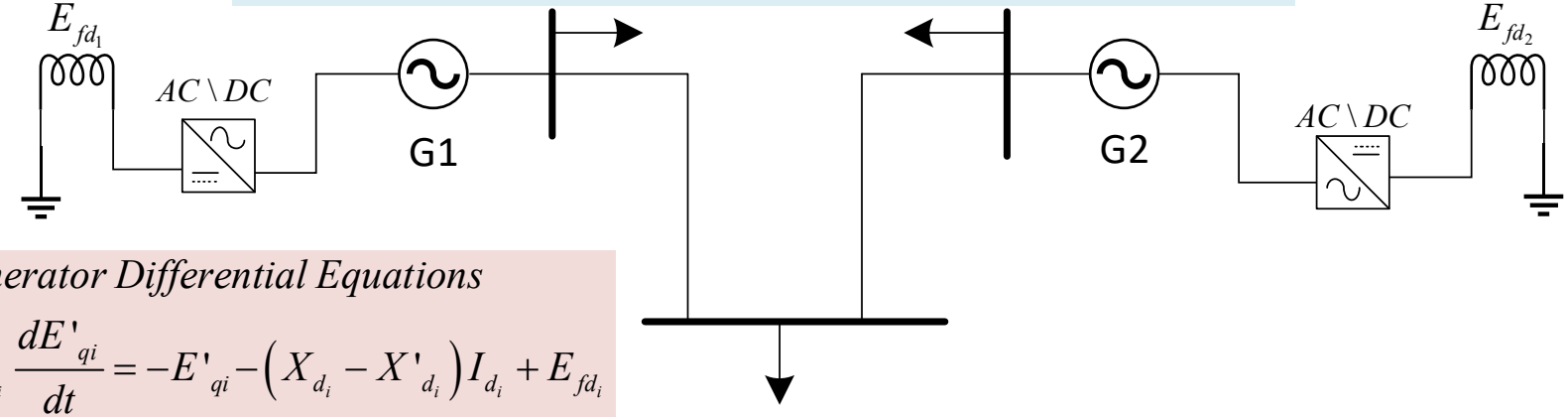
Generator Bus Network Equations :

$$\left(I_{d_i}\sin\delta_i + I_{q_i}\cos\delta_i\right) + \frac{P_{L_i}\cos\theta_i}{V_i} + \frac{Q_{L_i}\sin\theta_i}{V_i} + \sum_{k=1}^{n} B_{ik}V_k\sin\theta_k = 0$$

$$\left(I_{q_i}\sin\delta_i - I_{d_i}\cos\delta_i\right) + \frac{P_{L_i}\sin\theta_i}{V_i} - \frac{Q_{L_i}\cos\theta_i}{V_i} - \sum_{k=1}^{n} B_{ik}V_k\cos\theta_k = 0$$



Generator Differential Equations

$$T'_{do_i}\frac{dE'_{qi}}{dt} = -E'_{qi} - \left(X_{d_i} - X'_{d_i}\right)I_{d_i} + E_{fd_i}$$

$$T'_{qo_i}\frac{dE'_{di}}{dt} = -E'_{di} - \left(X_{q_i} - X'_{q_i}\right)I_{q_i}$$

$$\frac{d\delta_i}{dt} = \omega_i - \omega_s$$

$$\frac{2H_i}{\omega_s}\frac{d\omega_i}{dt} = T_{M_i} - E'_{d_i}I_{d_i} - E'_{q_i}I_{q_i} - \left(X'_{q_i} - X'_{d_i}\right)I_{d_i}I_{q_i} - D_i\left(\omega_i - \omega_s\right)$$

Load Bus Network Equations :

$$\frac{P_{L_i}\cos\theta_i}{V_i} + \frac{Q_{L_i}\sin\theta_i}{V_i} + \sum_{k=1}^{n} B_{ik}V_k\sin\theta_k = 0$$

$$\frac{P_{L_i}\sin\theta_i}{V_i} - \frac{Q_{L_i}\cos\theta_i}{V_i} - \sum_{k=1}^{n} B_{ik}V_k\cos\theta_k = 0$$

Stator Algebraic Equations

$$E'_{d_i} - V_{D_i}\sin\delta_i + V_{Q_i}\cos\delta_i - R_{s_i}I_{d_i} + X'_{q_i}I_{q_i} = 0$$

$$E'_{q_i} - V_{D_i}\cos\delta_i - V_{Q_i}\sin\delta_i - R_{s_i}I_{q_i} - X'_{d_i}I_{d_i} = 0$$