

1. (a) With a neat diagram explain in detail the construction and working principle of PMMC instrument .  
(b) What are the shunts and multiplier? Derive the expression for both, with reference to meters used in electrical circuits.
2. (a) With a neat diagram explain in detail the construction and working principle of Attraction type Moving iron(MI) instrument.  
(b) Derive the guiding equation  $\theta = \frac{1}{2K} * i^2 * \frac{dL}{d\theta}$  where  $\theta$  is deflection in the meter,  $i$  is the current flowing through coil,  $K$  is spring constant and  $L$  is inductance of the coil.
3. Write a short notes on Repulsion type MI instruments.
4. (a) Explain the construction and working principle of Dynamometer or Electromagnetic moving coil instrument(EMMC). And derive the expression of  $\theta = \frac{i_1 * i_2}{K} * \frac{dM}{d\theta}$  where  $M$  is Mutual coupling of the coil.  
(b) Explain how EMMC type instrument can be used as a Ammeter, voltmeter and Wattmeter.
5. Write a short note in (a) Error in PMMC instrument (b) Error in MI type Instrument (c) Error in EMMC Instrument.
6. Explain how we can make multi-range voltmeter and ammeter using PMMC type instrument.
7. Write a short note on types of bridges. Explain the Maxwell's Inductance bridge, Hay's Bridge and Anderson's bridge.
8. Explain the working principle of D' Arsonval Galvanometer and write short notes on Vibration and Ballistic galvanometer.
9. What is potentiometer? Write the difference between A.C and D.C Potentiometer. Explain the working principle of D.C Potentiometer.(Reference for A.C Potentiometer is <https://circuitglobe.com/ac-potentiometer.html>)
10. What is B-H curve. Explain how to measure magnetic properties(permeability) using B-H curve experiment?
11. What is Lissajous pattern of cathode ray oscilloscope? Draw the Lissajous pattern for different fields apply on the X and Y terminals/Plates.