Hello Students,

Here I'm going to explain you about measuring instruments.

Model name is AC and DC Volt meter, multirange voltmeter, extending multimeter range And transistor voltmeter.

Outline of this course is AC and DC Volt meter, multirange voltmeter, extending multimeter range And transistor voltmeter.

Learning outcomes, the student will be able to design and assemble DC And AC voltmeters of various ranges using D'Arsonval movement.

AC Voltmeter

The instrument which is used to measure AC voltage across any two points of electric circuit is called AC voltmeter.

If the AC voltmeter consists of rectifier, then it is said to be rectifier based AC Voltmeter.

If we want to use DC voltmeter for measuring AC voltages, then we have to follow these TWO steps.

The two types of Rectifier based AC voltmeters are

1) AC voltmeter using HALF wave rectifier
2) AC voltmeter using FULL wave rectifier

AC voltmeter using Half Wave Rectifier

Half wave rectifier is connected ahead of DC voltmeter.

The block diagram consists of two blocks, half wave rectifier

and a DC voltmeter.

Block Diagram of AC Voltmeter

The input to be measured is given to the attenuator circuit,
which performs the operation of selection of a particular range of voltage. The output of attenuator is given to rectifier which converts the AC voltage into pulsating DC voltage. The final output of DC amplifier is given to PMMC meter.
DC VOLTMETER

Study and Design DC Voltmeter using Permanent Magnetic Moving Coil (PMMC) Or 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 DC Voltmeter, we should find:-

1) Full scale deflection current of the Movement = Ifsd

2) Internal Resistance of the Movement = Rm

To determine Ifsd, this is the circuit.

Here voltage applied is equal to 1.5 volt.

Rs is the current limiting resistors

connected in series to the PMMC and we're finding out the

Ifsd full scale deflection current.

To get a full scale deflection current,

Keep V is equal to 1.5 Volt constant

and vary Rs till you get full deflection in the PMMC.

Therefore full scale deflection current is Ifsd is equal to V divided by Rs.

Second part, Once We found the full scale deflection current of the meter.

then we have to find out the meter resistance of this PMMC,

To determine the meter resistance of these PMMC,

Connect one resistance RB in parallel to the PMMC. 1st.

Keep RB open. See that very weather it is in full scale deflection.

Then connect RB .Vary this .till you get half scale deflection

When you get half scale deflection then the current flowing through the

Resistance RB is exactly equal to current flowing through the resistance

through the galvanometer or PMMC.

Therefore total current I is equal to I1 Plus I2 and when

it is in half scale deflection. I1 is exactly equal to I2. Therefore current

flowing through the resistance RB is exactly equal to the current

flowing through the PMMC.

Hence resistance is of the meter is exactly equal to resistance of the box,

which is connected in parallel.

You can go through this.

The next sensitivity of the meter.

Or you can find how much sensitive.

sensitivity is equal to

1 upon full scale deflection current.

The unit of this is kilo ohm per volt.

To calculate the sensitivity

of 200 microampere meter,

this is the FSD full scale

deflection current.

How much it can deflect maximum

is given to find the sensitivity

of this one upon Ifsd,

that is one upon 200 micro ampere and

sensitivity is equal to 500K ohm per.

Now let me come to DC Voltmeter

the basic D arsenal moment can be

converted into a DC voltmeter by

adding a series resistor known as multiplier.

The function of the multiplier is

to limit the current through the

movement so that the current does not

exceed the full scale deflection value.

The DC voltmeter measures the

potential difference between the two

points in a DC circuit or circuit.

Opponent, this is the circuit diagram,

so supply is given here.

Hold voltages V1.

Either it is zero to five or zero to 10 Volt or 0 to 15 Volt.or zero to 20 Volt.

Here see in the PMMC and use this multiplier to

get a full scale deflection full.

If I'm designing from zero to 15 Volt,

keep power supply 15 Volt constant and adjust series resistance for full scale

 deflection.

To measure the potential difference

between the two points in a DC circuit,

the DC voltmeter is always connected

across them with proper polarity.

This is very important.

The value of the multiplier

required is calculated as below.

I have seen first deflection current,

RM is internal resistance and Rs

is the multiplier resistance, so.

Therefore the total resistance to calculate is the designing voltage divided by Ifsd.

MULTIRANGE VOLTMETER:-Design a multirange voltmeter using D'Arsonval movement with an internal resistance of 50Ω
and a full scale deflection current of 2mA into a multirange dc
voltmeter with voltage ranges of 0-10V, 0-50V, 0-100V and
0-250V.

Design voltmeter

Given 1) Rm = 50Ω

2)Ifsd = 2mA

Solution:-

For 0-10V range (Position of the switch is at V4)
The TOTAL Resistance Rt= $V/Ifsd$= 10/2mA=5$k\Omega$
Therefore R4= Rt – Rm = 5$k\Omega$ −50Ω=4950Ω

2) For 0-50V range (Position of the switch is at V3)
The TOTAL Resistance Rt= $V/Ifsd$= 50/2mA=25$k\Omega$
Therefore R3= Rt –(R4+Rm) =25$k\Omega$−(4950Ω+50)
∴ R3= 20$k\Omega$

3) For 0-100V range (Position of the switch is at V2)
The TOTAL Resistance Rt= $V/Ifsd$= 100/2mA=50$k\Omega$
∴ R2= Rt –(R3+R4+Rm) =50$k\Omega$−(20k+4950Ω+50)
∴ R3= 50$k\Omega$ −25$k\Omega$=25$k\Omega$

4)For 0-250V range (Position of the switch is at V1)
The TOTAL Resistance Rt= $V/Ifsd$= 250/2mA=125$k\Omega$
∴ R1= Rt –(R2+R3+R4+Rm) =125k−(25k+20k+4950Ω+50)
∴ R1=125k−(50k)= 75$k\Omega$

EXTENDING VOLTMETER RANGES

The range of voltmeter can be extended to measure high

voltages, by using a high voltage probe or by using an

external multiplier resistor i. e. as shown in below figure.

TRANSISTOR VOLTMETER (TVM)

Here the input stage of the amplifier consist of a FET which

provides high input impedance to isolate the meter circuit from the circuit under measurement. The input impedance of

of a FET is greater than 10MΩ. Once the bridge is balanced then the dial indicates Zero for Zero input condition.

The two transistors Q1 and Q2 forms a dc coupled amplifier driving the meter movement. Within the dynamic range of the

amplifier, the meter deflection is proportional to the magnitude of applied input voltage.

APPLICATIONS of TVM :-1)Electronic voltmeters measure voltage both at audio as well as radio frequency power level.

2)Transistor voltmeters can be designed for measuring very high

3)Transistor voltmeters can be designed for measuring very high voltages such as to measure thousands of volts.

References and Acknowledgement

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

THANK YOU