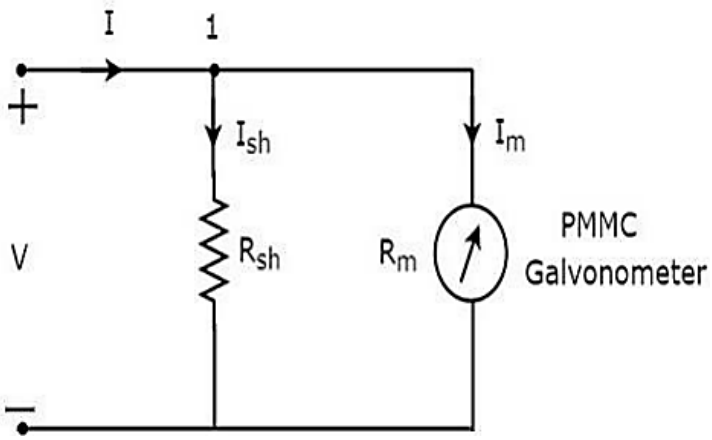
Al-Mustaqbal University College
Department of Medical Instrumentation Techniques Engineering
Class: Second
Subject: Measurements & Medical Transducers
Lecturer: Suhair Hussein
Lecture:6

DC Measuring Instruments

Dc ammeter.

Current is the rate of flow of electric charge. If this electric charge flows only in one direction, then the resultant current is called Direct Current (DC). The instrument, which is used to measure the Direct Current called DC ammeter. If we place a resistor in parallel with the Permanent Magnet Moving Coil galvanometer, then the entire combination acts as DC ammeter. The parallel resistance, which is used in DC ammeter is also called shunt resistance or simply, shunt. The value of this resistance should be considered small in order to measure the DC current of large value.



$$R_{sh} = \frac{Rm\ Im}{I_T - Im}$$

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Example:

If PMMC meter have internal resistance of 10Ω and full scale range of 1mA. Assume we wish to increase the meter range to 1A.

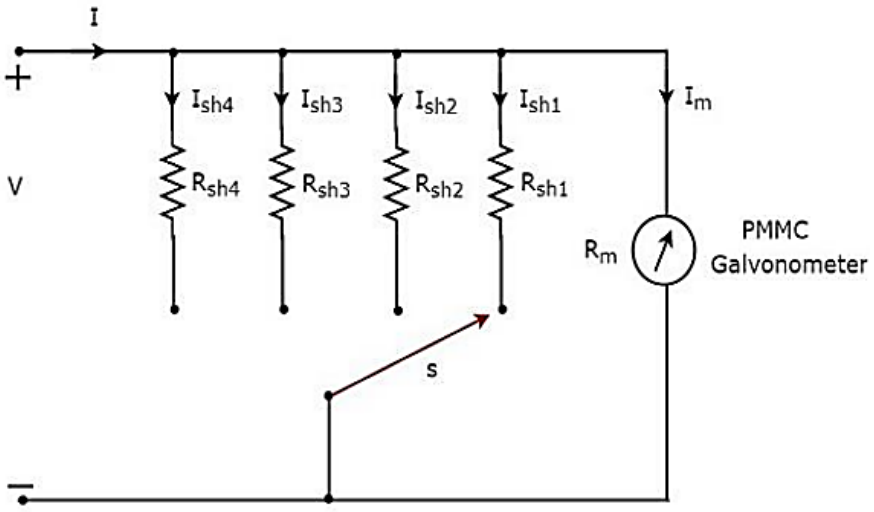
Sol.

So we must connect shunt resistance with the PMMC meter of

$$Rsh = \frac{\text{Im}\, Rm}{I_T - \text{Im}} \qquad Rsh = \frac{1\times10^{-3}\cdot 10}{1-1\times10^{-3}} = 0.01001\Omega$$

Multi range dc ammeter

DC ammeter can be used to measure a particular range of Direct currents. If we want to use the DC ammeter for measuring the Direct Currents of multiple ranges, then we have to use multiple parallel resistors instead of single resistor and this entire combination of resistors is in parallel to the galvanometer. The circuit diagram of multi range DC ammeter is shown in below figure.



$$R_{sh*} = \frac{Rm\ Im}{I_{sh*} - Im}$$

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Example (1):

Design a multirange ammeter by using ***direct method*** to give the following ranges 10mA, 100mA, 1A, 10A, and 100A. If d'Arsonval meter have internal resistance of 10Ω and full scale current of 1mA.

Sol:

Rm=10Ω Im=1mA

$$\boxed{Rsh_{*} = \frac{\mathrm{Im}\, Rm}{Ir_{*} - \mathrm{Im}}}$$

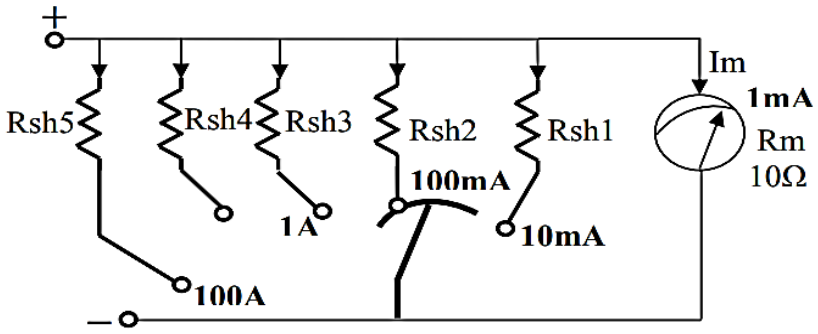
$$Rsh1 = \frac{1\times10^{-3}\cdot10}{(10-1)\times10^{-3}} = 1.11\Omega$$

$$Rsh2 = \frac{1\times10^{-3}\cdot10}{(100-10)\times10^{-3}} = 0.101\Omega$$

$$Rsh3 = \frac{1\times10^{-3}\cdot10}{1-10\times10^{-3}} = 0.0101\Omega$$

$$Rsh4 = \frac{1\times10^{-3}\cdot10}{10-1\times10^{-3}} = 0.0011\Omega$$

$$Rsh5 = \frac{1\times10^{-3}\cdot10}{100-1\times10^{-3}} = 0.00011\Omega$$



DC Voltmeters

DC voltmeter is a measuring instrument, which is used to measure the DC voltage across any two points of electric circuit. If we place a resistor in series with the Permanent Magnet Moving Coil (PMMC) galvanometer, then the entire combination together acts as DC voltmeter. The series resistance, which is used in DC voltmeter is also called series multiplier resistance or simply, multiplier. It basically limits the amount of current that flows through galvanometer in order to

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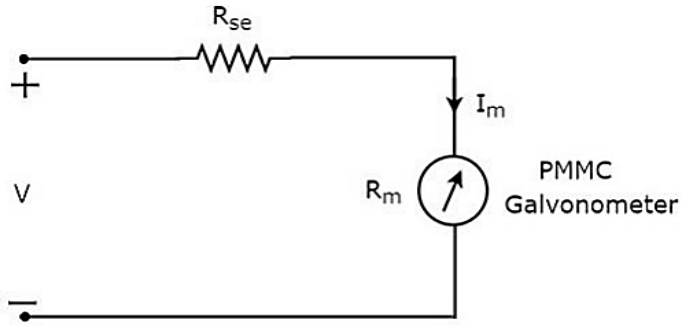
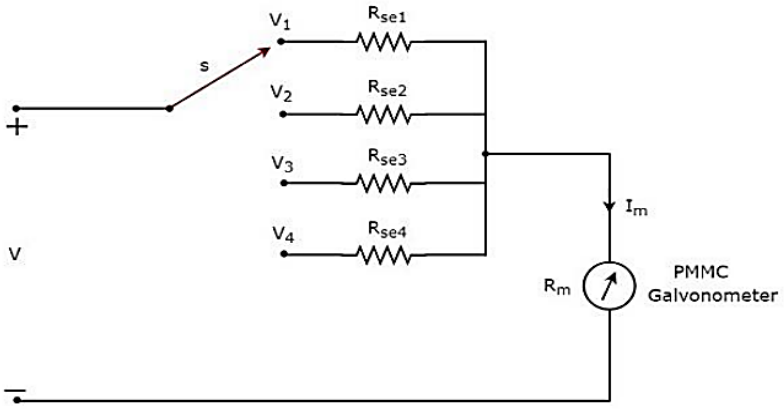
prevent the meter current from exceeding the full scale deflection value. The circuit diagram of DC voltmeter is shown in below figure.



$$R_{se} = \frac{V}{I_m} - Rm$$

Multi range Dc voltmeter

DC voltmeter can be used to measure a particular range of DC voltages. If we want to use the DC voltmeter for measuring the DC voltages of multiple ranges, then we have to use multiple parallel multiplier resistors instead of single multiplier resistor and this entire combination of resistors is in series with the galvanometer. The circuit diagram of multi range DC voltmeter is shown in below figure.



$$R_{se*} = \frac{V_*}{I_m} - Rm$$