$$\frac{\partial V}{\partial x} + \frac{\partial}{\partial t}(LI) + RI = E \qquad (1)$$

$$\frac{\partial I}{\partial x} + GV + C\frac{\partial V}{\partial t} = 0 \qquad (2)$$

ASSUME $V = 0$ $\Rightarrow$ FOR E = constant in space + cable + term. ≈ shorts

$$\frac{\partial I}{\partial x} = 0 \quad \text{i.e. Current constant over line}$$

$$\frac{\partial}{\partial t}(LI) + RI = E \longrightarrow \text{difference equation}$$

$$\frac{L(t+\Delta t)\,I(t+\Delta t) - L(t)\,I(t)}{\Delta t} + R(t+\Delta t)\,I(t+\Delta t) = E(t+\Delta t)$$

Let $t+\Delta t \to k$ $\quad t \to k-1$

$$\frac{L_k I_k - L_{k-1} I_{k-1}}{\Delta t} + R_k I_k = E_k$$

$$\Rightarrow \qquad I_k = \frac{\frac{L_{k-1}}{L_k} I_{k-1} + \frac{\Delta t}{L_k} E_k}{1 + \frac{\Delta t}{L_k} R_k}$$