Key assumptions - If $\psi$ don't change unless specified.

- $\omega_m$ is constant

Since $E_A = K\psi\omega$ per Chap 4

$E_A$ is constant!

By KVL

$E_A = I_A(R_A + jX_S) + \overline{V_\phi}$

With $|E_A| = E_A$ constant, show Figure 5-22 and $R_A = 0$
FIGURE 5-22
The effect of an increase in generator loads at constant power factor upon its terminal voltage. (a) Lagging power factor; (b) unity power factor; (c) leading power factor.
Measurement Parameter -> Voltage Regulation

\[ VR = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100 \% \]

(Can calculate VR for \( V_L \neq V_{FL} \))

Lagging pf \( \Rightarrow VR > 0 \) (can be large)

Unity pf \( \Rightarrow VR > 0 \) (smallish)

Leading pf \( \Rightarrow VR \) can be negative!

Obviously, letting \( V_{\phi} (+V_t) \) fall for lagging pf would not be acceptable for many applications. So, how can we avoid this? \( E_t = L \omega_m \phi \) don't change controlled by \( J_i \)!

So, using a control system,

1) Decrease \( R_{FL} \) to increase \( I_f \)
2) \( I_f \uparrow \) causes \( \phi \uparrow \)
3) \( \phi \uparrow \) causes \( E_t \) \( \uparrow \) increase
4) \( E_t \uparrow \) causes \( V_{\phi} (+V_t) \uparrow \) increases