Quadrant -II- Transcript and Related Materials

Programme :- T.Y. B.Sc.

Subject : Physics

Semester : VI

Course Code : PYC109

Course Title : Solid State Devices and Instrumentation

UNIT 1 : Measuring Instrument

Module Name : Ohmmeter- Series and Shunt type and Multimeter

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Notes:-OHMMETER

Study and Design DC Voltmeter using Permanent Magnetic Moving Coil (PMMC) Or D'Arsonval movement .

What is D' Arsonval Movement?

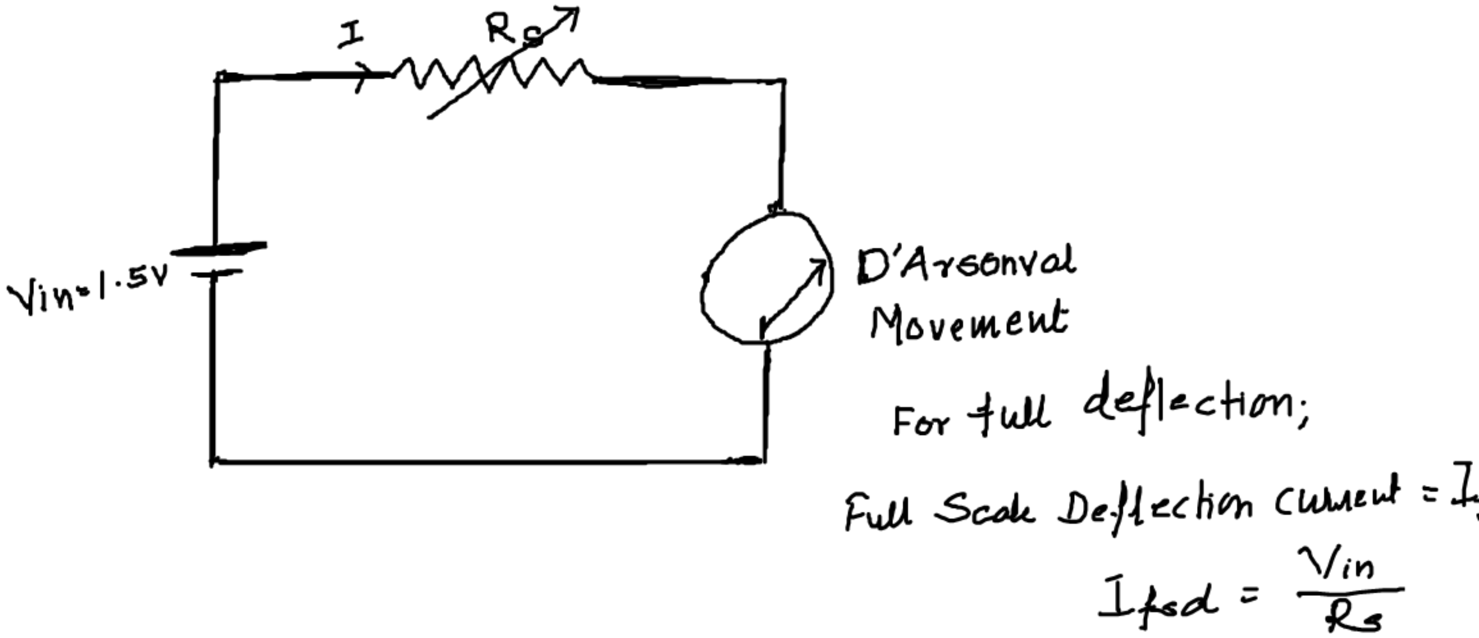
D' Arsonval Movement has the basic of a dc ammeter. The coil winding of this PMMC is small and light, it can carry only small currents. When the large currents are to be measured through D' Arsonval Movement, it is necessary to bypass a major part of the current through a resistance called SHUNT.

To design PMMC as OHMMETER, we should find

1) Full scale deflection current of the Movement = Ifsd

2) Internal Resistance of the Movement = Rm

Circuit diagram to determine Ifsd of PMMC



To Find Full Scale Deflection Current=Ifsd

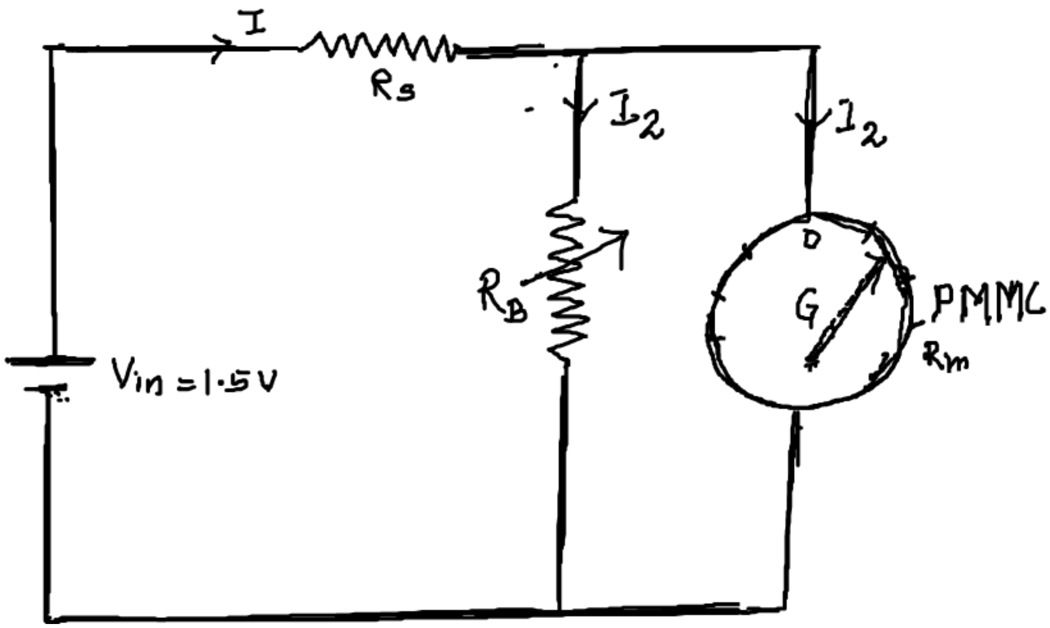
1) Connect the circuit as shown.

2) Vary the resistance Rs, till you get full deflection in the D' Arsonval Movement

Here Full Scale Deflection Current is

Ifsd = Vin / Rs

Circuit Diagram do determine Rm



Total current I=

For half deflec

$I_1 = I_2$

$V/R_B = V/R_M$

$\cancel{V} R_M = \cancel{V} R_B$

$\therefore R_M = R_B$ //

1) **Vin= constant**

2) Vary Rs till you get full scale deflection in the PMMC.

3) Connect Resistance Box (0-500Ω) across PMMC

4) Remove the resistances from the resistance box, till you get half deflection in the meter movement.

5)Note down the resistance value of the resistance box and it is Exactly equal to the value of meter resistance.

Sensitivity of a meter= S

Sensitivity=S= □/□□□□.=□/□□□μ□ = 5 kΩ/Volt

Calculate the sensitivity of a 200μA meter movement which is To be used as a dc voltmeter.

OHMMETER (SERIES TYPE OHMMETER)

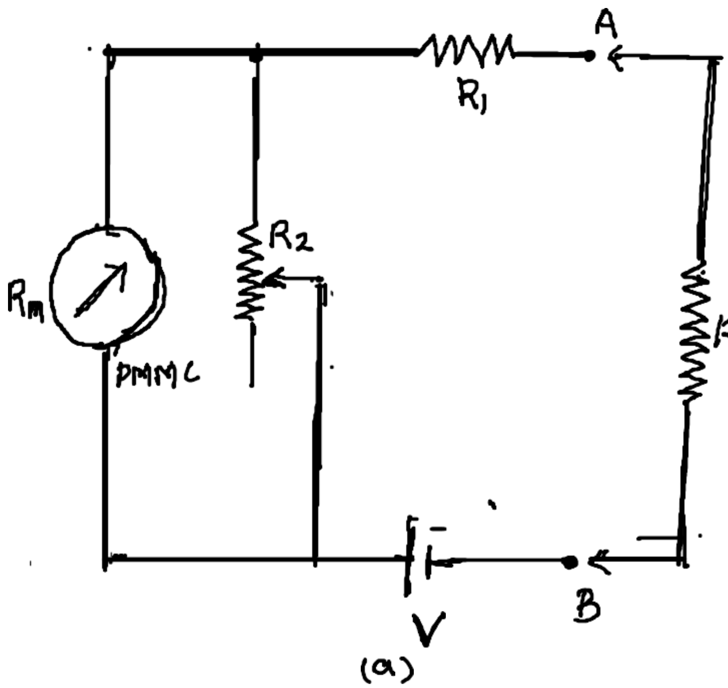
The basic D'Arsonval movement is connected in series with

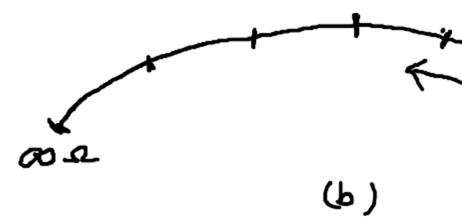
a resistance R1 and a battery which is connected to a pair of terminals A and B, across which the unknown resistance is connected. The current flowing through the movement then depends on the magnitude of the unknown resistance. Hence the meter deflection is directly proportional to the value of unknown resistance.

Circuit Diagram:- Here R1=Current Limiting Resistance,

R2= Zero adjust resistance V= Battery Rm=meter resistance

And Rx=Unknown resistance





(a) Series type ohmmeter

(b) Dial of series ohmmeter

Calibration of the Series Type Ohmmeter:- To mark "0" reading on the scale, the terminals A and B are shorted i.e.

The unknown resistance Rx=0 and hence maximum current flows in the circuit and the shunt resistance R2 is adjusted until the movement indicates full scale current (Ifsd).The position of the pointer on the scale is then marked "0" Ohms.

Similarly to mark "∞" reading on the scale. Terminals A and B are

Open.

Therefore the unknown resistance Rx= ∞,no current flow in the circuit and there is no deflection in the pointer.The position of the pointer is marked as "∞" ohms.

By connecting different known values of the unknown resistance to terminals A and B, intermediate markings can be done on the scale. The accuracy of the instrument can be checked by measuring different values of standard resistance.

The major drawback in the series ohmmeter is the decrease in voltage of the intThe series Ohmmeter is a simple design, The values of R1 and R2 can be determined from the values of Rx which gives half the full deflection.ernal battery with time and age. Due to this, the full scale deflection current drops and the meter does not read "0" when A and B shorted. The variable shunt resistor R2 across the movement is adjusted to counteract the drop in battery voltage, thereby bringing the pointer back to "0" ohms on the scale. It is also possible to adjust the full scale deflection current without the shunt R2 in the circuit.

The series Ohmmeter is a simple design, The values of R1 and R2 can be determined from the values of Rx which gives half the full deflection.

Here Rh=R1+R2 IIel Rm =R1 +□2□□/(□2+□□)------ (1)

Where Rh=Half of full deflection resistance.

The total resistance presented to the battery then equals 2Rh and the battery current needed to supply half deflection is half deflection is Ih=□/2□*h* --------------------------------- (2)

To produce full scale current, the battery current must be doubled. Therefore the total current of the ckt.It=□/□*h*---------(3)

The shunt current through R2 is I2= It – Ifsd -----------(4)

The voltage across the shunt, Vsh=voltage across the meter

Therefore Vsh=Vm

I2 R2 = Im Rm

Therefore R2=□□□□□□□/□2

Therefore R2=□□□□□□□/(□□−□□□□) −−−−−(5)

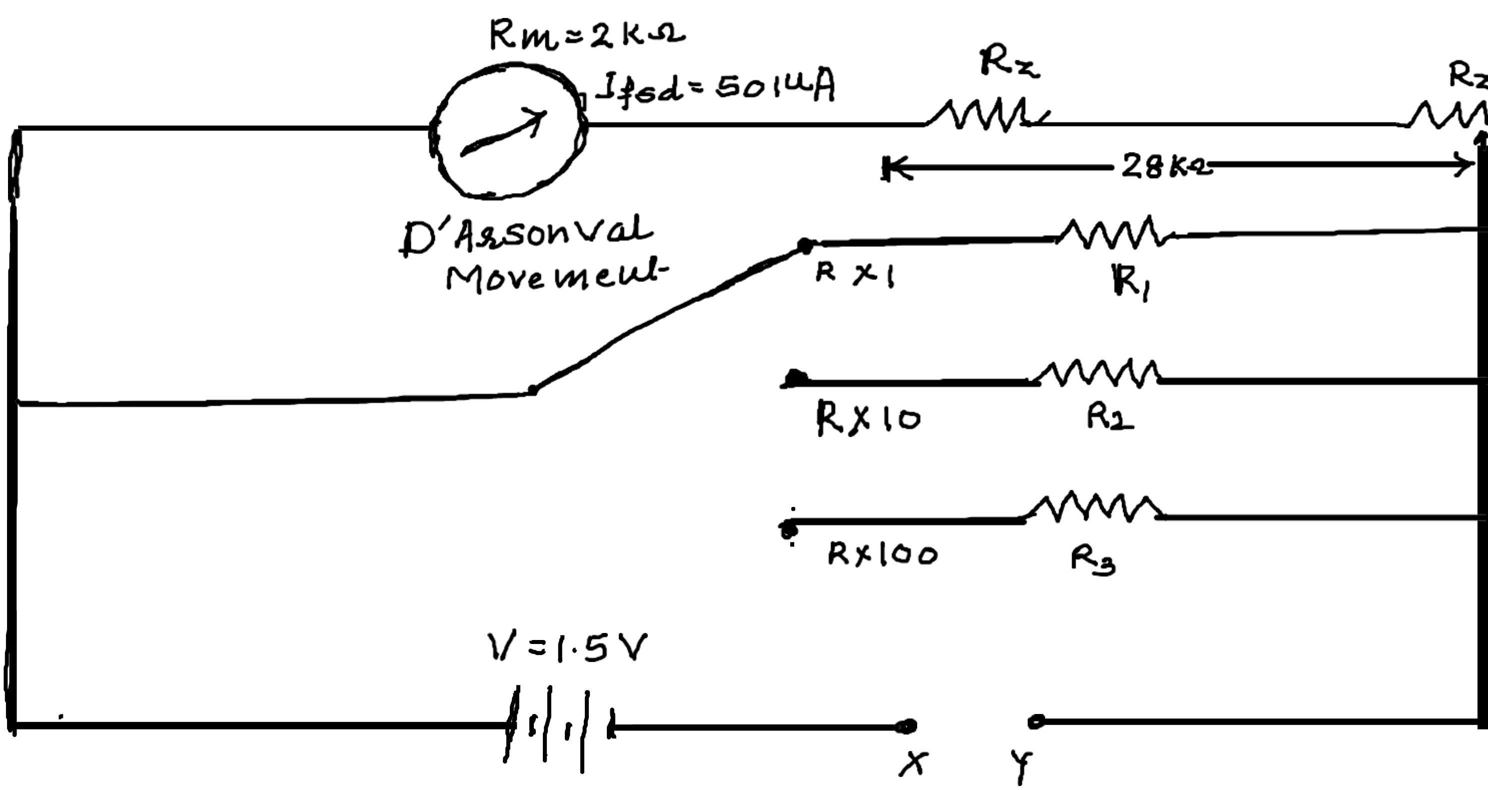
But It = □/□*h*

And R1= Rh -□□□□□□□*h*/□ −−−−−−−(6)

Hence R1 and R2 can be determined

MULTIRANGE OHMMETER

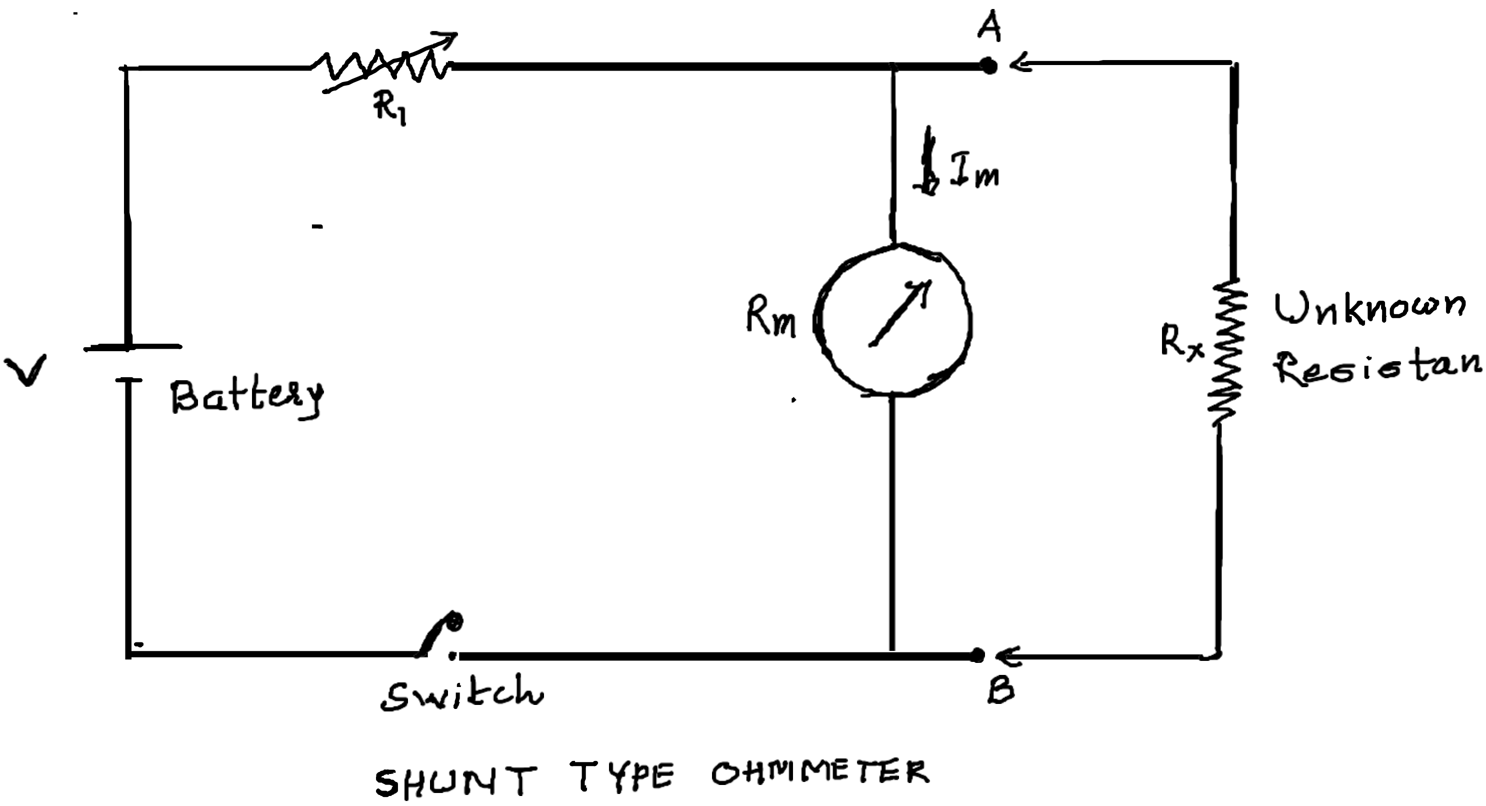
To measure resistance over a wide range of values, we need to extend the ohmmeter ranges. This type of Ohmmeter is called a multirange ohmmeter.



SHUNT TYPE OHMMETER

Shunt type Ohmmeter is usually designed for low resistance applications. It consist of a battery in series with an adjustable resistance R1 and a D'Arsonval movement. The unknown resistance is connected in parallel with the meter, across the terminals A and B. Therefore it is called as Shunt type Ohmmeter. In this circuit it is necessary to have an ON/OFF switch to disconnect from the circuit when not in use.

Circuit Diagram of Shunt Type Ohmmeter



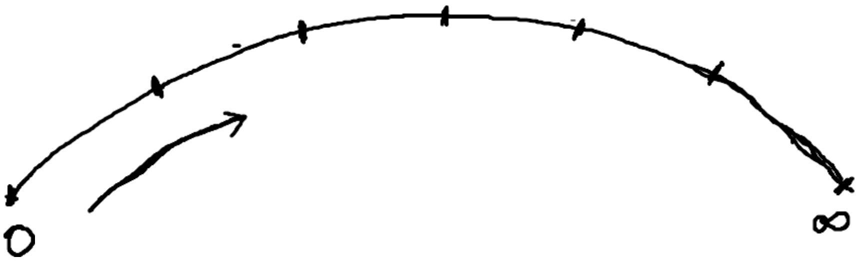
Calibration of the Shunt Type Ohmmeter

To mark the "0" ohms reading on the scale,terminals A and

B are shorted, i.e. the unknown resistance Rx=0, and the current through the meter movement is zero, since it is bypassed by the short-circuit,This pointer position is marked as "0" ohms.

Similarly to mark "∞" on the scale, the terminals A and B ar[redacted]opened, i.e. Rt=∞, and full current flows through the meter movement. By appropriate selection of the value of R1, the pointer can be made to read full scale deflection current. This
Position of the pointer is marked as " ∞" ohms. Intermediate markings can be done by connecting known values of standard Resistors to the terminals A and B.

Therefore this ohmmeter has a zero mark at the left side of the scale and an ∞ mark on the right side of the scale, corresponding to full scale deflection current i. e. as shown



MULTIMETER

Multimeter is also known as AVO meter. It is a electronic measuring instrument that combines several measurement functions in one unit.

The main part of an analog multimeter is the D'Arsonval movement also known as the Permanent-Magnet moving-coil (PMMC) movement. It has multiple scales on the dial, a moving needle and many manual settings on the function switch.Analog Multimeter scales and zero position adjustment. A typical analog multimeter has several scales.

Each scale consist of a curved line that is marked of into sections or divisions. A range identifies the high and low limits of the scale. The zero adjustment should not normally need to be touched, but it may vary slightly with time and temperature.Adjustment should be made with the meter not in use and it should be gently adjusted with the screwdriver to ensure the meter is properly zeroed.

References and Acknowledgement

1)H.S.Kalsi, Electronic Instrumentation, TMH (2004)