(0:00) Galvanometer, a galvanometer is a device used to detect current with appropriate modification (0:09) it can be converted into an ammeter which can measure currents of the order of an ampere (0:17) or milliampere to measure currents in the range of milliampere or microampere to measure (0:26) microampere currents. Construction, a light rectangular frame on which a coil on thin (0:35) copper wire is wound is pivoted between two almost frictionless pivots and placed between (0:43) cylindrical poles of a permanent magnet so that it can freely rotate in the region between (0:50) the poles. The poles are suitably shaped and a small soft iron cylindrical coil is placed (0:58) at the axis of the coil, free from the coil to obtain uniform magnetic field.
When the (1:06) current is passed through the coil, a torque acts on it and is deflected. This deflection (1:13) causes the restoring torque in the spiral springs attached at the two ends of the coil (1:21) and the coil attains a steady deflection. The pointer attached to the coil moves on (1:28) a scale and indicates the current.
Principle and working, the torque developed (1:36) in the coil due to the current passing through it is given by tau equals to n i a b sin theta (1:46) where n stands for number of turns in the coil, i stands for current through the coil, (1:54) a stands for area of the coil, b stands for magnetic intensity of the field and theta (2:03) stands for angle between area vector of the coil and the direction of magnetic intensity. (2:11) As the magnetic field is radial, angle between a bar and b bar is 90 degree in any position (2:18) of the coil and sin 90 degree being 1. Tau equals to n i a b. The restoring torque produced (2:29) in the springs is directly proportional to the deflection phi of the coil.
Therefore, (2:37) tau restoring equals to k phi where k stands for effective torsional constant of the springs.
(2:48) For steady deflection phi, n i a b equals to k phi. Therefore, i equals to k by n a b phi or (3:01) i is directly proportional to phi. The scale of the galvanometer can be appropriately (3:08) calibrated to measure the current.
To measure very weak currents of the order of 10 power (3:15) minus 11 ampere, the galvanometers with coils suspended by an elastic fiber between (3:22) appropriately designed magnetic poles are used. Conversion of galvanometer to voltmeter. (3:31) A galvanometer can be converted into a voltmeter by connecting a high resistance in series with (3:38) the galvanometer as shown.
The value of this resistance depends upon the range of the voltmeter. (3:47) In series connection, the current through the galvanometer is same as that due to the resistance. (3:56) The total resistance of voltmeter equals to R g plus R. I g equals to V by R g plus R. (4:07) R equals to V by I g minus R g. This works as a voltmeter of range 0 to V volt.
(4:21) Since the value of R is high, the effective resistance also has a higher value. (4:29) Thus, voltmeters have high resistance. Ideal voltmeter has infinite resistance.
(4:38) Conversion of galvanometer into ammeter. A galvanometer can be converted into an ammeter, (4:47) device measuring the current flowing through a conductor by connecting a low resistance (4:55) called shunt resistance in parallel to the galvanometer as shown in the figure. (5:03) Let R g represent the resistance of the galvanometer, I g the current which produces (5:11) full scale deflection in the galvanometer.

Since the shunt is connected in parallel to (5:18) the galvanometer, the potential difference across galvanometer equals to potential difference (5:25) across shunt. That is, I g R g equals to I minus I g S, whereas S is the shunt resistance. (5:40) S equals to I g by I minus I g into R g. This works as an ammeter of range 0 to 1 (5:53) ampere.
The effective resistance of shunt and galvanometer is 1 by R effective equals to 1 by (6:04) R g plus 1 by S. It is to be noted that as the value of S is low, the parallel combination (6:14) has a much lower resistance. It is for this reason that ammeter have very low resistance. (6:23) Ideal ammeters have zero resistance.

Summary:

- A **galvanometer** is an instrument used to **detect and measure small electric currents**.
- It consists of a **coil of thin copper wire** placed between **cylindrical poles of a permanent magnet**. When current flows, it experiences a **torque** and deflects, allowing current measurement.
- **Principle**: The torque τ\tauτ is proportional to the **current (I)**, where τ=NIAB\tau = N I A Bτ=NIAB, with NNN being the number of coil turns, AAA the area of the coil, and BBB the magnetic field strength.
- A **galvanometer can be converted into a voltmeter** by **connecting a high resistance in series**. **Ideal voltmeters have infinite resistance** to prevent current loss.
- A **galvanometer can be converted into an ammeter** by **connecting a low resistance (shunt) in parallel**. This allows it to measure **higher currents** while maintaining low resistance. **Ideal ammeters have zero resistance** to allow maximum current flow.

Quiz Questions

Question 1:

What is the function of a **galvanometer**?
A) It measures voltage
B) It detects and measures small electric currents ✅ (Correct)
C) It generates an electric current
D) It stores electrical energy

Question 2:

How can a **galvanometer be converted into a voltmeter**?
A) By connecting a high resistance in series ✅ (Correct)
B) By connecting a low resistance in parallel
C) By increasing the coil turns
D) By increasing the magnetic field strength

Question 3:

What type of resistance does an **ideal voltmeter** have?
A) Zero resistance
B) Low resistance
C) Infinite resistance ✅ (Correct)
D) Variable resistance

Question 4:

Why does an **ammeter have low resistance**?
A) To allow maximum voltage drop
B) To minimize current flow
C) To allow maximum current to pass through ✅ (Correct)
D) To store electrical charge
