Electromagnetic Flowmeters

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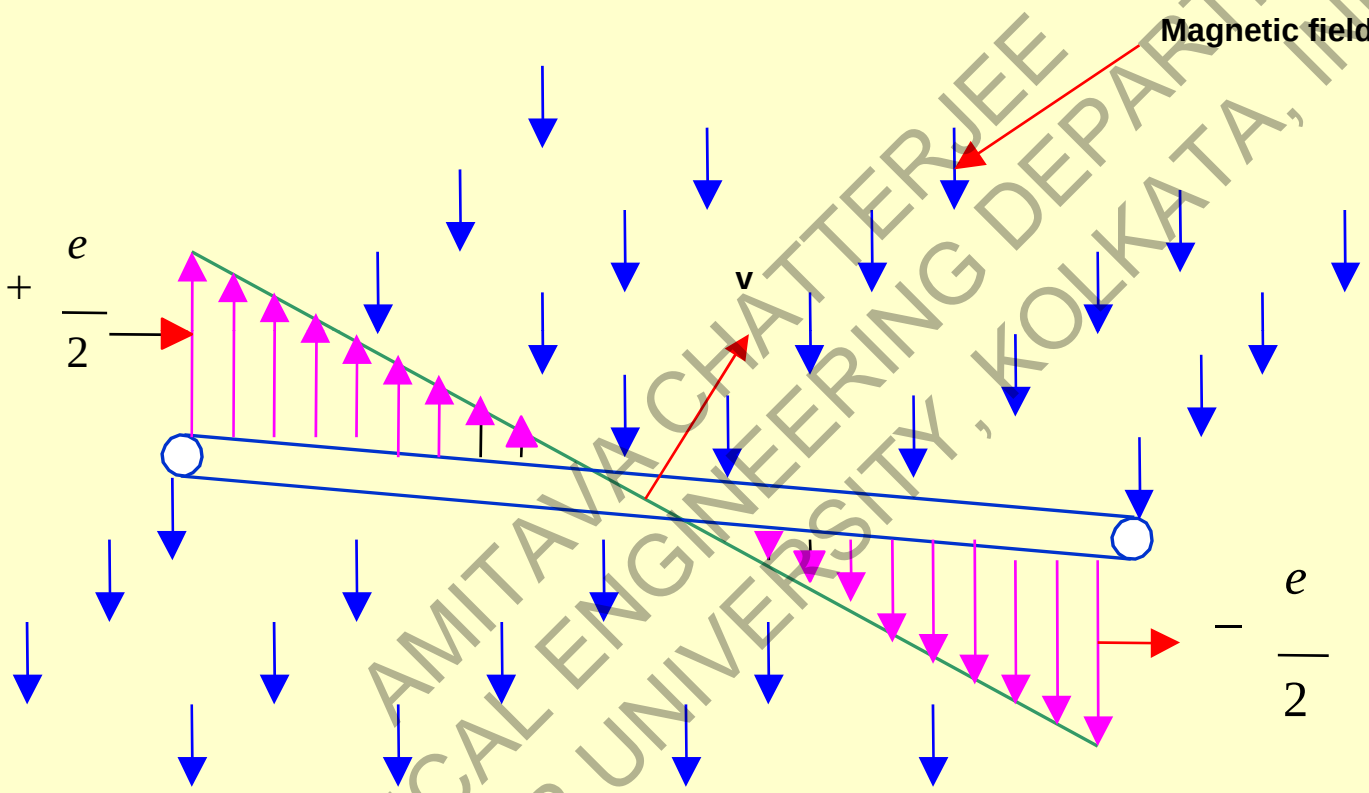
Electromagnetic flowmeters

Features:

- ✓ **The electromagnetic flowmeter is an application of the principle of induction.**
- ✓ **If a conductor of length *l* moves with a transverse velocity *v* across a magnetic field of intensity *B*, the voltage difference generated between its two ends is: $e = Blv$.**
- ✓ **If the ends of the conductor are connected to some external circuit that is stationary with respect to the magnetic field, this *e* will cause a current *i* to flow and the terminal voltage of the moving conductor becomes $e - iR$.**

Electromagnetic Flowmeters



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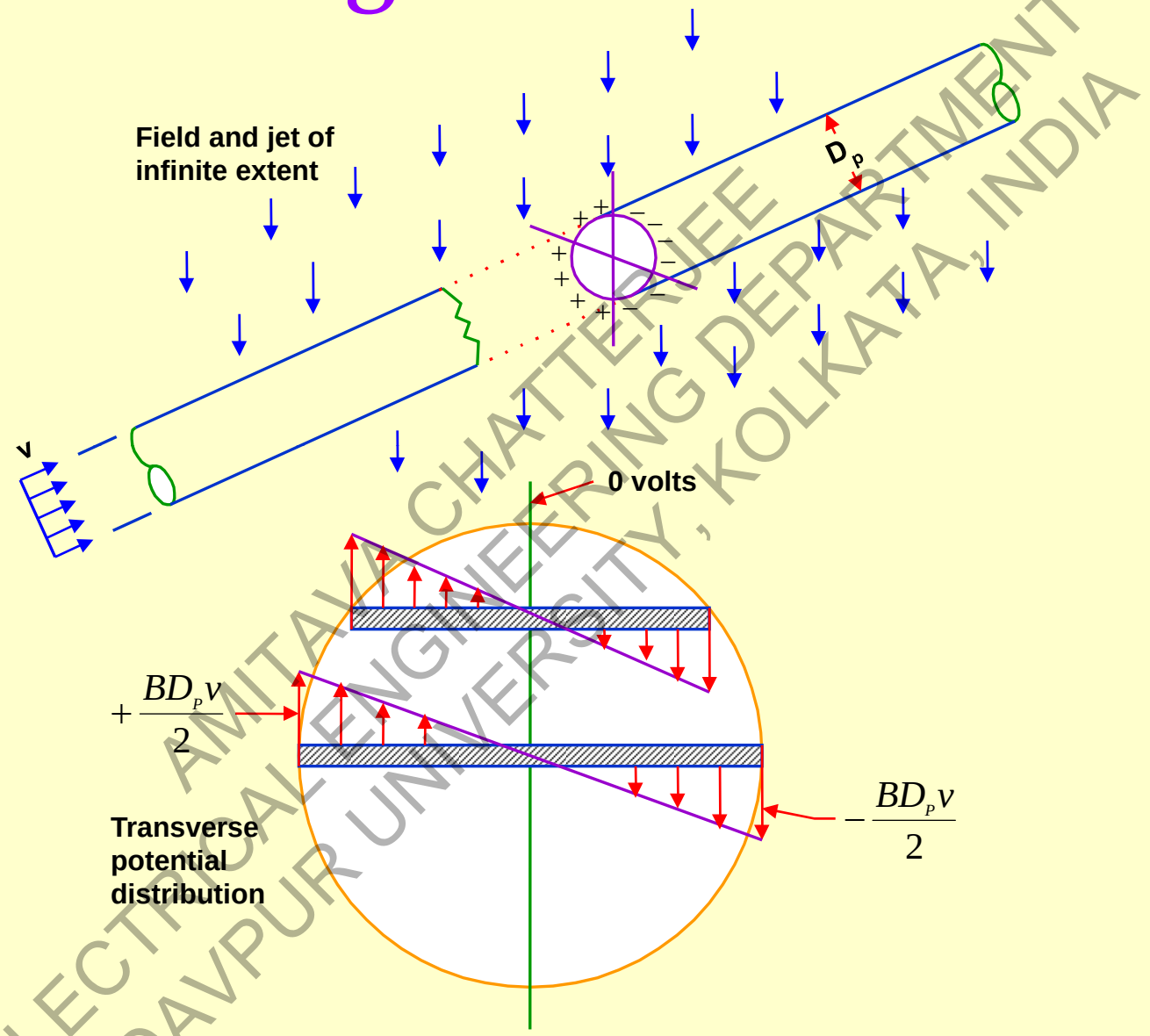

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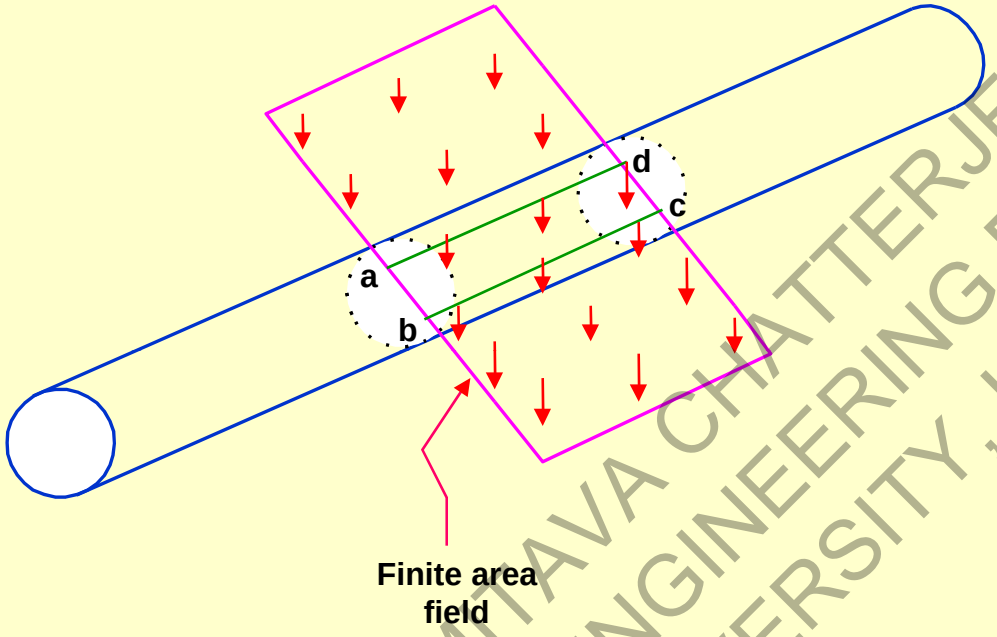
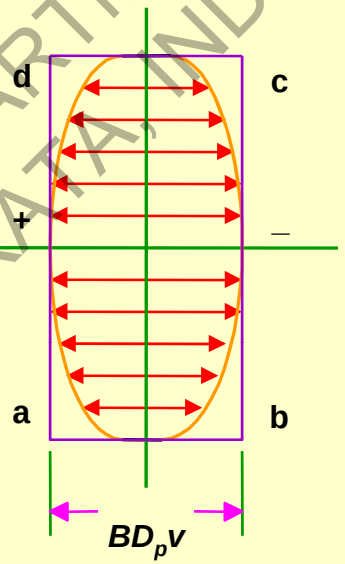
Practical Situation:





Axial potential distribution

- ✓ **The magnetic field is of limited extent.**
- ✓ **no voltage is induced in that part of the jet which is outside the field.**
- ✓ **These parts of the fluid are still conductive paths, and they tend to partially short circuit the voltages induced in the section exposed to the field.**

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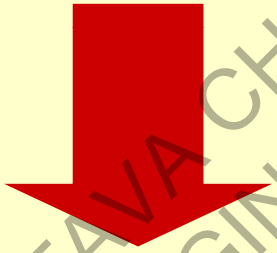
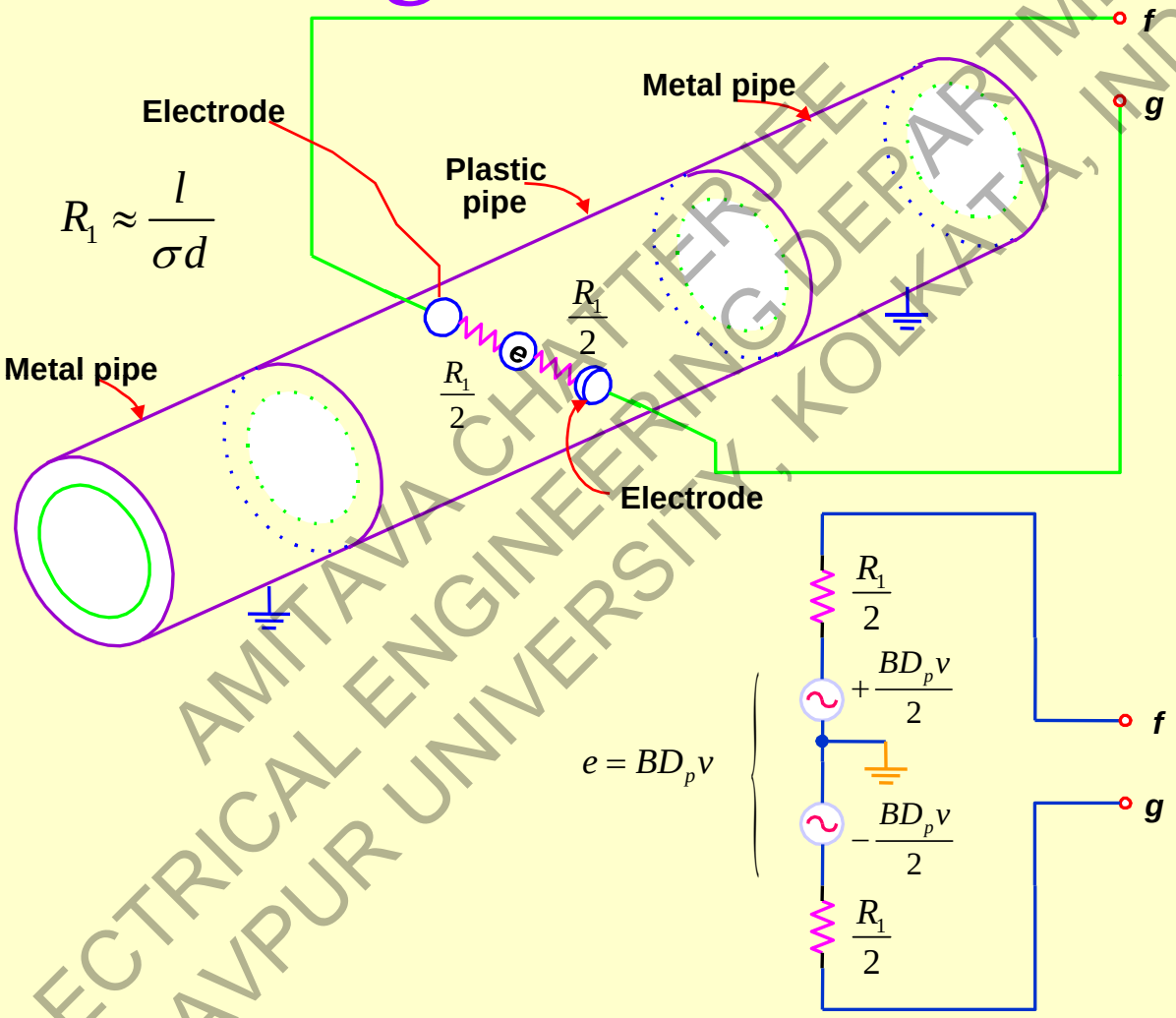
Practical Constraints:

- ✓ **The pipe must be nonmagnetic.**
- ✓ **The pipe is usually nonconductive.**



- ✓ **It is impractical to make the entire pipe non-conductive and a short length (the flowmeter itself) of non-conductive pipe is coupled into an ordinary metal-pipe installation.**

A Practical Solution for Electromagnetic Flowmeters



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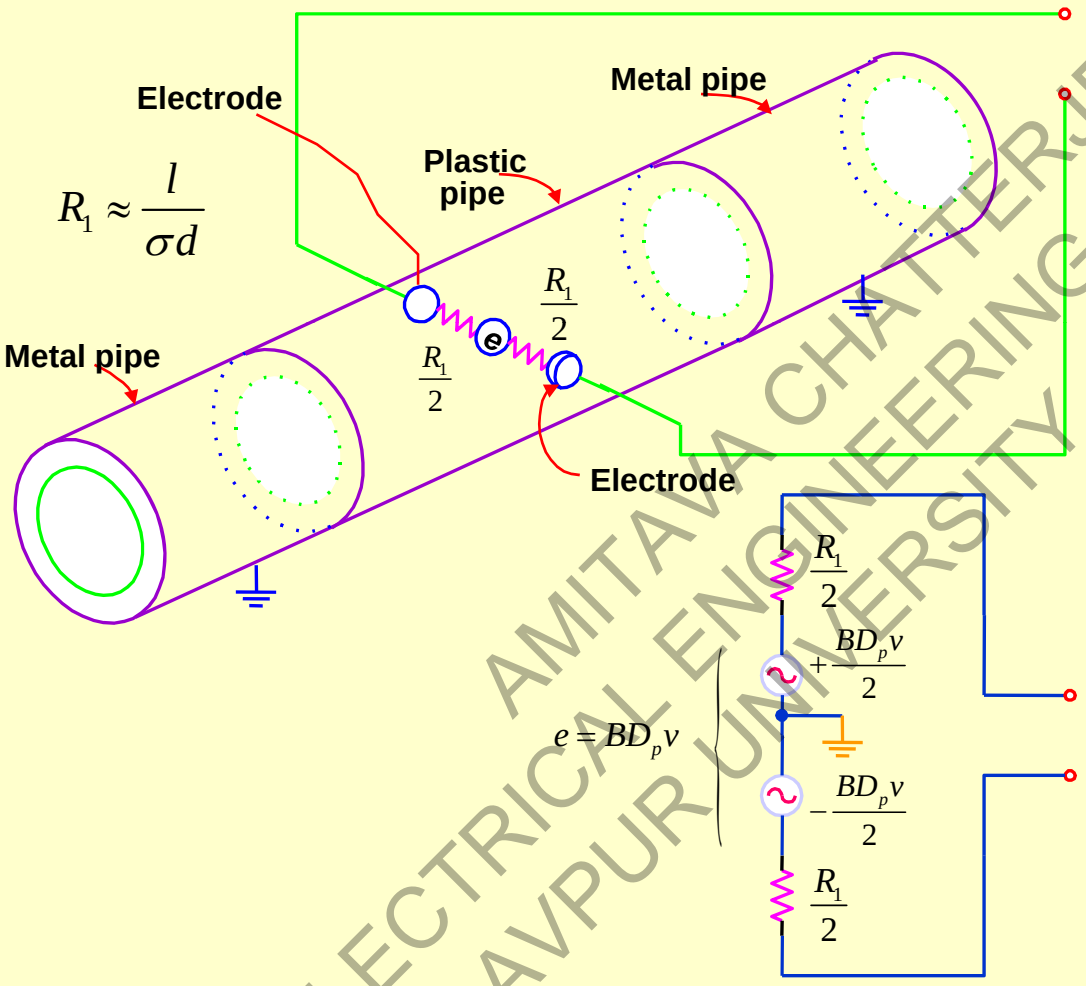
A Practical Solution for Electromagnetic Flowmeters (contd…)



- The signal source $e=BD_p v$; D_p = separation of electrodes = metering tube diameter.
- If a conductive fluid is moving with an average velocity $\bar{V}$, and if we assume that the fluid fills the tube, then:

$$\bar{v} = \frac{Q}{\pi D_P^2 / 4} \Rightarrow e = \frac{4B}{\pi D_P} Q$$

- Calculation of R_1 is complex.

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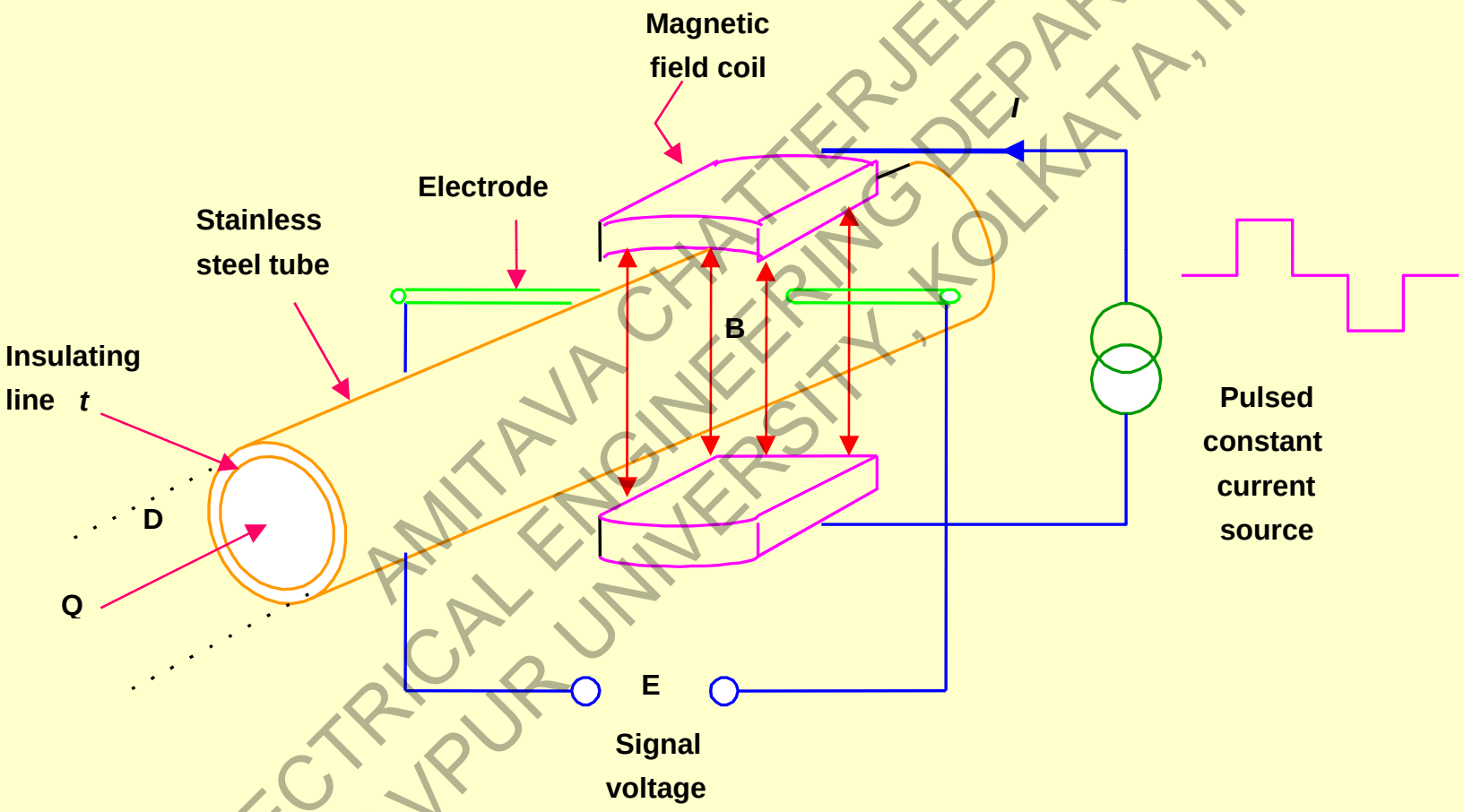
Magnetic field in Electromagnetic Flowmeters

- ✓ The magnetic field used in such a flowmeter can be either constant or alternating giving rise to a dc or an ac output signal, respectively.
- ✓ For many years, ac systems (50 or 60 Hz) were most common, since they reduced polarization effects at the electrodes, and had other advantages.
- ✓ However the major disadvantage was that the powerful ac field coils induced spurious ac signals into the measurement circuit.
- ✓ About 1975, industrial meters utilizing an interrupted dc field became available, and currently the market is shared mainly by these two types.

Magnetic field in Electromagnetic Flowmeters (contd…)



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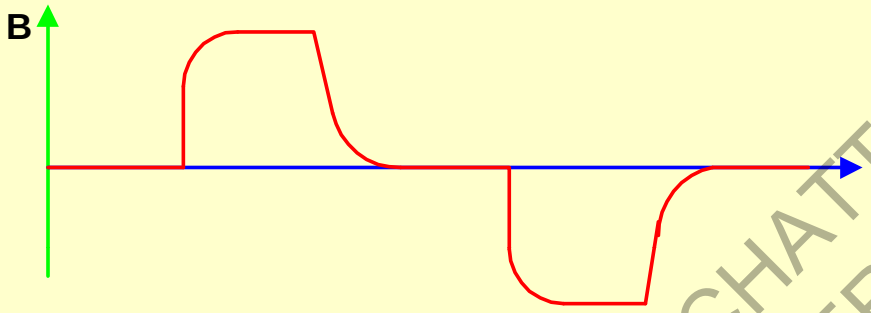
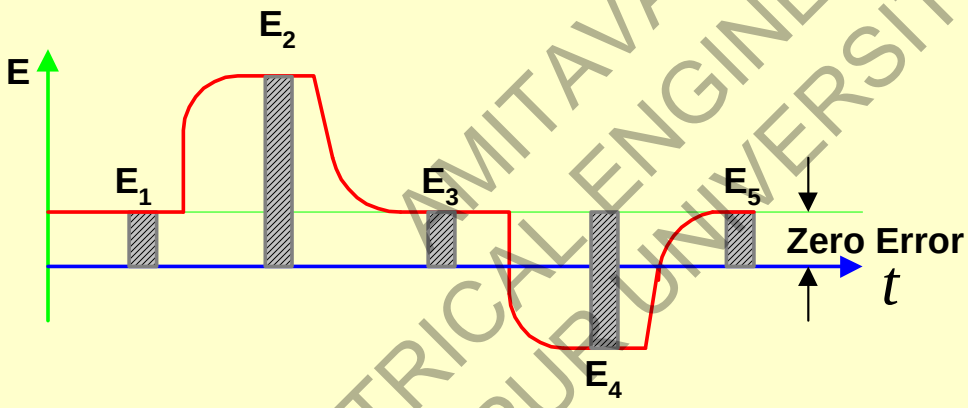
Magnetic field in Electromagnetic Flowmeters (contd…)

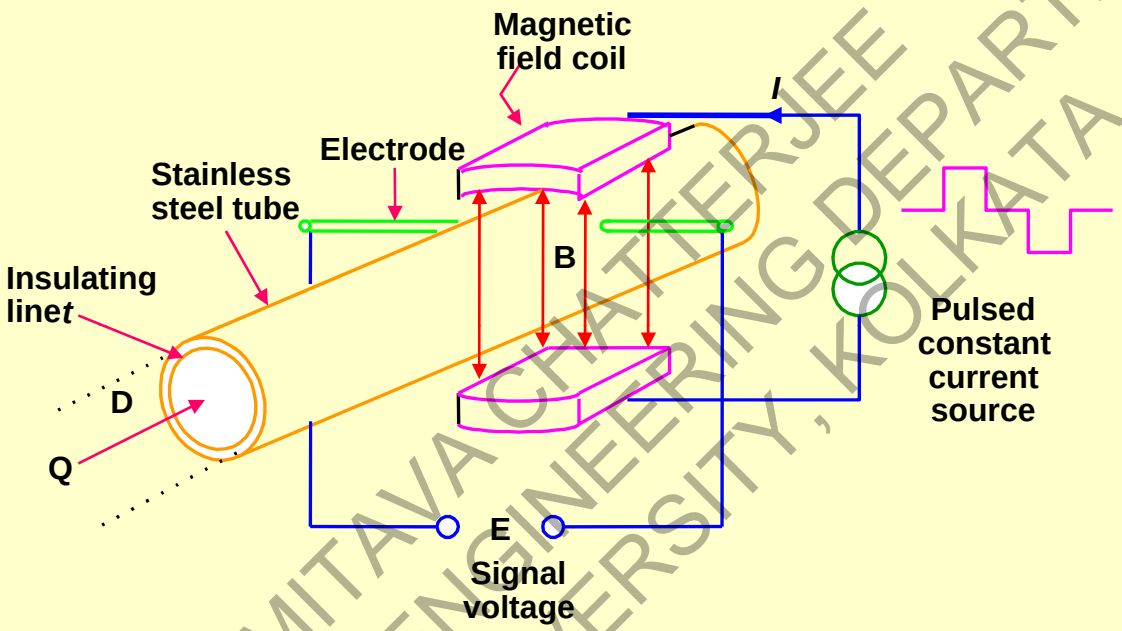




Flow related signal

$$E_Q = \left[E_2 - \frac{(E_1 + E_3)}{2} \right] - \left[E_4 - \frac{(E_3 + E_5)}{2} \right]$$

Magnetic field in Electromagnetic Flowmeters (contd…)



- ✓ This arrangement implements an automatic zero correction feature which corrects for zero errors several times a second .
- ✓ Such an arrangement can provide significant power savings. However, response time may be a little slow in some applications.

Thank You