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Lec - 20
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$$\begin{bmatrix} \dot{\psi}_d \\ \dot{\psi}_q \\ \dot{\psi}_H \\ \dot{\psi}_F \\ \dot{\psi}_G \\ \dot{\psi}_K \end{bmatrix} = A_1 \begin{bmatrix} \psi_d \\ \psi_q \\ \psi_H \\ \psi_F \\ \psi_G \\ \psi_K \end{bmatrix} + A_2 \begin{bmatrix} i_d \\ i_q \end{bmatrix} + B_2 \cdot E_{fd}$$

1.0 pu.

$$A_1 = \begin{bmatrix} 0 & -\omega & 0 & 0 & 0 & 0 \\ \omega & 0 & 0 & 0 & 0 & 0 \\ 1/T_d'' & 0 & -\frac{1}{T_d''} & 0 & 0 & 0 \\ \frac{1}{T_d'} & 0 & 0 & -\frac{1}{T_d'} & 0 & 0 \\ 0 & \frac{1}{T_q''} & 0 & 0 & \frac{1}{T_q''} & 0 \\ 0 & 1/T_q' & 0 & 0 & 0 & \frac{1}{T_q'} \end{bmatrix}$$

$$i_d = -\frac{E_{fd}}{x_d}$$

in steady state

-0.55

$$i_q = 0$$

$$\begin{bmatrix} v_d \\ v_q \end{bmatrix} = \begin{bmatrix} R_L & 0 \\ 0 & R_L \end{bmatrix} \begin{bmatrix} i_d \\ i_q \end{bmatrix}$$

$R_L \to \infty$ - open ckt

$R_L = 0$ - short ckt.

$$\begin{bmatrix} i_d \\ i_q \end{bmatrix} = A_3 \Psi = \left[A_{31} \;\vdots\; A_{32} \right]$$

$$A_{31} = \begin{bmatrix} 1/x_d'' & 0 & -\dfrac{(x_d' - x_d'')}{x_d' \, x_d''} \\ 0 & \dfrac{1}{x_q''} & 0 \end{bmatrix}$$

$$A_{32} = \begin{bmatrix} -\dfrac{(x_d - x_d')}{x_d \, x_d'} & 0 & 0 \\ 0 & -\dfrac{(x_q' - x_q'')}{x_q' \, x_q''} & -\dfrac{(x_q - x_q')}{x_q \, x_q'} \end{bmatrix}$$

$$T'_{do} + T''_{do} = \frac{x_d}{x'_d} T'_d + T''_d \times \left(1 - \frac{x_q}{x'_q} + \frac{x_q}{x''_q}\right)$$

$$T'_{do} T''_{do} = T'_d T''_d \cdot \frac{x_d}{x''_d}$$

SIMILARLY FOR Q-AXIS.

$e^{-t/T_{do}'}$

dominant

not clearly visible

$\checkmark \; e^{-t/T_{do}'}, \; e^{-t/T_{do}''}$

step

$$\left\{ e^{-t/T_{ao}'}, \; e^{-t/T_{ao}''} \right.$$

$\dot{x} = Ax + Bu$

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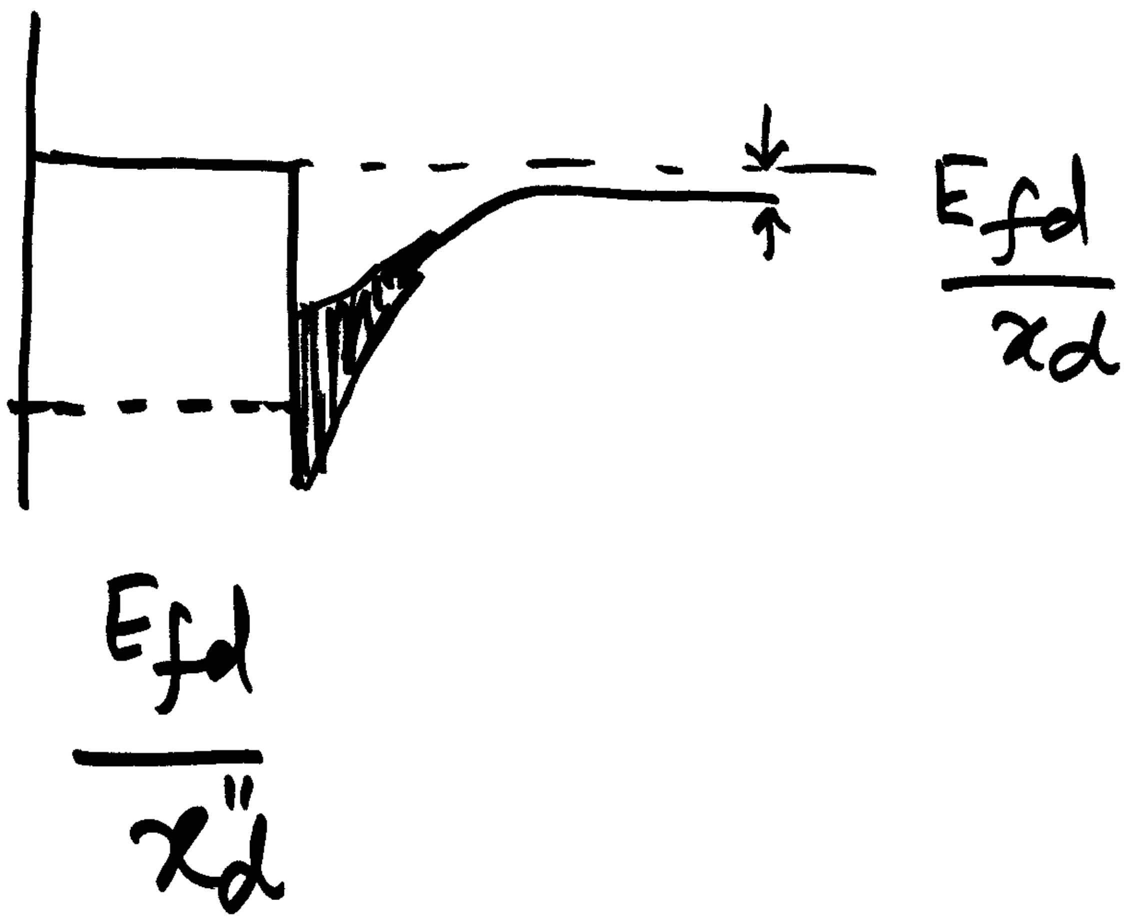
$x(5) \leftarrow$ given

$$x(t) = e^{A(t-5)}x(5) + \int_5^t e^{A(t-\tau)} B u \, d\tau$$

$t \geq 5$

$$x(t) = e^{A(t-5)} \cdot x(5) + \int_5^t e^{A(t-5-\tau)} B u \, d\tau .$$

$$= e^{A(t-5)} x(5) + A^{-1} \left[I_{6\times 6} - e^{A(t-5)} \right] \times B \cdot u$$


$\frac{E_{fd}}{x_d}$
$\frac{E_{fd}}{x''_d}$

$$0 \leftarrow \begin{bmatrix} \dot{x}_f \\ \dot{x}_s \end{bmatrix} = \begin{bmatrix} A_{ff} & A_{fs} \\ A_{sf} & A_{ss} \end{bmatrix} \begin{bmatrix} x_f \\ x_s \end{bmatrix}$$

$$\dot{x}_s = A_{ss} - A_{sf} A_{ff}^{-1} A_{fs} x_s$$

$$\left.\begin{array}{l}\dot{\psi}_d \\ \dot{\psi}_q\end{array}\right\} = \underline{\text{fast states}}$$

$$\left.\begin{array}{l}\psi_H \\ \psi_F \\ \psi_G \\ \psi_K\end{array}\right\} \text{slower states}$$