Prof. A.M. Kulkarni
Lec. No. 17
Date : 19/2/10

FROM THE MODEL (field shorted)

$$\frac{\psi_d(s)}{I_d(s)} = L_d \frac{1 + B_N s + A_N s^2}{1 + B_D s + A_D s^2}$$

$$\left.\begin{array}{l} A_N,\ B_N,\ A_D,\ B_D \end{array}\right\}$$

in terms of L_d, M_{df}, M_{dh}, L_{ff}, L_{fh}, L_{hh}, R_h, R_f 8.

q axis

L_q, T_q', T_q'', T_{q0}'', T_{q0}'

$$\frac{\psi_q(s)}{I_q(s)}$$

FROM THE MEASUREMENT (field shorted)

$$\frac{\psi_d(s)}{I_d(s)} = \frac{L_d\,(1+sT_d')(1+sT_d'')}{(1+sT_{do}')\,(1+sT_{do}'')}$$

L_d, T_d', T_{do}', T_d', T_d''

chosen so that $\rightarrow$ fit experimental data (frequency response)

TRANSFER FN
$\psi_d(s)/\underline{I}_d(s)$ "5"

original
state space
ψ_d, ψ_f, ψ_h
8 parameter

state space
5 parameters
ψ_d, ψ_F, ψ_H $\longleftrightarrow$ ψ_d
ψ_f ✓
ψ_h ✓

$$T_{q0}' + T_{q0}'' = \frac{L_q}{L_q'} T_q' + \left(1 - \frac{L_q}{L_q'} + \frac{L_q}{L_q''}\right) \times T_q''$$

$$T_{q0}' T_{q0}'' = T_q' T_q'' \cdot \frac{L_q}{L_q''}$$

Either

$$L_d,\ \underline{T_{do}'},\ \underline{T_{do}''},\ T_d',\ T_d'' \qquad d$$

$$L_q,\ \underline{T_{qo}'},\ \underline{T_{qo}''},\ T_q',\ T_q'' \qquad q$$

OR

$$L_d,\ L_d',\ L_d'',\ T_d',\ T_d''$$

$$L_q,\ L_q',\ L_q'',\ T_q',\ T_q''.$$

$$T_{do}' + T_{do}'' = \frac{L_d}{L_d'} T_d' + \left(1 - \frac{L_d}{L_d'} + \frac{L_d}{L_d''}\right) \times T_d''$$

$$T_{do}' \, T_{do}'' = T_d' \, T_d'' \, \frac{L_d}{L_d''}$$

$$\frac{d\Psi_q}{dt} = \omega \Psi_d - R_a i_q - V_q$$

$$\frac{\psi_q(s)}{I_q(s)} = \frac{L_q\,(1+sT_q')(1+sT_q'')}{(1+sT_{q0}')(1+sT_{q0}'')}$$

$\psi_q,\ \psi_g,\ \psi_k$

$\psi_q,\ \psi_G,\ \psi_K$

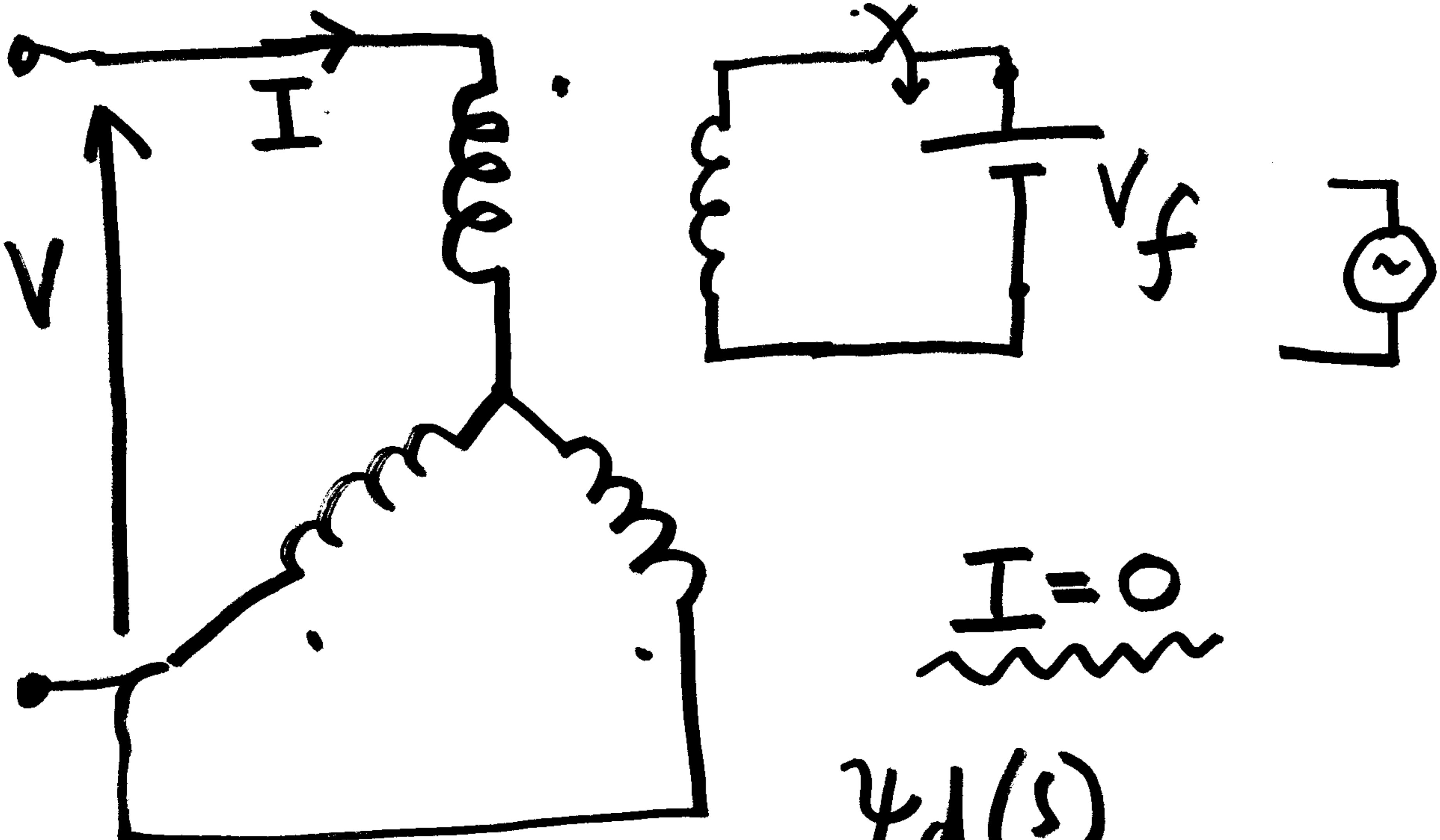
$$\frac{d\psi_G}{dt} = \frac{1}{T_q'}\left[-\psi_G + \psi_q\right]$$ ✓

$$\frac{d\psi_K}{dt} = \frac{1}{T_q''}\left[-\psi_K + \psi_q\right]$$ ✓

$$\psi_q = L_q'' i_q + \frac{(L_q' - L_q'')}{L_q'}\psi_K + \frac{(L_q - L_q')}{L_q} \cdot \frac{L_q''}{L_q'}\psi_G$$

$$\frac{d\psi_d}{dt} = -\omega \psi_q - R_a i_d - V_d$$

$$\frac{\psi_d(s)}{I_d(s)} = \frac{L_d (1+sT_d')(1+sT_d'')}{(1+sT_{do}')(1+sT_{do}'')}.$$



$I = 0$

$$\frac{\psi_d(s)}{V_f(s)}$$

$$\left\{ L_d,\ T_d',\ T_d'',\ \underbrace{T_{do}',\ T_{do}''}_{\to\ L_d'\ \&\ L_d''} \right.$$

$$T_{dc}'',\ \frac{M_{df}}{R_f}$$

$$\underline{\underline{7}}$$

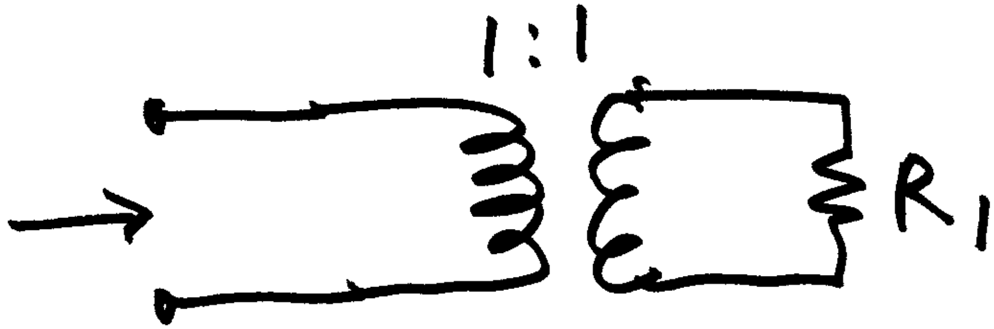
DAXIS

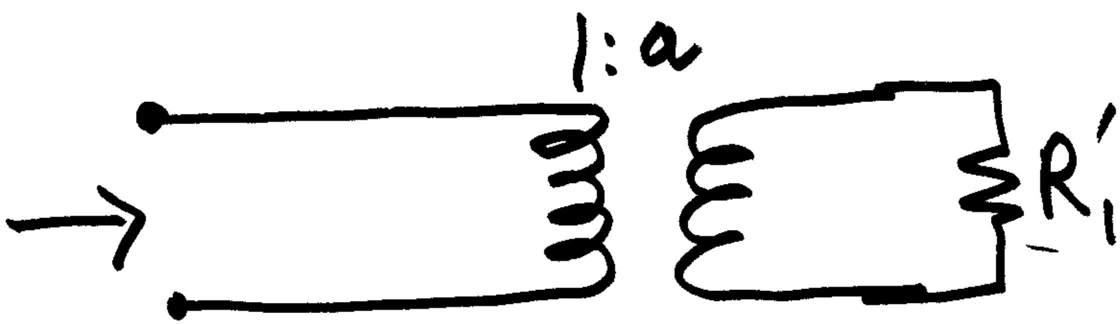
$$\frac{d\psi_H}{dt} = \frac{1}{T_d''}\left[-\psi_H + \psi_d\right] + \frac{\beta_1}{T_d''}\cdot V_f$$

$$\frac{d\psi_F}{dt} = \frac{1}{T_d'}\left[-\psi_F + \psi_d\right] + \frac{\beta_2}{T_d'}\cdot V_f$$

$$\psi_d = L_d''\cdot i_d + \frac{(L_d' - L_d'')}{L_d'}\psi_H + \frac{(L_d - L_d')}{L_d}\cdot\frac{L_d''}{L_d'}\cdot\psi_F$$

$$\frac{\Psi d(s)}{Id(s)} \rightarrow$$





$$\frac{\psi_d(s)}{V_f(s)} = \frac{1 + sT''_{dc}}{1 + \underline{B_D}s + \underline{A_D}s^2} \cdot \frac{M_{df}}{R_f}$$

$$T''_{dc}, \quad \frac{M_{df}}{R_f}$$

$$\begin{bmatrix} \psi_d \\ \psi_f' \\ \psi_h' \end{bmatrix} = \begin{bmatrix} L_d & M_{df}' & M_{df}' \\ M_{df}' & L_{ff}' & L_{fh}' \\ M_{df}' & L_{fh}' & L_{hh}' \end{bmatrix} \begin{bmatrix} \psi_d \\ i_f' \\ i_h' \end{bmatrix}$$

$$i_h' \longleftrightarrow i_h / \{\alpha_h\}$$

$$\left\{ \overset{L_\ell}{L_d},\ T_d',\ T_d'',\ T_{do}',\ T_{do}'' \right\}^{7},\ \underbrace{\overbrace{T_{dc}'',\ \left(\frac{M_{df}}{R_f}\right)}^{\times}}$$

$$\begin{bmatrix} \psi_d \\ \psi_f' \\ \psi_h' \end{bmatrix} = \begin{bmatrix} L_d & \alpha_f M_{df} & \alpha_h M_{dh} \\ \alpha_f M_{df} & \alpha_f^2 L_{ff} & \alpha_f \alpha_h L_{fh} \\ \alpha_h M_{dh} & \alpha_h L_{fh} & \alpha_h^2 L_{hh} \end{bmatrix} \begin{bmatrix} i_d \\ i_f' \\ i_h' \end{bmatrix}$$

$\times \alpha_f$

$$\frac{d\psi_f'}{dt} + R_f \overset{\times \alpha_f^2}{} i_f' = V_f'$$

$$\frac{d\psi_h'}{dt} + \underline{\underline{R_h \alpha_h^2}}\, i_h' = 0$$

$$\underline{\psi_h' = \psi_h \alpha_h}$$

$$\underline{i_h' = i_h} / \alpha_h$$

$$L_d,\ T_d',\ T_d'',\ T_{do}',\ T_{do}''$$

'L_l': "6" "7"

$$L_d - L_l = M_{df}'$$

✓
$$\begin{bmatrix} \psi_d \\ \psi_f' \\ \psi_h' \end{bmatrix} = \begin{bmatrix} L_d' & \overset{2}{M}_{df}' & M_{df}' \\ M_{df}' & \overset{3}{L}_{ff}' & M_{df}' \\ M_{df}' & M_{df}' & \overset{4}{L}_{hh}' \end{bmatrix} \begin{bmatrix} i_d \\ i_f' \\ i_h' \end{bmatrix}$$

$$
\begin{cases}
\dfrac{d\psi'_f}{dt} = -{}^{6}R'_f\, i'_f + V'_f \\[2ex]
\dfrac{d\psi'_h}{dt} = -{}^{5}R'_h\, i'_h \\[2ex]
\dfrac{d\psi_d}{dt} = -\omega\psi_q - R_a i_d - V_d
\end{cases}
$$

$$V'_f = \alpha_f V_f$$