$\psi_{ds}$

$\frac{1}{sT_{ds}}$

$1 + \frac{s}{3}\pi$

$X_p - \psi_{ds}$

$\psi_{ds}$
Start think w/ Inductor

\[ V - iR = \frac{V}{Z} \]

\[ i = \frac{V}{Z} \]

VE: \( \psi = V - iR \)

As material saturates

\[ P \downarrow \downarrow L \downarrow \frac{1}{4} \]

Let \( \frac{1}{2} = \frac{1 + 5\varepsilon}{L_u} \)

\[ L \left[ \text{Unstat Value} \right] \]
Choose base so ln v.

Current results from a 1p.

Voltage: \( V_{\text{base}} = RI_{\text{base}} \) \( \Rightarrow \frac{V - \text{v}}{\text{v}} \text{v} \)}
\[ i = \frac{R_1}{R_{\text{base}}} \frac{V_{\text{nse}}}{L_{\text{nse}}} \]

\[ V_{\text{nse}} = \frac{L_n}{R_n} e^{\frac{v_n}{R_n}} \]

\[ i = \frac{1}{\frac{V_{\text{nse}}}{R_{\text{base}}}} \frac{1}{\frac{L_n}{R_n}} e^{\frac{v_n}{R_n}} \]

\[ i = \frac{1}{V_{\text{nse}}} \frac{1}{L_n} e^{\frac{v_n}{R_n}} \]

Let \( \theta_{0} = 0 \)

\[ i = \frac{1}{V_{\text{nse}}} \frac{1}{L_n} e^{\frac{v_n}{R_n}} \]
Review of lecture #13 (Determine parameters for generator transient model)

For a synchronous generator without damper winding model, determine $X_d$, $X'_d$, and $T'_{do}$. Note: Although the “u” has been dropped from the subscript, it should be noted that these parameters are unsaturated values. Unless otherwise noted, I will use per unit values in this class. Only the saturation needs to be accounted for to complete the model.

The test to determine these parameters consists of synchronizing a generator to the system and adjusting the generator to produce no real load and absorb reactive power in the amount of 10-20% rated MVA. Trip the unit while measuring field voltage, field current, stator voltage, reactive generation, and speed (have controls/protection set to maintain a constant field voltage and remain at synchronous speed). If the unit speeds up or slows down significantly on the trip, question the assumption of no real power initially. If the field voltage changes, find out why; fix the problem; and rerun the test. Graph the stator voltage and field current versus time. The results should look like:

![Diagram of Direct axis parameter test](image-url)
\[ \dot{y} = y - i \]

\[ i = \frac{1}{\tau_z} \dot{y}(1 + \tau_z) \]

\[ x = \tau \dot{y} \]
Open Circuit Characteristic

Steady state \( \Rightarrow i_d + i_2 = 0 \)

\[ v_3 = 0 \leq\]

Open id, \( i_d = i_2 = 0 \)
Stator voltages $\theta$

\[ V_1 = -\omega r \psi_2 = 0 \]

\[ V_2 = \omega r \psi_d \]
Plot terminal voltage vs field current.
* Select base field current such that it produces rated current on airgap line.

* Select our base field voltage so that during state $I_{pu}$ field voltage produces $I_{pu}$ field current.
Example of SE(1,0) SE(1,2)
\[ SE(1.2) = \frac{729 - 540}{540} = 0.35 \]

\[ SE(1.0) = \frac{468 - 450}{450} = 0.04 \]
Two ways calculate $SE$.

Program Polynomial:

$$s = \frac{B(A^2 - A)}{Y < A}$$

$$s = 0$$

$$s = \int e^x \, dx = e^x$$

Exp.