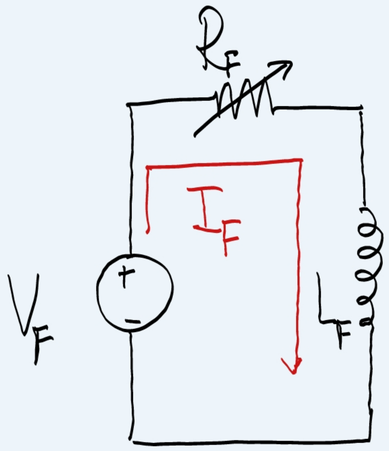
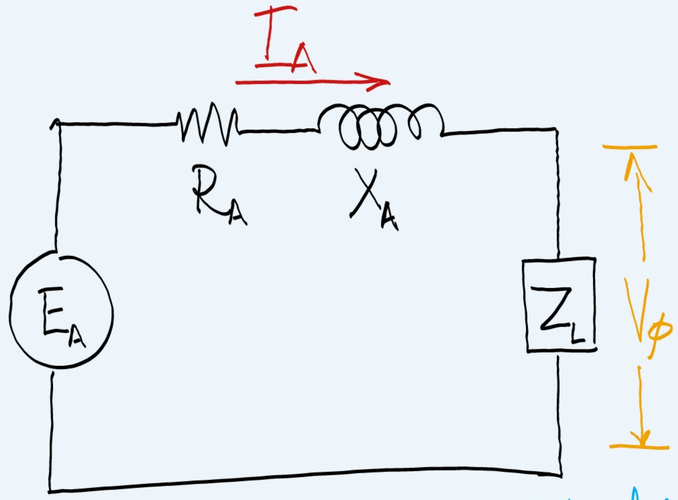
Sync. Gen.

$I_f \rightarrow \vec{B}$



Rotor
(Connected with Prime Mover)

$I_F = \frac{V_F}{R_F}$



Stator Winding

$E_A = I_A R_A + I_A X_A + V_\phi$

$E_A = \sqrt{2}\pi N_c \phi f$

Related Quantities

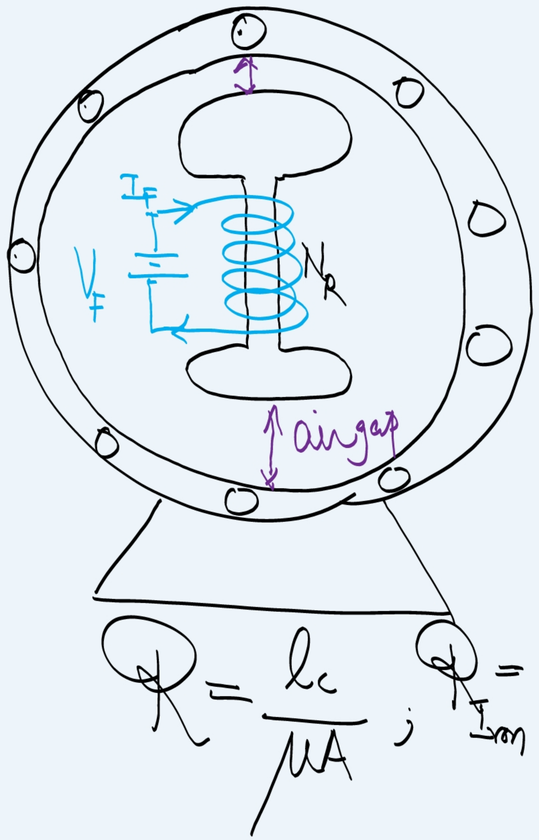
(i) E_A with I_F (Mag. flux)

(ii) R_A & X_A

$\Rightarrow$ OPEN & SHORT CKT. TESTS

Open-Circuit test/characteristics (OCC):

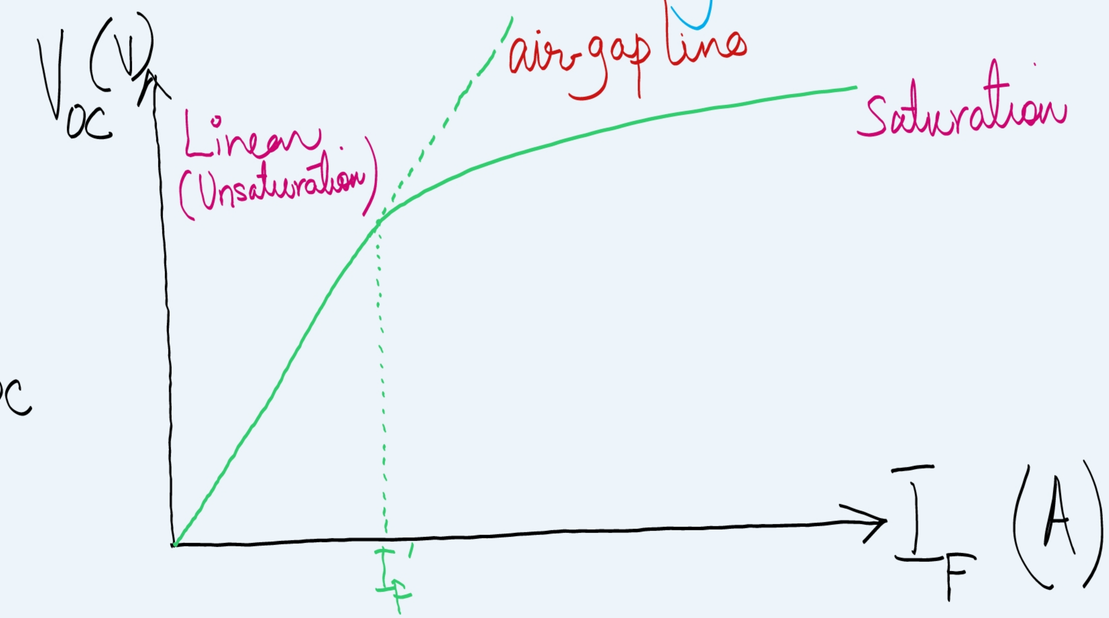
$I_F N_R = \phi \mathcal{R}_{Iron\,core}$



Load Z_L is not connected to stator winding

$\Rightarrow I_A = 0$

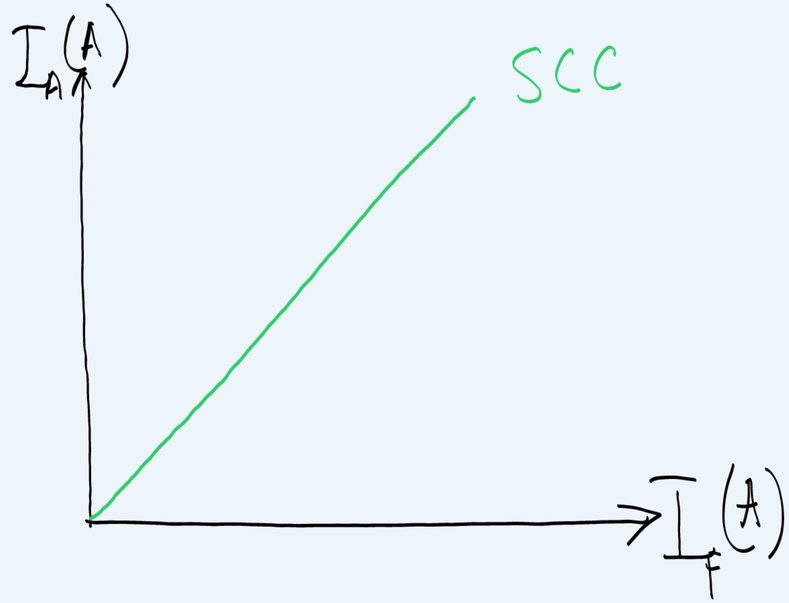
$\Rightarrow V_\phi = E_A = V_{OC}$



$\mathcal{R} = \frac{l_c}{\mu A}$; $\mathcal{R}_{Iron} = \frac{l_c}{\mu_0 \mu_{r\,iron}}$; $\mathcal{R}_{air\,gap} = \frac{l_c}{\mu_0 A}$

Short-ckt Test / Characteristics (SCC)

In armature winding, Remove Z_L and connect ammeter to measure I_A



$$I_A = \frac{E_A}{\sqrt{R_A^2 + X_A^2}}$$

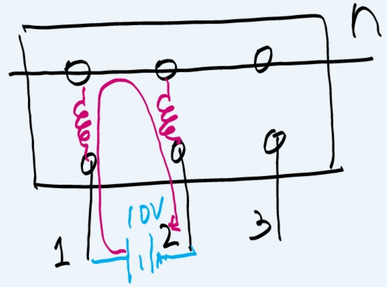
Assuming $X_A \gg R_A \Rightarrow I_A \sim \frac{E_A}{X_A}$

$$\Rightarrow X_A = \frac{E_A}{I_A}$$

Problem 5.1

Sync. Gen.

1) Rated values: 200kVA, 480V, 50Hz, Y-connected



2) Rated Field Current, $I_{F,rated} = 5A$

Test Results:

① $V_{T,OC}$ at $I_{F,rated} = 5A$ is 540V $\Rightarrow E_A = \frac{540V}{\sqrt{3}} = 312V$

② $I_{L,SC}$ at $I_{F,rated} = 5A$ is 300A $\Rightarrow I_A = 300A$

③ For $V_{DC} = 10V$; $I_A = 25A$ $\Rightarrow 2R_A = \frac{10V}{25A} = 0.4\Omega \Rightarrow R_A = 0.2\Omega$

Assuming $X_S \gg 0.2\,\Omega$

$$X_S = \frac{E_A}{I_A} = \frac{312\,V}{300\,A} = \_\_\_\_\_$$

$$\sqrt{R_A^2 + X_S^2} = \frac{E_A}{I_A} \Rightarrow X_S = \sqrt{\left(\frac{E_A}{I_A}\right)^2 - R_A^2} = \_\_\_\_\_$$

Problem 5.11 – 5.21

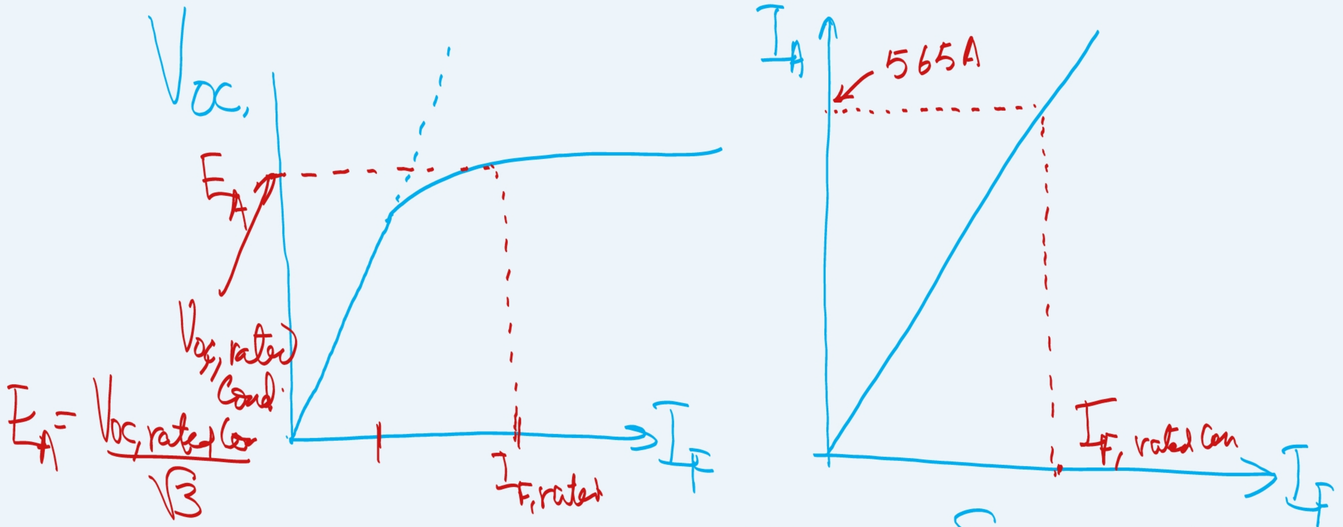
$S = \sqrt{3}\, I_L V_L$

Sync. Gen.

1) Y-connected
2) Four poles
3) 470kVA, 480V, 60Hz, 0.8pf (lagging)
4) $R_A = 0.016\,\Omega$
5) $P_{Loss} = 7 + 8\,kW = 15\,kW$

Charac. Curves P5-2

Reference: 5.7



$$I_{A,\,rated\,condition} = I_L = \frac{S}{\sqrt{3}\,V_L} = \frac{470kVA}{\sqrt{3} \times 480V} = 565A$$