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UG. SEM-IV Unit-05 paper-06

Transmission Line.

→ A transmission line is a distributed parameter system used to transmit electrical energy in the form of EM waves from source to load.

Examples:-
- Coaxial cable
- Two-Wire line
- Microstrip line

Unlike ordinary circuits, parameters are distributed continuously along length.

(1.1) Primary constants (Per Unit length).

Every transmission line has four distributed parameters:-
- Resistance (R) → (Ω/m.)
- Inductance (L) → (H/m)
- Capacitance (C) → (F/m)
- Conductance (G) → (S/m).

These form the RLGC model.

(1.2) Derivation of Telegrapher's Equations:-

→ Consider a small section of line of length dx.

Applying KVL:-

$$V(x) - V(x+dx) = R \cdot dx \cdot I + L\,dx \cdot \frac{\partial I}{\partial t}$$

Dividing by dx.

$$\boxed{\frac{\partial V}{\partial x} = -RI - L\frac{\partial I}{\partial t}}$$

Again applying KVL.

$$I(x) - I(x+dx) = G \cdot dx \cdot V + C\,dx \cdot \frac{\partial V}{\partial t}$$

$$\frac{\partial I}{\partial x} = -GV - C\frac{\partial V}{\partial t}$$

These are the Telegrapher's Equations:

In phasor form:

$$\frac{\partial V}{\partial x} = -(R + j\omega L)I$$

$$\frac{\partial I}{\partial x} = -(G + j\omega C)V$$