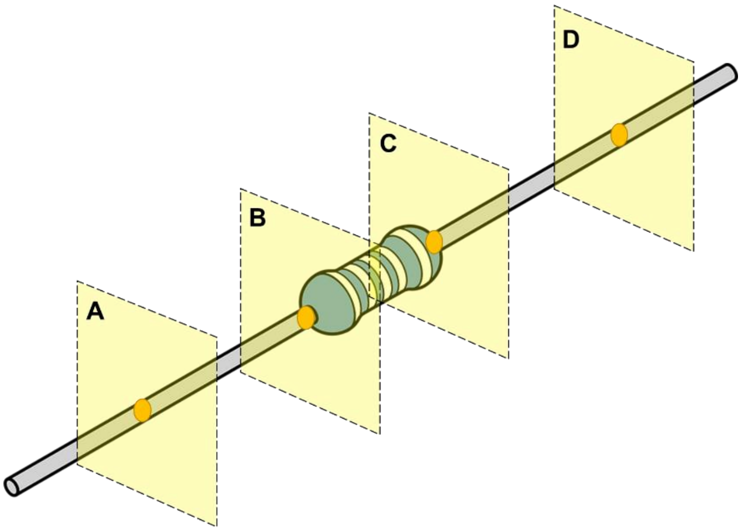
LECTURE 1 – FUNDAMENTALS OF ELECTRICAL ENGINEERING



Q1. There are 500 electrons flowing across the cross-sectional area of a copper wire every 5 seconds from A to B. What is the current in the copper wire from A to B?

1 electron charge is $-1.6022 \times 10^{-19}\ C$

500 electrons crossing in 5 seconds, so 100 electrons per second.

Current flow of $-1.6022 \times 10^{-17}\ C$ from A to B.

Q2. In the above situation, what is the current flowing from B to C?

Current flow of $-1.6022 \times 10^{-17}\ C$ from B to C.

Q3. In the above situation, what is the current flowing from C to D?

Current flow of $-1.6022 \times 10^{-17}\ C$ from C to D.

Q4. In the above situation, what is the current flowing from B to D?

Current flow of $-1.6022 \times 10^{-17}\ C$ from B to D.

Q5. How many electrons would have to flow (and what direction) for there to be 5A of current flow from A to D?

1 electron charge is $-1.6022 \times 10^{-19}\ C$

$5A$ is $5C/s$

Number of electrons is $\frac{5}{-1.6022 \times 10^{-19}} = -3.12 \times 10^{19}$, or 3.12×10^{19} in the opposite direction, D to A

Q6. Say we had to apply 10V at A with respect to D to have 5A of current flow in the resistor. How much is the resistance of the resistor?

$V = IR$ so, $R = \frac{V}{I} = \frac{10}{5} = 2\Omega$

Q7. The resistor is between B and C, the copper wire (between A and B, and between C and D) has zero resistance. What is the voltage between A and B?

Voltage is zero when resistance is zero, even if there is current flowing through.

Q8. What is the voltage at B with respect to D?

Resistance between B and C is 2Ω, so voltage at B with respect to C is $10V$.

Q9. What is the power flow from C to B?

$Power = Voltage \times Current = 10V \times 5A = 50W$ in direction of current, i.e., B to C. Hence power flow from C to B is $-50W$

Q10. Is voltage an across variable or through variable? Why?

Across variable, as voltage is always with reference to something. It is across two points.

Q11. Is current an across variable or through variable? Why?

Through variable, as current passes through an element.

Q12. You have been presented with an inductor (above). There is 10A of current flowing through it, i.e., $I = 10A$. As you have not been told how long the current has been flowing, you should assume it has been flowing a long time. What happens if you suddenly open-circuit the inductor, i.e., stop any current flow through the inductor?

As there is a lot of energy stored in the inductor, and current is flowing, forcing the flow of current may result in an explosion!

Q13. In the above situation (i.e., the moment when $I = 0A$ changed from $I = 10A$), would there be a voltage induced across the inductor? What would be the value of V (be careful about the polarity)?

Theoretically infinite amount of voltage will get generated across the inductor to force 10A current to flow from left to right in the inductor. $V = -\infty$

Q14. Say we had an identical situation, but with a capacitor instead of an inductor, and you open-circuited the capacitor while there was 10A current flowing through it, what would happen? What would be the new value of V across the capacitor?

New value of V would be the old value of V, i.e., nothing would change at the moment, but the voltage would decline gradually due to leaking of charge between the parallel plates of the capacitor.

Q15. With the capacitor, what would have happened if you had short-circuited the capacitor (instead of open-circuit)?

Potential explosion! The stored positive and negative charged particles would want to neutralise each other immediately resulting in a theoretically infinite amount of current.

Q16. When we "open-circuit an element", we are forcing (select option(s) from below) –

- **a. Current flowing through it to be zero**
- b. Current flowing through it to be infinity
- c. Voltage across it to be zero
- d. Voltage across it to be infinity

Q17. When we "short-circuit an element", we are forcing (select option(s) from below) –

- a. Current flowing through it to be zero
- b. Current flowing through it to be infinity
- **c. Voltage across it to be zero**
- d. Voltage across it to be infinity

Q18. In an inductor, the voltage across it is proportional to (select option(s) from below) –

- a. Current through it
- **b. Rate of change of current through it**

Q19. In a capacitor, the current through it is proportional to (select option(s) from below) –

- a. Voltage across it
- **b. Rate of change of voltage across it**