

ELL 301

22.01.2019

Voltmeter

(analog, based on electromagnetic effects)

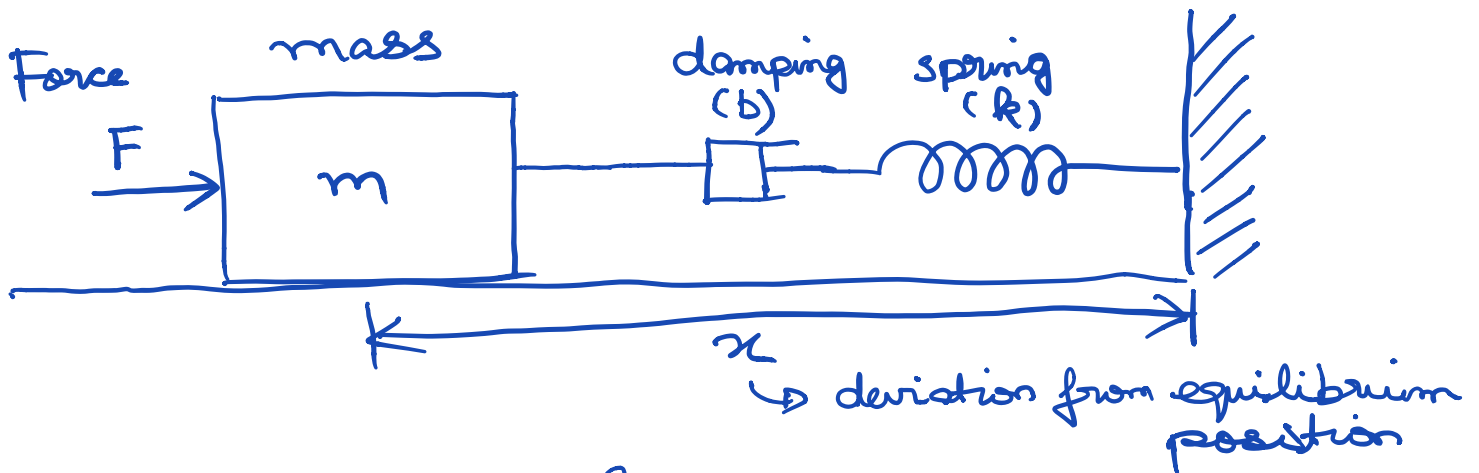


Instrument to measure voltage.

↳ PMMC (Permanent Magnet + Moving Coil)

↳ MI (Moving Iron)

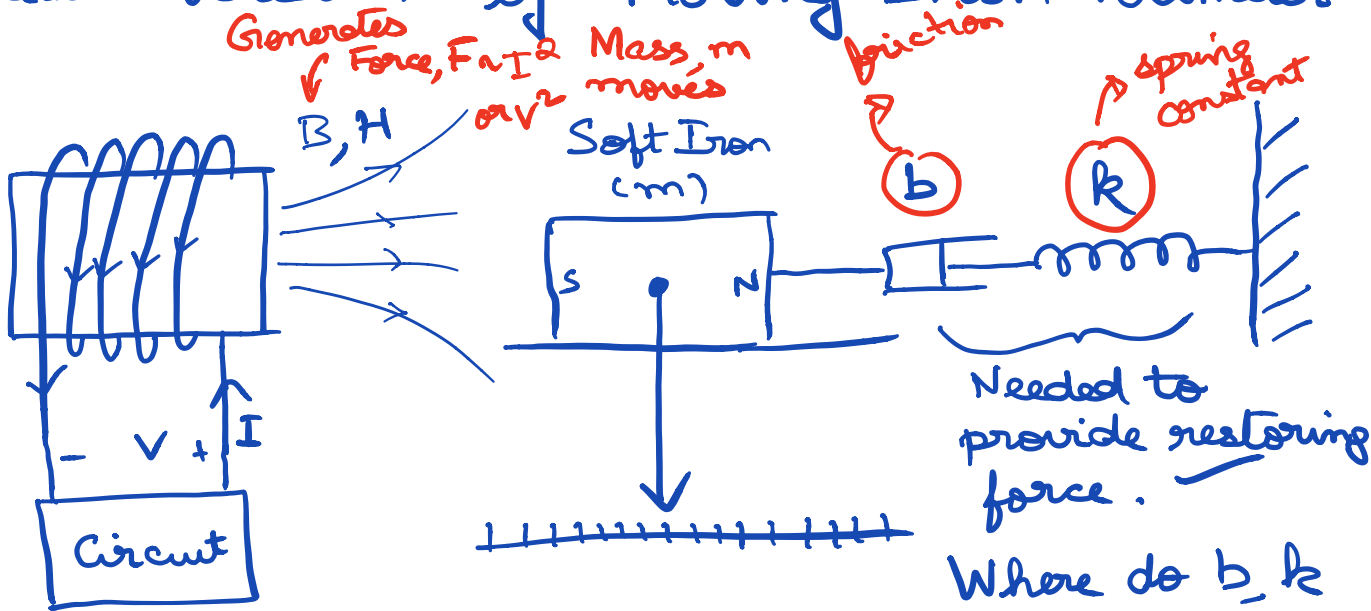
Mass - spring - damper system



Equations of motion?

$$m \ddot{x} + b \dot{x} + kx = F$$

"Linear version" of Moving Iron Voltmeter



voltage measurement, high resistance path

Needed to provide restoring force.

Where do b, k come from?

- k comes from a rotational spring



restoring torque

$$= k \theta$$

↳ deviation from angular position equilibrium.

- b comes from friction

↳ mechanical

↳ magnetic, due to eddy currents

How is force related to current?

$$F \sim B \times \text{magnetic moment of soft iron}$$

(+ geometric factors - Somydeep will get)

depends on magnetic field intensity, which also depends on I

$$\Rightarrow F \sim I \times I = I^2$$

as B depends on I

$$\sim V^2$$

(other factors also there, more turns \Rightarrow more magnetic field)

(as we are measuring voltage)

* some arrangement can be used to measure current, but current path should be in series to the circuit and also low resistance

Eqn of motion of "linear" voltmeter

$$m \ddot{x} + b \dot{x} + kx = KV^2$$

What is steady-state x ?