



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

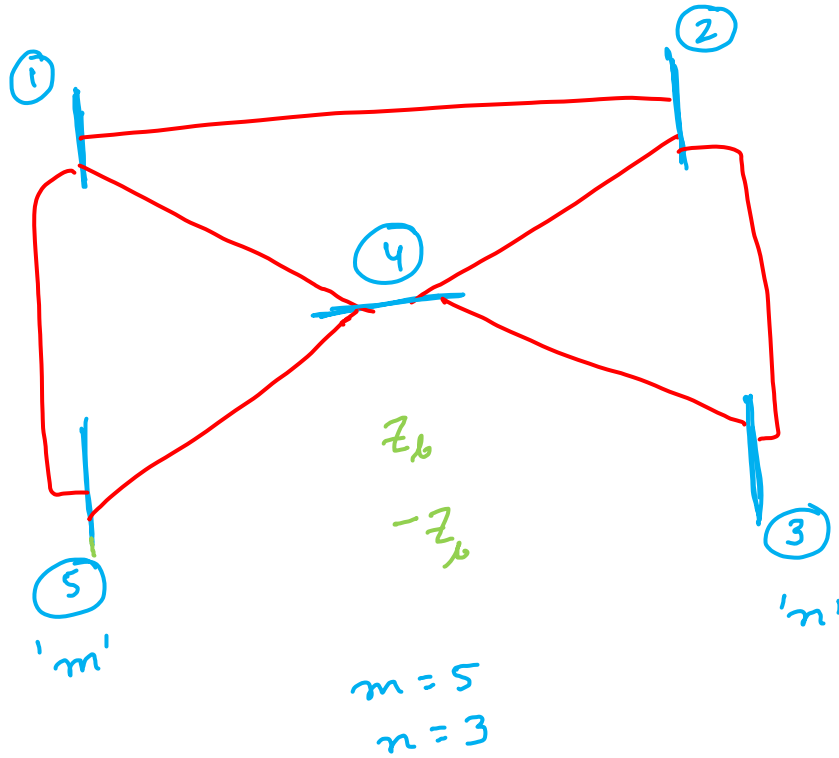
Computer aided power system analysis

Line outage sensitivity factor (Contd.)

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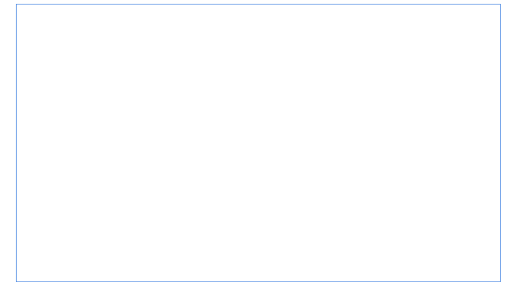


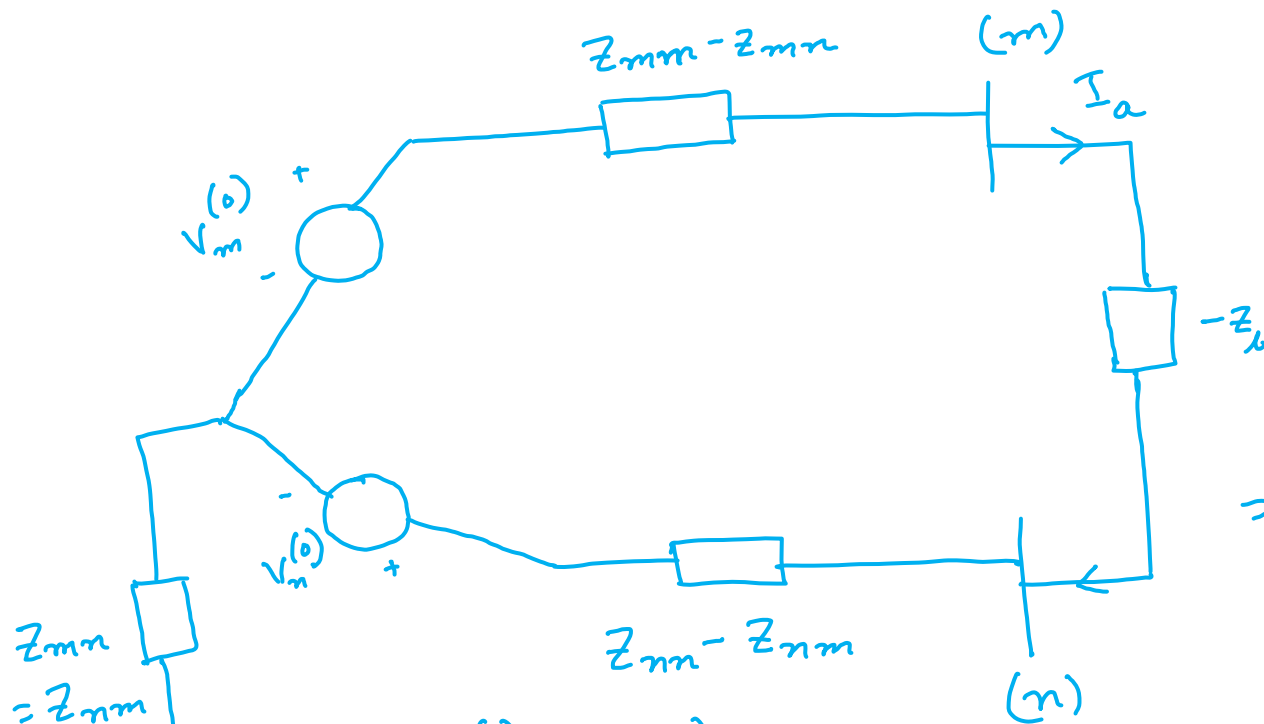
$$Z_{Th,mn} = Z_{mm} + Z_{nn} - 2Z_{mn}$$



$Z_b \rightarrow$ branch impedance of the line '3-5'.

$$Z_{eqv.} = \frac{Z_b \times (-Z_b)}{Z_b - Z_b} = \infty$$





$$I_a = \frac{V_m^{(0)} - V_n^{(0)}}{Z_{Total}}$$

$$Z_{Total} = Z_{mm} - Z_{mn} + Z_{nn} - Z_{nm} + (-Z_b)$$

$$= Z_{Th,mn} - Z_b$$

$$I_a = \frac{V_m^{(0)} - V_n^{(0)}}{Z_{Th,mn} - Z_b}$$

$Z_b \rightarrow$ impedance of the line betⁿ bus 'm' and 'n'



change in injected current due to addition of $-Z_c$ impedance
is $\Delta I_m = -I_a$ and $\Delta I_n = +I_a$

Now consider any two buses 'p' and 'q'

$$\Delta V_p = Z_{pm} \Delta I_m + Z_{pn} \Delta I_n$$
$$= (Z_{pn} - Z_{pm}) I_a$$

Similarly $\Delta V_q = Z_{qm} \Delta I_m + Z_{qn} \Delta I_n = (Z_{qn} - Z_{qm}) I_a$

change in current flow over the line 'p-q'

$$\Delta I_{pq} = \frac{\Delta V_p - \Delta V_q}{Z_c}$$

↘ Impedance of the line
between bus 'p' and 'q'.



$$\Delta I_{pq} = \frac{\Delta V_p - \Delta V_q}{z_c} = \frac{(z_{pn} - z_{pm}) - (z_{qn} - z_{qm})}{z_c} \cdot I_a$$

$$\Rightarrow \Delta I_{pq} = \frac{(z_{pn} - z_{pm}) - (z_{qn} - z_{qm})}{z_c} \cdot \frac{V_m^{(0)} - V_n^{(0)}}{z_{Th,mn} - z_b}$$

$$= \frac{(z_{pn} - z_{pm}) - (z_{qn} - z_{qm})}{z_{Th,mn} - z_b} \cdot \frac{V_m^{(0)} - V_n^{(0)}}{z_b} \cdot \frac{z_b}{z_c}$$

We note $\frac{V_m^{(0)} - V_n^{(0)}}{z_b} = I_{mn}^{(0)}$

$$\Delta I_{pq} = \frac{z_b}{z_c} \cdot \frac{(z_{pn} - z_{pm}) - (z_{qn} - z_{qm})}{z_{Th,mn} - z_b} \cdot I_{mn}^{(0)}$$



$$\Rightarrow \frac{\Delta I_{pq}}{I_{mn}^{(0)}} = \frac{z_L}{z_c} \cdot \frac{(\overbrace{z_{pn}} - \overbrace{z_{pm}}) - (\overbrace{z_{qn}} - \overbrace{z_{qm}})}{\overbrace{z_{Th,mn}} - z_L}$$

Elements of bus impedance matrix

$x \rightarrow$ impedance of the individual line.

Assumptions of DC load-flow

1. $|V_i| = 1.0$
2. $\theta_i \approx 0$ $(\theta_i - \theta_j) \approx 0$
3. All resistances of the lines are neglected.