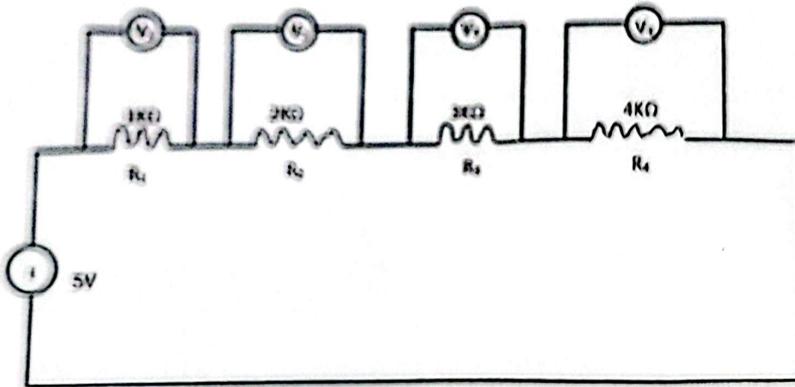
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the most important mathematical relationship between voltage, current and resistance in a capacitor circuit. Particularly for resistors, the law that, the voltage across a resistor is directly proportional to the current through the resistor is

a series circuit consisting of four (4) resistors as shown in the circuit

mate the total series resistance using $R_t = R_1 + R_2 + R_3 R_4 = 1+2+3+4 = 10 K\Omega$

nate the series current from $I = V/_{RT} = \frac{10}{6} = 0.5V$ ✓

: are the values of the voltage drops; as indicated in the voltmeters?

........................V

.....................V

.....................V

....................V

d. Calculate the voltages from $V_n = IR_n$ i.e

$V_1 = IR_1$ ... $0.5 \times 1 = 0.5$ V

$V_2 = IR_2$ ... $0.5 \times 2 = 2$ V

$V_3 = IR_3$ ... $0.5 \times 3 = 1.5$ V

$V_4 = IR_4$ ... $0.5 \times 4 = 2$ V

e. What is your comment on the voltage drops, with respect to the values of the resistors in the series circuit?..

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ARALLEL CIRCUIT CONNECTION

e main difference between a series circuit and a parallel circuit is in the way the mponents are connected. In a parallel circuit, there are at least two loads sistors in this case) connected separately to the voltage source, so that the ltage across the loads are the same. But the currents in the different loads esistors) are not the same for the parallel circuit.

resistance of the parallel network is obtained as;

$$= \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n} \ldots\ldots\ldots\ldots\ldots(1)$$

only two resistors in parallel, the total parallel resistance is;

$$= \frac{R_1 R_2}{R_1 + R_2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

three resistors in parallel, the total parallel resistance is;

$$= \frac{R_1 R_2 R_3}{R_1 R_2 + R_1 R_3 + R_2 R_3} \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Connect two resistors in parallel as shown below;

OR
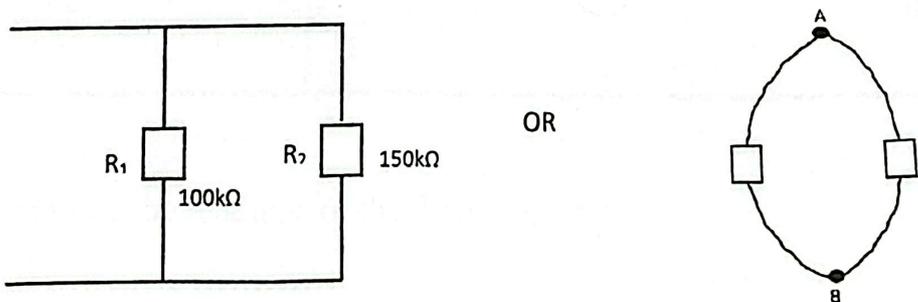
Measure the parallel resistance between test points A and B

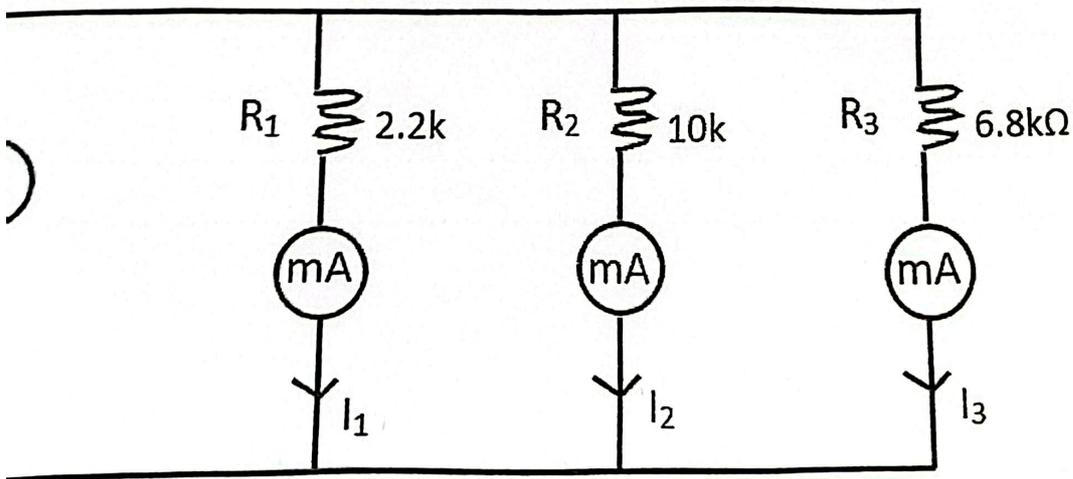$R_T = \ldots\ldots\ldots\ldots\Omega$

Compute the parallel resistance from

$$R_T = \frac{R_1 R_2}{R_1 + R_2} = \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$

$$\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$

d. Comment on the total parallel resistance with respect to the resistance values of the individual resistor...

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rents in A Parallel Circuit

ough the voltage in a parallel circuit is the same, the currents in the branches
ot the same in most cases.

Connect a parallel network of the resistors as shown below:

ompute the readings of the three millimeters

=.........................mA

=.........................mA

=.........................mA

c. Estimate the branch currents from the following expressions

$$I_1 = \frac{V}{R_1} = \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$

$$I_2 = \frac{V}{R_2} = \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$

$$I_3 = \frac{V}{R_3} = \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$

d. What is your comment on currents in a parallel circuit....................

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e. Does your millimeter readings and the calculated values of current tally?

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If the answer is No. why?

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APPLICATION OF SERIES AND PARALLEL CIRCUITS

Voltage division – series

Current limitations.

Voltage Division

In this practical, we will see how the supply voltage of 5V is divided among the series connected resistor. In the circuit, R_1 is a fixed valued resistor but R_2 is a variable resistor. Gradually increasing the resistance value of the variable resistor (from 0Ω to 500Ω), by turning the shaft in the clockwise direction, ensures that the circuit voltages is divided among R_1 and R_2.

Voltage Division Principle
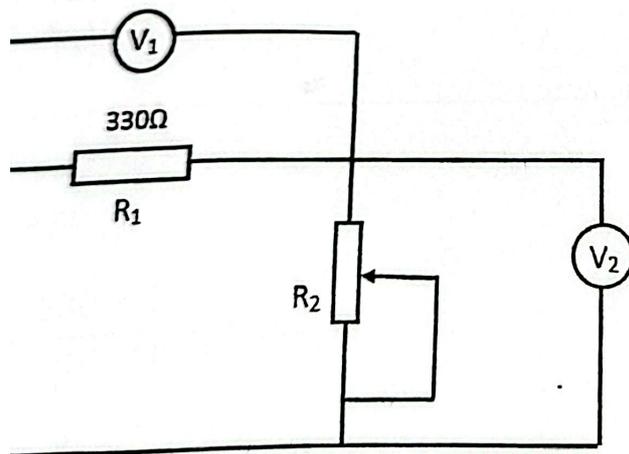
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Connect the circuit as shown above

2. Adjust the supply voltage to 5V by turning the variable power supply
3. Turn R_2 counter clockwise to the end, so that the value of RAC is zero
   N|B: RAC is the resistance between the left and the enter terminals of the variable resistor.
4. Read the value of V_1 across R_1 and write it down in the table below.
5. Turn R_2 clockwise so that RAC have different values as shown in the false.
   Record the values of V_1 and V_2 against the value of RAC.

Ω	0	50	100	150	200	250	300	350	400	450	500
Measure											
Calculated	4.342	3.837	3.438	3.11	2.845	2.619	2.5	2.426	2.260	2.115	1.988
Measure											
Calculated	0.658	1.163	1.563	1.888	2.155	2.38	2.5	2.524	2.739	2.885	3.012

$R_{AC} = 50$

$$V_1 = \frac{330 \times 5}{330 \times 50} = 4.342$$

$$V_2 = \frac{50 \times 5}{330 \times 50} = 0.658$$

$R_{AC} = 100$

$$V_1 = \frac{(330 \times 5)}{(330 \times 100)} = 3.837$$

$$V_2 = \frac{(100 \times 5)}{(330 \times 100)} = 1.163$$

$R_{AC} = 150$

$$V_1 = \frac{(330 \times 5)}{(330 \times 150)} = 3.438$$
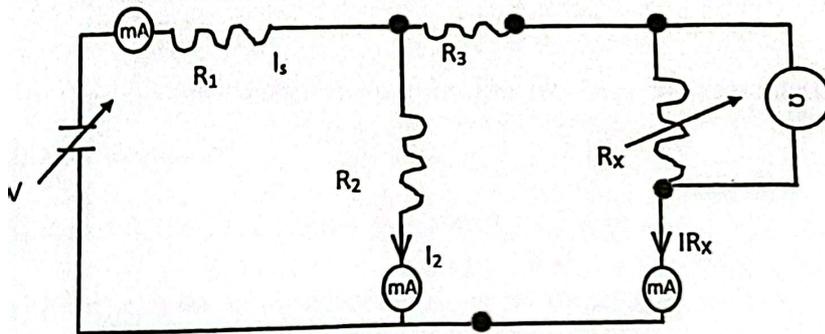
$$V_2 = (\frac{(150 \times 5)}{330 \times 150} = 1.563$$

$R_{AC} = 200$

$$V_1 = \frac{(330 \times 5)}{(330 \times 200)} = 3.11$$

$$V_2 = (\frac{(200 \times 5)}{330 \times 200} = 1.888$$

$R_{AC} = 250$

$$V_1 = \frac{(330 \times 5)}{(330 \times 250)} = 2.845$$

$$V_2 = (\frac{(250 \times 5)}{330 \times 250} = 2.155$$

$R_{AC} = 300$

$$= \frac{(330 \times 5)}{(330 \times 300)} = 2.619$$

$$= (\frac{(300 \times 5)}{330 \times 300} = 2.38$$

$$V_1 = \frac{(330 \times 5)}{(330 \times 330)} = 2.5$$

$$V_2 = (\frac{(330 \times 5)}{330 \times 330)} = 2.5$$

$R_{AC}=350$

$$V_1 = \frac{(330 \times 5)}{(330 \times 350)} = 2.426$$

$$V_2 = (\frac{(350 \times 5)}{330 \times 350)} = 2.524$$

$R_{AC}=400$

$$V_1 = \frac{(330 \times 5)}{(330 \times 400)} = 2.260$$

$$V_2 = (\frac{(400 \times 5)}{330 \times 400)} = 2.739$$

$R_{AC}=450$

$$= \frac{(330 \times 5)}{(330 \times 450)} = 2.113$$

$$= (\frac{(450 \times 5)}{330 \times 450)} = 2.885$$

500

$$\frac{(330 \times 5)}{(330 \times 500)} = 1.980$$

$$\frac{(500 \times 5)}{(500 \times 500)} = 3.022$$

URRENT DIVISION PRINCIPLE

paratus

1. $R_1 = 1k\Omega$

2. $R_2 = 2k\Omega$

3. $R_3 = 1k\Omega$

1. $R_X = 2k\Omega$ (PoT)

i. A variable power supply

i. Ohmmeter

'. Millimeter – 3pcs

maximum circuit current will occur when the variable resistor is zero to zero

$$x = \frac{V}{R_1} + [R_2 \| (R_3 + R_x)]$$

$$nax = \frac{V}{R_1} + [R_2 \| R_3] = R_1 + \left(\frac{R_2 R_3}{R_2 + R_3}\right) = \frac{9}{1 + \left[\frac{2 \times 1}{2 \times 1}\right]} = \frac{9}{1.666} mA$$

$$= 5.4 mA$$

the maximum passage of ... is expected to be shared by the branches ... R_1 ... and the of the branch consisting of R_2 and R_3 in series ...

R_2 when R_x is maximum, current in the R_x branch will be:

$$I_2 = \frac{R_1 \times I}{R_1 + R_2 + R_3}\ mA = \frac{2 \times 5.4}{2 + 1 + 2}\ mA = \frac{10.8}{5} = 2.16\ mA$$

by the current division principle, the IR_x branch. The maximum current in the R_x branch would be

$$I_{max} = 5.4\ mA - 2.16\ mA = 3.24\ mA$$

$I_x(min)$ can be obtained when R_x is set to zero (0)

$$I_x(min) = \frac{R_3 \times 5.4}{R_1 + R_3}\ mA = \frac{1 \times 5.4}{1 + 2} = \frac{5.4}{3}\ mA = 1.8\ mA$$

Complete the table below as the value of R_x is varied.

	0	100	150	200	400	600	800	1000	1200	1400	1600	1800	2000
Measure													
Calculated	5.26			5.14	4.93	4.76	4.62	4.5	4.39	4.30	4.22	4.16	4.09
Measure													
Calculated													
Measure													
Calculated													

R_X can be obtained from the expression

$$RX = \frac{R_2 \times I_s}{R_2 + R_3 + R_X} \dots\dots\dots\dots\dots$$

After obtaining the I_{RX}, the I_2 can be obtained from two methods.

Method I

$$= I_s - I_{RX}\dots\dots\dots\dots\dots$$

Method II

$$= \frac{(R_3 + R_X)I_S}{R_2 + R_3 + R_X}\dots\dots\dots\dots$$

Questions

. For every value of R_X measure the I_2 value

. Use the I_2 expression to estimate its value for all cases of R_X

. Obtain the value of I_{RX} using both the millimeter, and the I_{RX} expression, and tabulate the results.

Current division principle

$$= \frac{V}{R_1 + [R_2 \| (R_3 + R_X)]} = \frac{9}{1 + [2\|1 + 0.1]} = \frac{9}{1 + 2\|1.1} = \frac{9}{1.71}$$

$$= 5.26 mA$$

$$) = \frac{9}{1.73} = 5.20 mA$$

$$\frac{9}{1 + (2\|1.2)} = \frac{9}{1.75} = 5.14 mA$$

$$_{_{500}} = \frac{9}{1 + (2 \| 1.4)} = \frac{9}{1.824} = 4.93mA$$

$$_{_{500}} = \frac{9}{1 + (2 \| 1.6)} = \frac{9}{1.888} = 4.76mA$$

$$_{_{00}} = \frac{9}{1 + (2 \| 1.8)} = \frac{9}{1.947} = 4.622mA$$

$$_{_{00}} = \frac{9}{1 + 2 \| 2} = \frac{9}{2} = 4.5mA$$

$$_{_{00}} = \frac{9}{1 + 2 \| 2.2} = \frac{9}{2.047} = 4.39mA$$

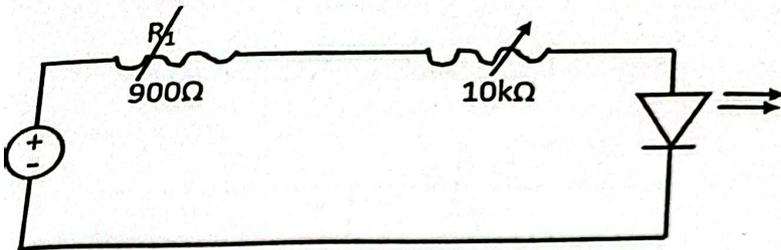$$_{_{0}} = \frac{9}{1 + 2 \| 2.4} = \frac{9}{2.09} = 4.30mA$$

$$_{_{0}} = \frac{9}{1 + (2 \| 2.6)} = \frac{9}{2.13} = 4.22mA$$

$$= \frac{9}{1 + 2 \| 2.8} = \frac{9}{2.166} = 4.155mA$$

$$= \frac{9}{1 + 2 \| 3} = \frac{9}{2.2} = 4.09mA$$

IGHTNESS CONTROLOF LEDS USING A POT


practical: the application of a potentiometer for controlling the brightness of
is demonstrated, the variable resistor is connected such that, as the PoT is
lockwise, the LED gives more light. And if the PoT is turned in the counter
e direction, the LED gives less light.

tion of the 900Ω fixed resistor is to ensure that the LED is protected
ort-circuit, when the PoT is turned counter clockwise to the end (zero

KIRCHHOFF'S VOLTAGE LAW (KVL)

Kirchhoff's voltage law (KVL) State that the algebraic sum of voltage in a closed loop is equal to zero.
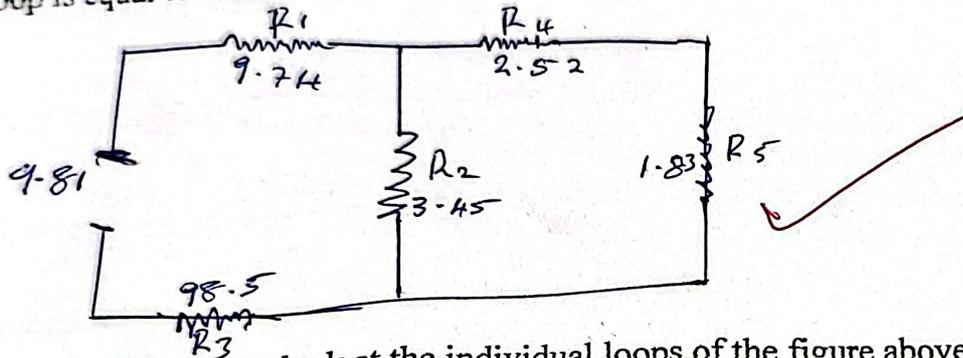
To verify KVL, let us look at the individual loops of the figure above.

loop 1, following the clockwise direction of the mesh current.

$$_s + V_1 + V_2 + V_3 = 0$$

$$\cdot V_2 + V_3 = V_s \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

2

second loop (loop 2), the voltage drop across R_2; i.e. V_2 serves as the voltage

Therefore, the expression is as follows;

$$^{\prime}4 + V5 = 0$$

$$= V_2 \ldots\ldots\ldots\ldots\ldots (2)$$

ation; The first loop voltages are as follows;

$$R_1 = \frac{R_1 V_s}{R_1 + R_2 + R_3} = \frac{1 \times 5}{1 + 2.4 + 1.2} V = \frac{5}{4.6} = 1.086V$$

$$= \frac{R_2 V_s}{R_1 + R_2 + R_3} = \frac{2.5 \times 5}{4.6} V = \frac{12}{4.6} = 2.60V$$

$$= \frac{R_3 V_s}{4.6} = \frac{1.2 \times 5}{4.6} V = \frac{6}{4.6} = 1.304V$$

the second loop, the voltages are as follows;

nce $V_2 = 2.60V$ for loop 1,

$$= \frac{R_4 V_2}{R4 + R5} = \frac{1.2 \times 2.6}{41.2 + 1} = \frac{3.12}{2.2} V = 1.418V$$

$$= \frac{R_5 V_2}{R4 + R5} = \frac{1 \times 2.6}{2.2} = 1.18V$$

edure:

Connect the circuit as shown

Record the readings of the voltages in the table below:

V_1	V_2	V_3	V_4	V_5	V_s
5.83	0.30	8.45	0.18	0.12	9.81

sing equation (1), and the figures in the table above, compute $V_1 + V_2 + V_3$

I_s

ng equation (2), compute $V_4 + V_5 = V_2$

KVL satisfied in the loop 1? If yes, how.................................

Is the KVL satisfied in loop 2? If yes, how?