

18ECO133T

# Sensors and Transducers

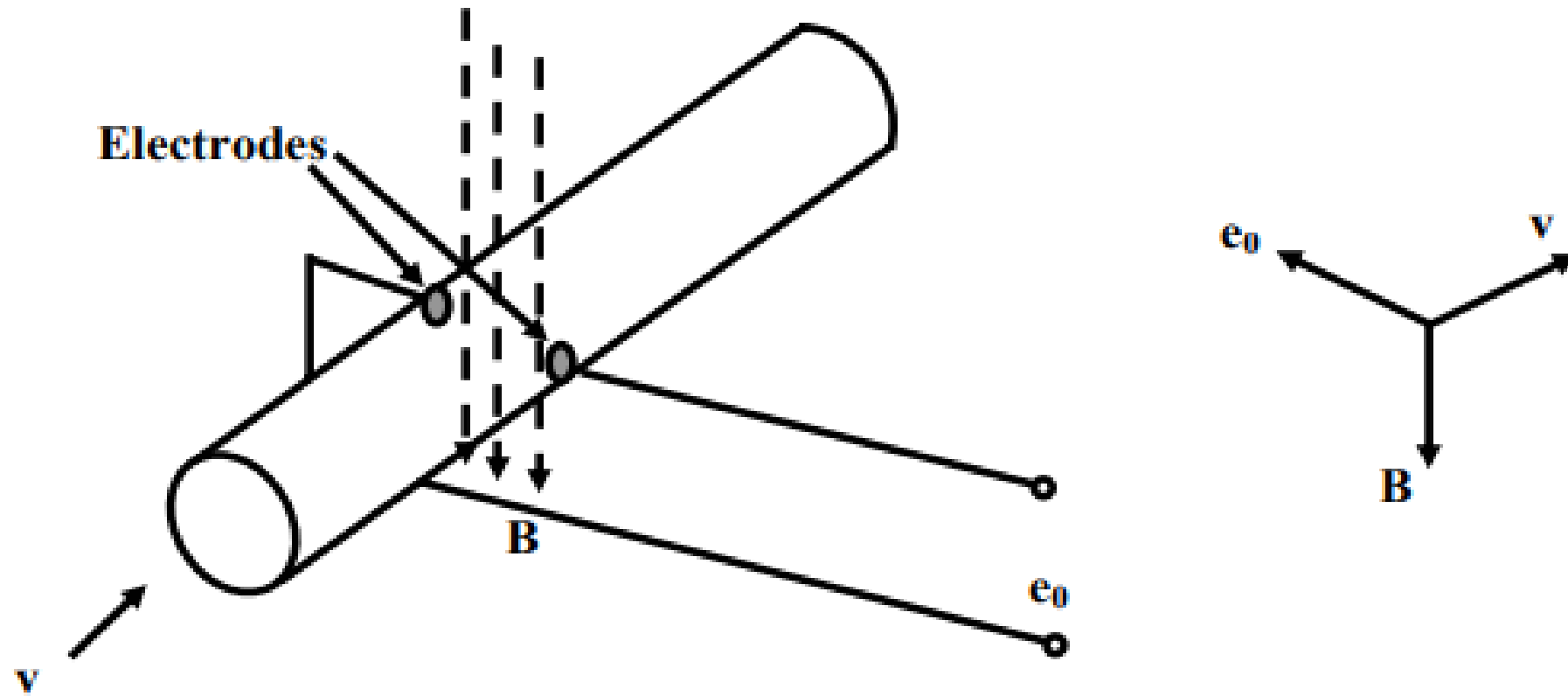
UNIT V

Unit V : Session 3 : SLO 2

# ELECTROMAGNETIC FLOWMETER

- Electromagnetic flowmeter is different from all other flowmeters due to its uniqueness on several accounts.
- The advantages of this type of flowmeter can be summarized as:
  1. It causes no obstruction to flow path.
  2. It gives complete linear output in form of voltage.
  3. The output is unaffected by changes in pressure, temperature and viscosity of the fluid.
  4. Reverse flow can also be measured.
  5. Flow velocity as low as  $10^{-6}$  m/sec can be measured.

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**Fig. 10** Electromagnetic Flowmeter

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- Electromagnetic flowmeters are suitable for measurement of velocity of conducting (Mercury) and weakly conducting (water) liquid.
- The basic principle of operation can be understood from fig. 10.
- It works on the principle of basic electromagnetic induction; i.e. when a conductor moves along a magnetic field perpendicular to the direction of flow, a voltage would be induced perpendicular to the direction of movement as also to the magnetic field. The flowing liquid acts like a conductor. External magnetic field is applied perpendicular to the direction of the flow and two electrodes are flushed on the wall of the pipeline as shown.
- The expression for the voltage induced is given by:  $e_o = Blv$

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- where  $l$  is the length of the conductor (diameter  $d$  in this case) and  $v$  is the velocity of the liquid.
- The above expression shows the complete relationship between the voltage induced and the velocity. However, the magnetic field applied is not d.c. if the liquid medium is water or any other polarizable liquid. This is because, if the magnetic field is d.c. the voltage induced will also be d.c. and a small amount of d.c. current will flow if a measuring circuit is connected to the terminals.
- This small d.c. current will cause electrolysis; oxygen and hydrogen bubbles will be formed and they will stick to the electrodes surfaces for some time. This will provide an insulating layer on the electrodes surfaces that will disrupt the voltage generation process. As a result, the magnetic field applied for these cases is a.c., or pulsed d.c. excitation. The meter can only be used for liquids having moderate conductivities (more than  $10 \mu\text{mho cm} / \text{cm}$ ). As a result, it is not suitable for gases or liquid hydrocarbons. The accuracy is around  $\pm 1\%$ .