



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

Computer aided power system analysis

Modeling of Power System Components (Contd.)

Prof. Biswarup Das

Department of Electrical Engineering



Load model

- ① Constant Power
- ② Constant current
- ③ Constant Impedance

$$\bar{S}_i = \bar{V}_i \bar{I}_i^*$$

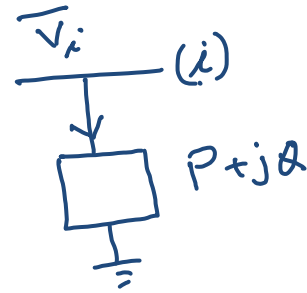
$$V_i, \bar{I}_i$$

$$S_i = \bar{V}_i \bar{I}_i \quad \text{--- ①}$$

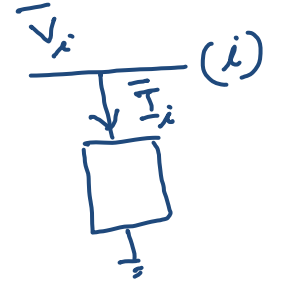
$$\bar{V}_i^* \bar{I}_i \quad \text{--- ②}$$

$$\bar{V}_i \bar{I}_i^* \quad \text{--- ③} \quad \checkmark$$

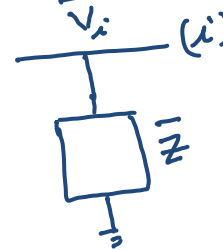
$$\bar{V}_i^* \bar{I}_i^* \quad \text{--- ④}$$



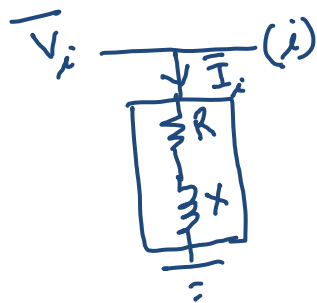
Constant Power



Constant current



Constant Impedance



$$\overline{V}_i = V_i \angle 0^\circ = V_i$$

$$\begin{aligned}\overline{I}_i &= I_i \angle -\theta \\ &= I_i \cos \theta - j I_i \sin \theta\end{aligned}$$

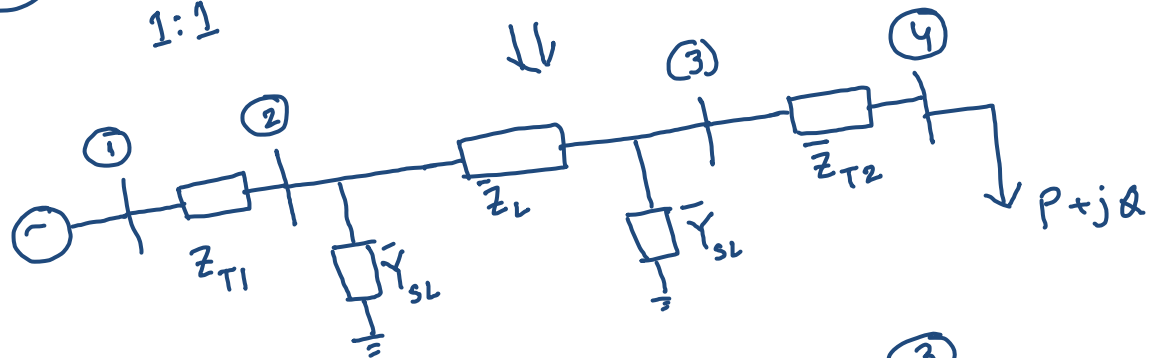
$$\overline{S}_i = P_i + jQ_i$$

$$\begin{aligned}S_i &= \overline{V}_i \overline{I}_i = V_i (I_i \cos \theta - j I_i \sin \theta) \\ &= V_i I_i \cos \theta - j V_i I_i \sin \theta \\ &= P_i + jQ_i\end{aligned}$$

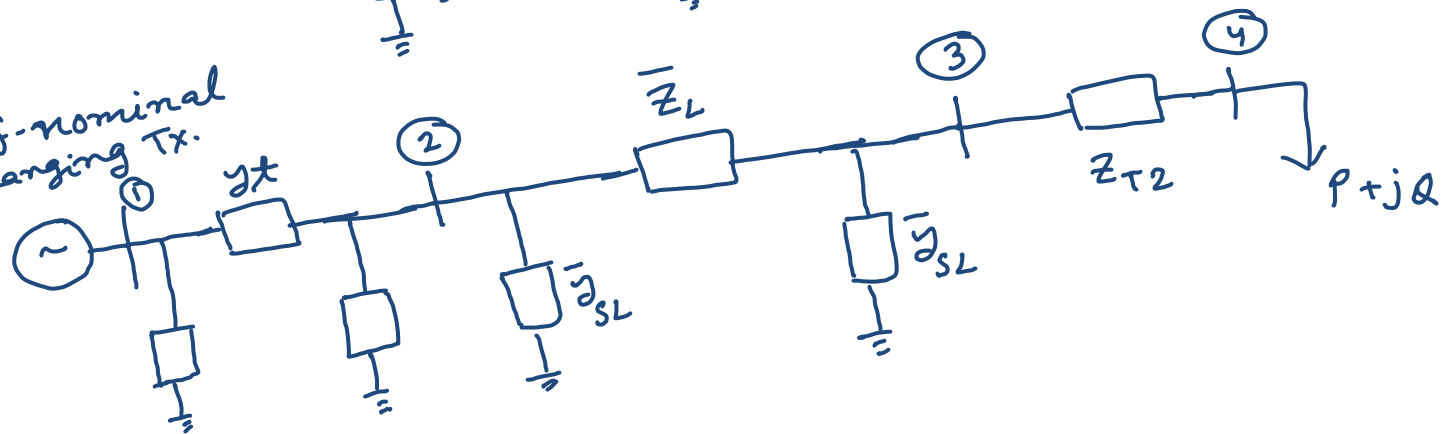
$$\begin{aligned}\Rightarrow P_i &= V_i I_i \cos \theta \\ Q_i &= -V_i I_i \sin \theta\end{aligned}$$

$$\begin{aligned}S_i &= \overline{V}_i \overline{I}_i^* \\ &= V_i (I_i \cos \theta + j I_i \sin \theta) \\ &= V_i I_i \cos \theta + j V_i I_i \sin \theta \\ &= P + jQ\end{aligned}$$

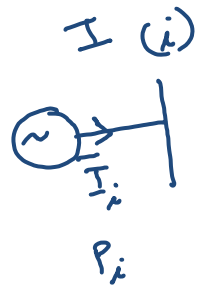
$$Q = V_i I_i \sin \theta$$



T1 is off-nominal
tap changing Tx.



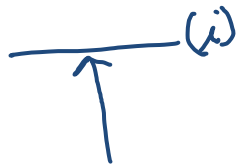
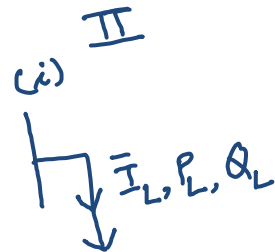
Injected quantity



$$\bar{I}_i = \bar{I}_a$$

$$P_i = P_a$$

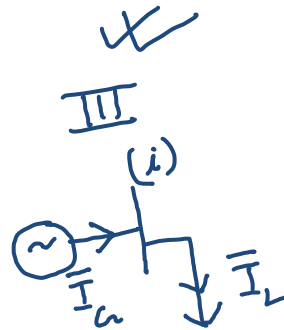
$$Q_i = Q_a$$



$$\bar{I}_i = -\bar{I}_L$$

$$P_i = -P_L$$

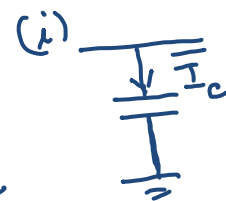
$$Q_i = -Q_L$$



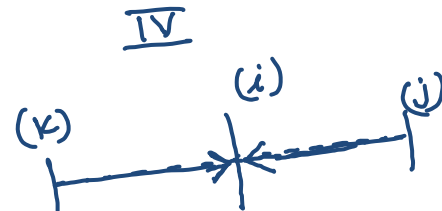
$$\bar{I}_i = \bar{I}_a - \bar{I}_L$$

$$P_i = P_a - P_L$$

$$Q_i = Q_a - Q_L$$



$$\bar{I}_i = -\bar{I}_c$$



$$\bar{I}_i = 0$$

$$P_i = 0$$

$$Q_i = 0$$