



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

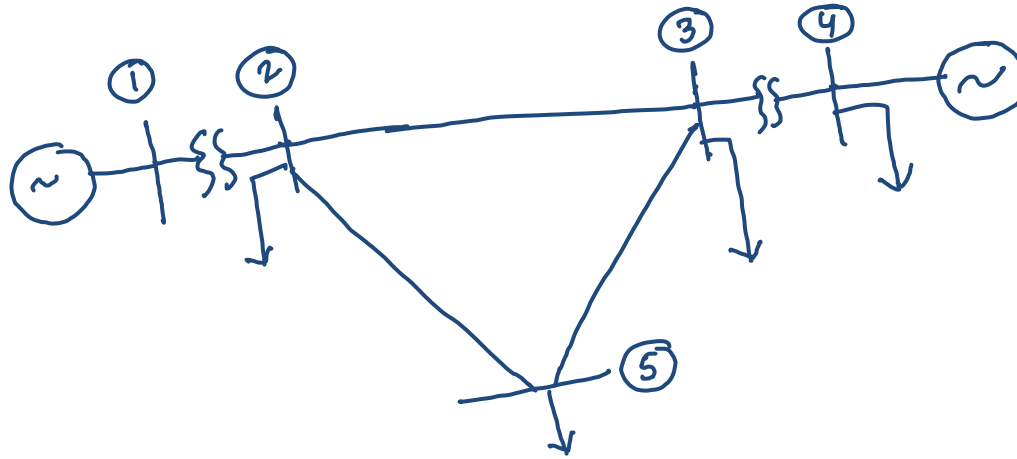
Computer aided power system analysis

Modeling of Power System Components

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Generator
Transformer
Transmission
line

Loads.

Generator modeling
 $\bar{E} = E/\delta$


Transmission line model

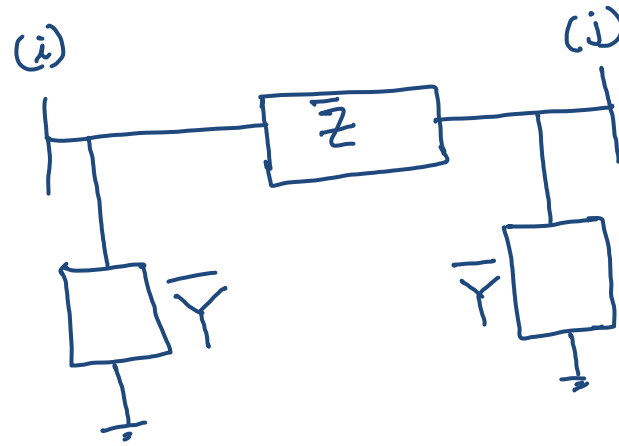
- ① Long
- ② medium
- ③ Short

Long transmission line

$\bar{z}$ /unit length

$\bar{y}$ /unit length





$$\bar{Z} = \bar{Z}_c \sinh(\gamma l)$$

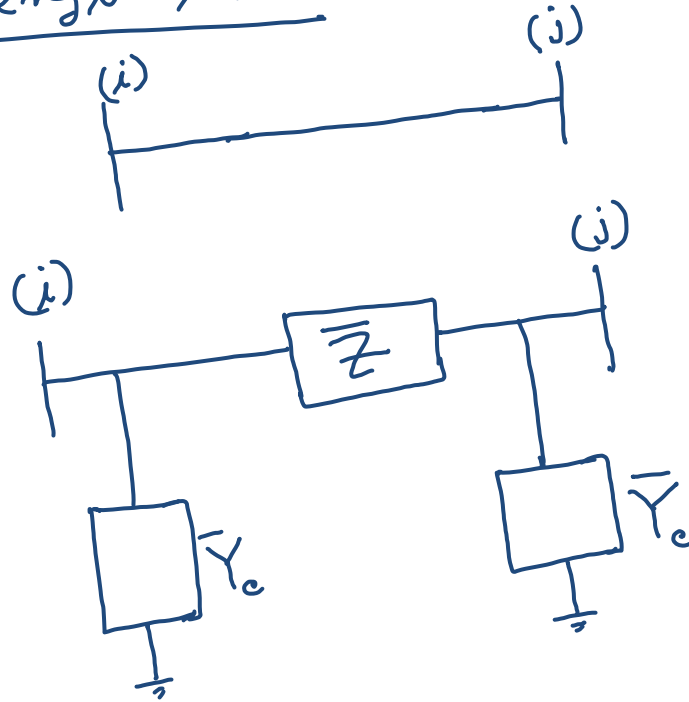
$l \rightarrow \text{length}$

$$\bar{Z}_c = \sqrt{\frac{\bar{Z}}{\bar{Y}}}$$

$$\gamma = \sqrt{\bar{Y}\bar{Z}}$$

$$\bar{Y} = \frac{1}{\bar{Z}_c} \tanh\left(\frac{\gamma l}{2}\right)$$

Medium length line



$$\bar{Z} = R + jX$$

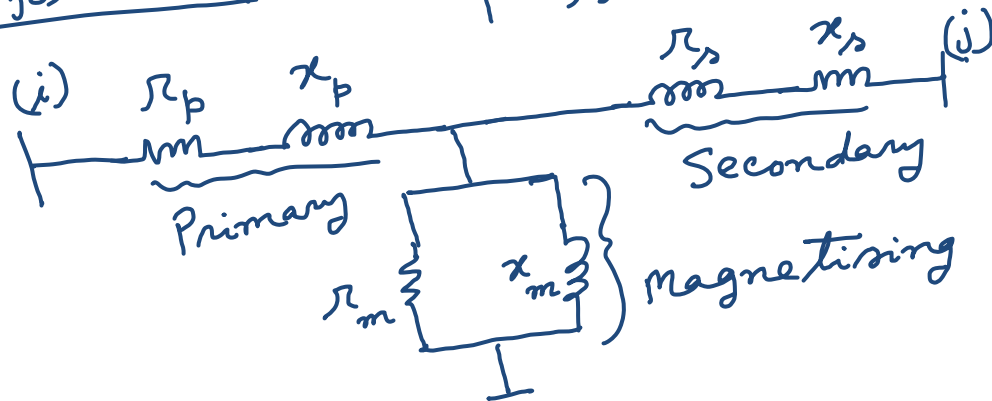
$$\bar{Y}_c = j \frac{B_c}{2}$$

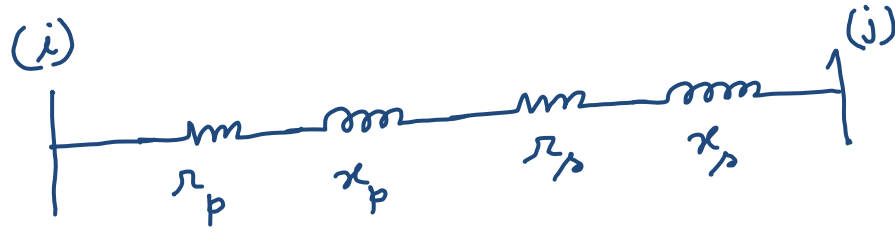
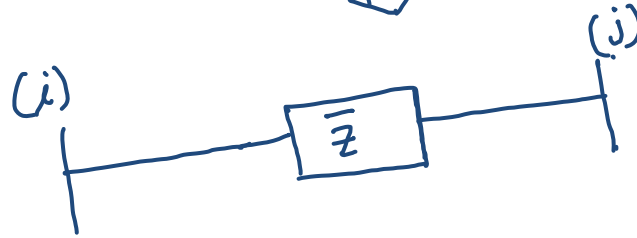
Short transmission line



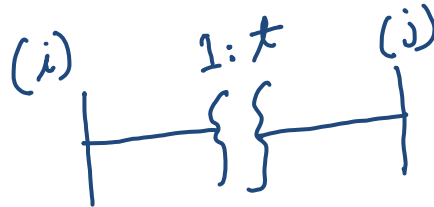
33/400 kV

Transformers

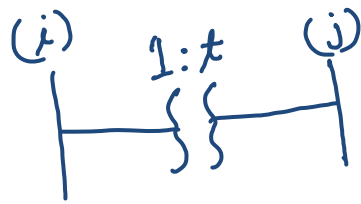




$$Z = (r_p + r_p) + j(x_p + x_p)$$

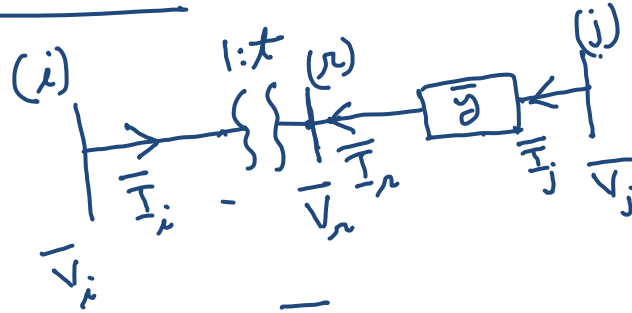


Tap changing Transformer



$$\bar{y} = \frac{1}{\bar{Z}}$$

$\Rightarrow$



$$S_i \rightarrow$$

$$S_j \leftarrow$$

$$\bar{V}_n = t \bar{V}_i$$

$$\begin{aligned} \bar{S}_i &= \bar{V}_i \bar{I}_i^* \\ \bar{S}_n &= \bar{V}_n \bar{I}_n^* \end{aligned}$$

$$= t \bar{V}_i \bar{I}_n^*$$

$$= t \bar{V}_i \bar{I}_j^*$$

$$\Rightarrow \bar{S}_i = -\bar{S}_n$$

$$\Rightarrow \bar{V}_i \bar{I}_i^* = -t \bar{V}_i \bar{I}_j^*$$

$$\Rightarrow \bar{I}_i^* = -t \bar{I}_j^*$$

$$\Rightarrow \bar{I}_i = -t \bar{I}_j$$



$$\bar{I}_j = (\bar{V}_j - \bar{V}_i) \bar{y}$$

$$= (\bar{V}_j - x \bar{V}_i) \bar{y}$$

$$= \bar{y} \bar{V}_j - \bar{y} x \bar{V}_i$$

$$= \bar{y} \bar{V}_j - \bar{y} x \bar{V}_i + \bar{y} x \bar{V}_j - \bar{y} x \bar{V}_j$$

$$= \bar{y} \bar{V}_j - \bar{y} x \bar{V}_i + \bar{y} x \bar{V}_j - \bar{y} x \bar{V}_j$$

$$\bar{I}_j = \bar{y} x (\bar{V}_j - \bar{V}_i) + \bar{y} (1-x) \bar{V}_j$$

$$\bar{I}_i = -x \bar{I}_j = -\bar{y} x \bar{V}_j + \bar{y} x^2 \bar{V}_i = -\bar{y} x \bar{V}_j + \bar{y} x^2 \bar{V}_i + \bar{y} x \bar{V}_i - \bar{y} x \bar{V}_i$$

$$\bar{I}_i = \bar{y} x (\bar{V}_i - \bar{V}_j) + \bar{y} x (x-1) \bar{V}_i$$

