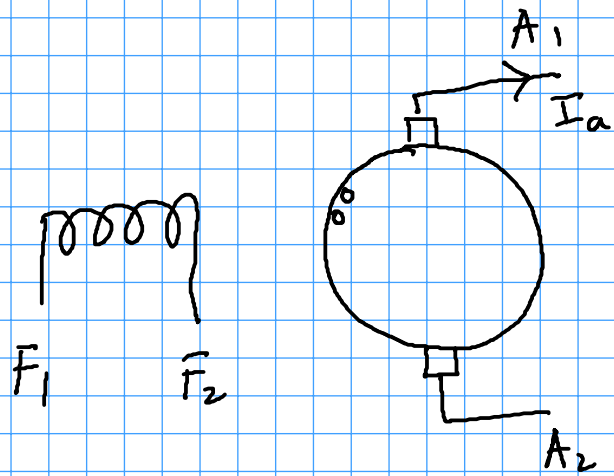




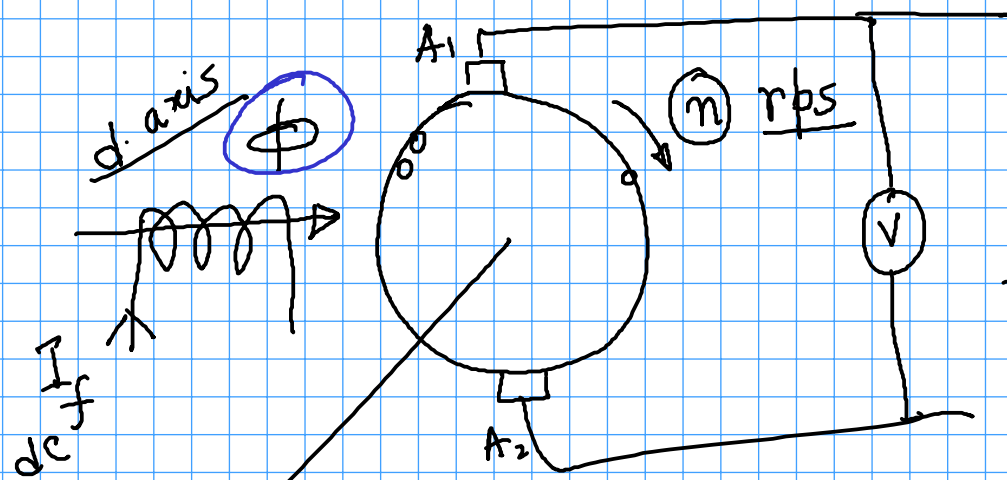
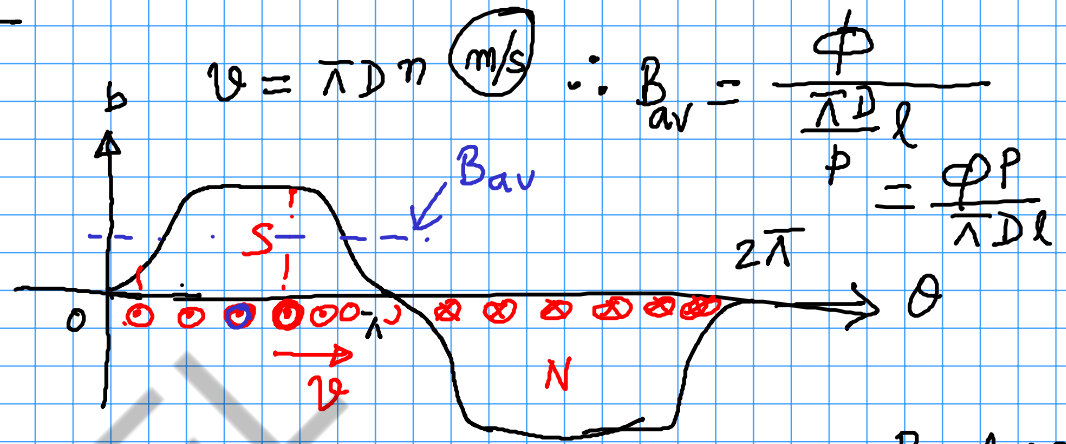
If I_a = external armature current

Then current through the armature conductors = $\frac{I_a}{a}$

where a = number of parallel paths in the armature circuit (i.e., across the brushes)

In case of lap winding

$a = P$ = number of poles of the machine.

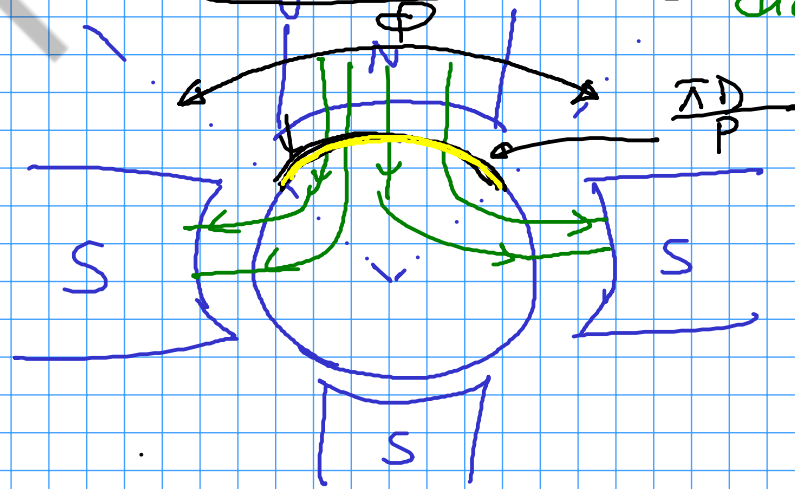


$B_{av} l \pi D n$ ← Induced voltage in a single conductor = ? $B_{av} l v$
 dia of rotor = D

prime waver

let ϕ = total flux
 per pole
 in Wb.

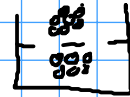
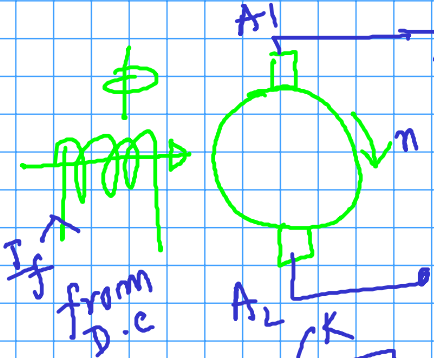
area through which this
 ϕ is present = $\frac{\pi D l}{p}$



Dec-63

Induced voltage in a single conductor = $B_{av} l v$

$n \rightarrow$ rps



$$= \frac{\phi}{\frac{\pi D}{p}} \times \pi D n$$

$$= \frac{\phi p}{\pi D} \pi D n = \phi p n \text{ volts.}$$

Let $E_{A1A2} = k \phi n$

Z = total number of armature conductors.

a = number of parallel paths across the armature terminals. $= (p \text{ if lap wdg})$

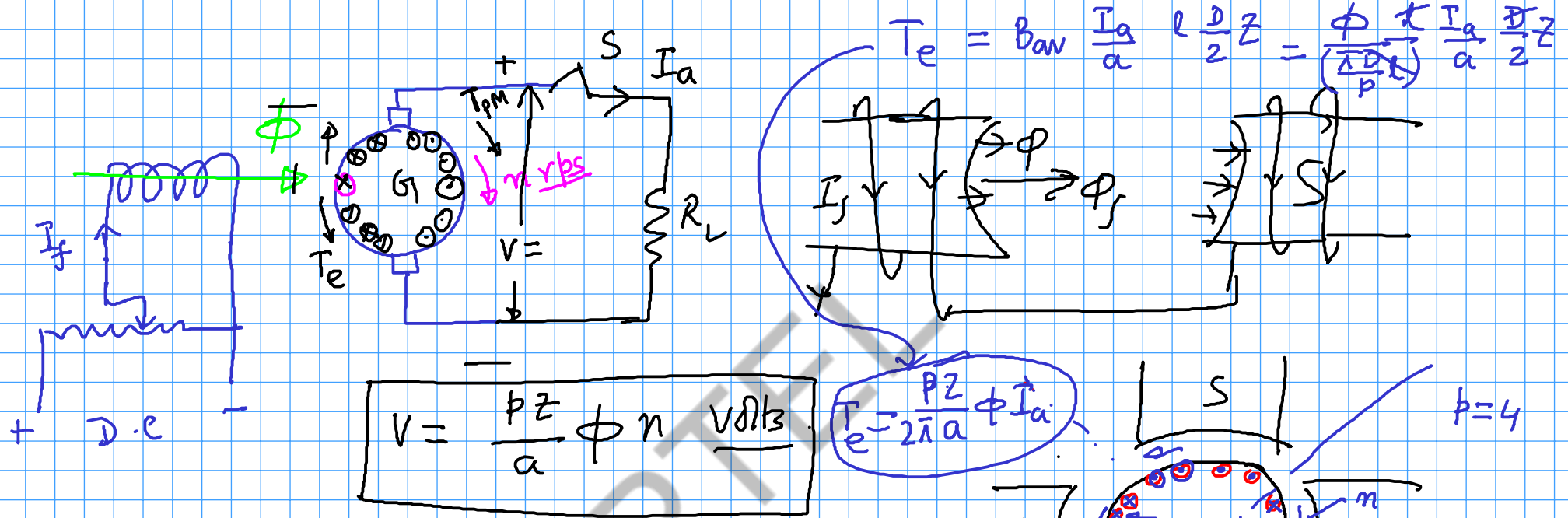
So no. of conductors in each parallel path $= \frac{Z}{a}$

voltage available across the brush or armature terminals

$$= \phi p n \frac{Z}{a} = \frac{p Z}{a} \phi n$$

$$E_{A1A2} = \left(\frac{p Z}{a} \right) \phi n$$

$\phi \propto I_f$
 $E_{A1A2} \propto k I_f n$
 $\therefore E_{A1A2} \propto I_f n$

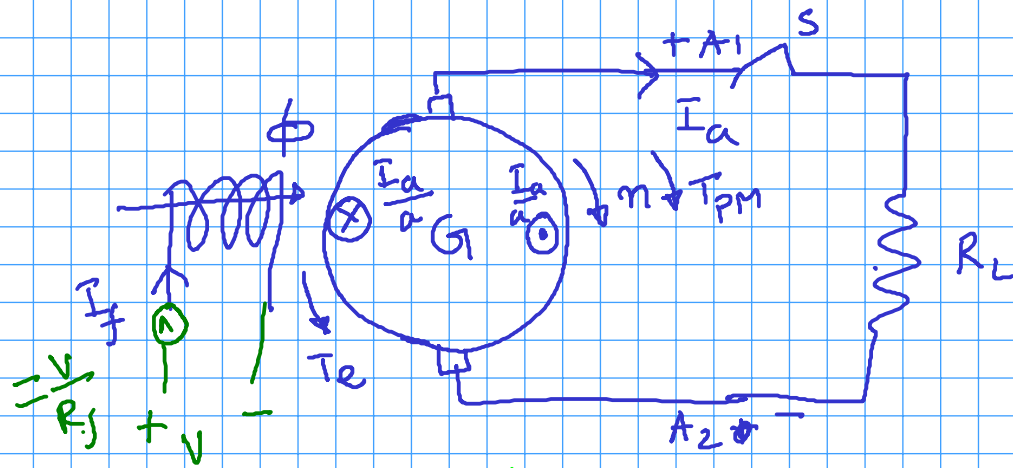
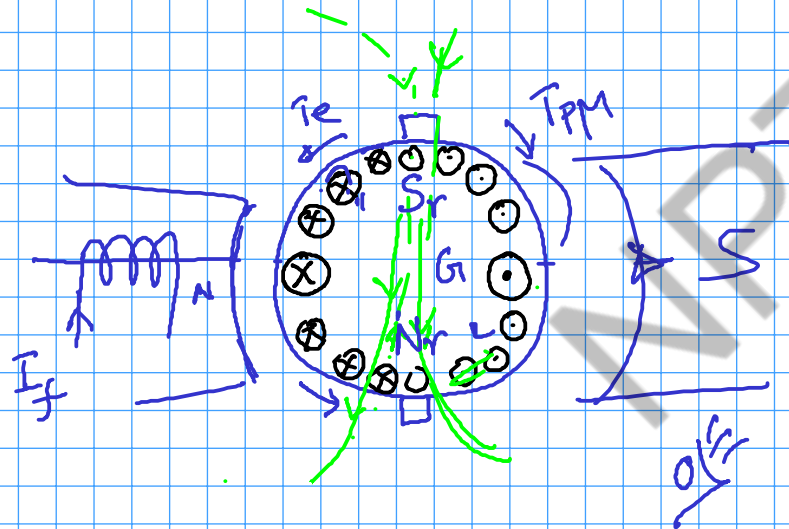


Av force experienced by a single conductor = $B_{av} \left(\frac{I_a}{a} \right) l$

torque experienced by this conductor = $B_a \left(\frac{I_a}{a} \right) l \frac{D}{2}$

$\therefore$ Total torque

$$T_e = B_{av} \left(\frac{I_a}{a} \right) l \frac{D}{2} \times Z$$



$$E_g = \frac{pZ}{a} \Phi n \quad \text{volts}$$

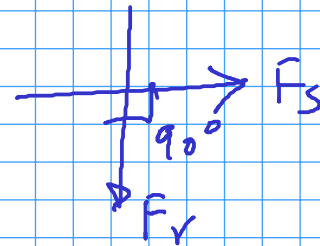
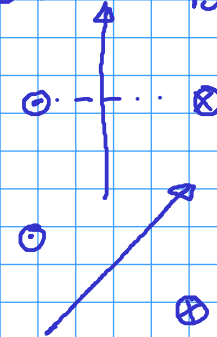
$\frac{pZ}{2\pi a} \Phi 2\pi n$ (rps)
 $= \frac{pZ}{2\pi a} \Phi \omega$ (rad/sec)

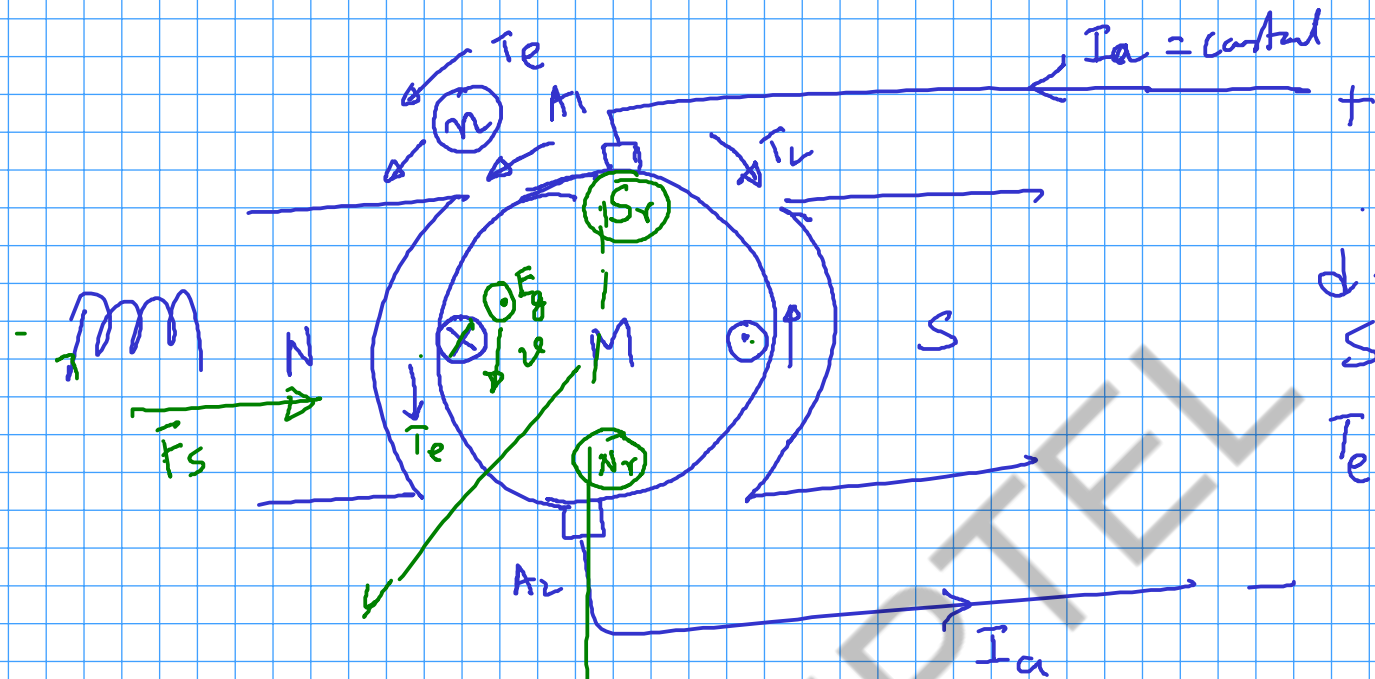
$$T_e = \frac{pZ}{2\pi a} \Phi I_a \quad \text{N-m}$$

$\frac{pZ}{2\pi a} \Phi \omega$ (rad/sec)

Armature $\rightarrow$ rotor

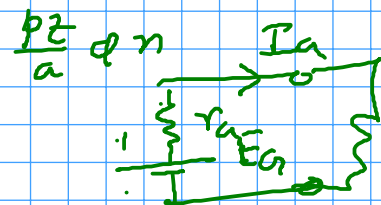
Armature coils are also called Pseudo stationary coils.



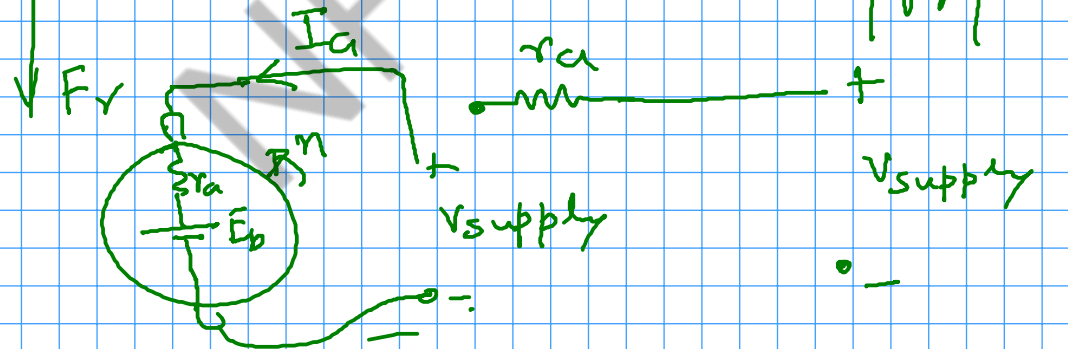
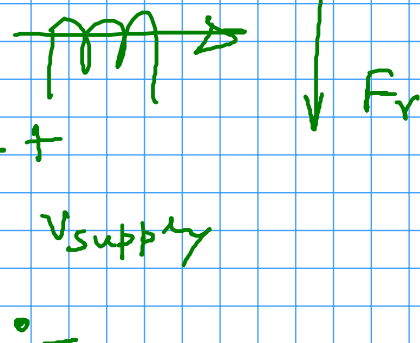


V_{supply}
d.c
Source

$$T_e = \frac{pZ}{2\pi a} \Phi I_a = T_L$$



$$E_b = \frac{pZ}{a} \Phi^n$$



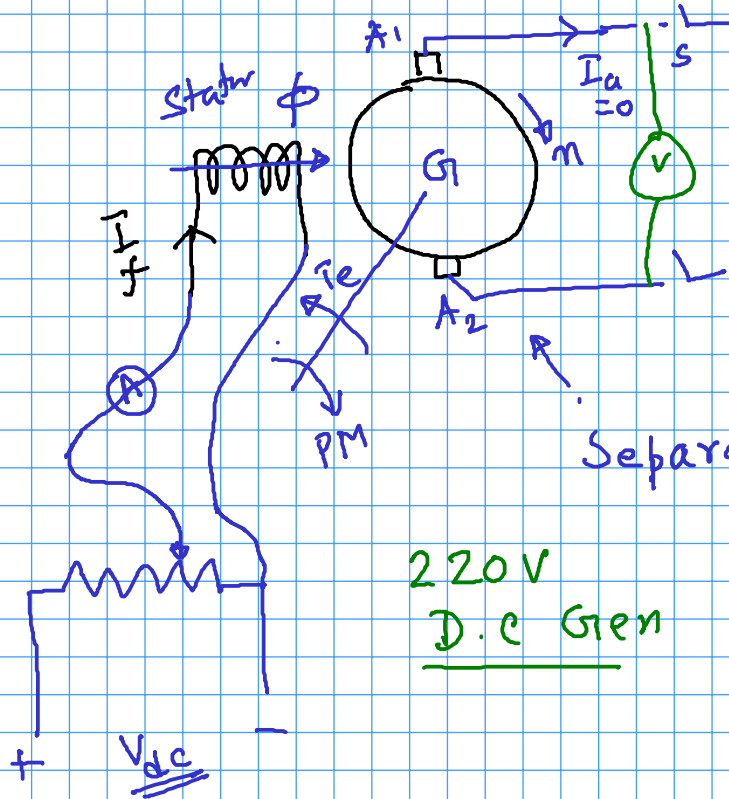
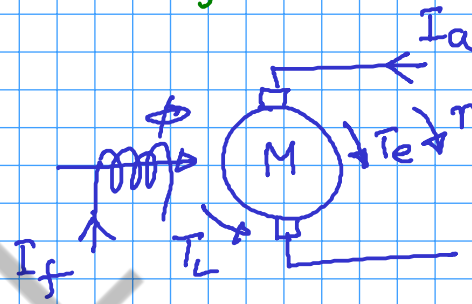
DC Machines

Dec-65

ϕ depends on I_f

$$E_G = \frac{pZ}{a} \phi n$$

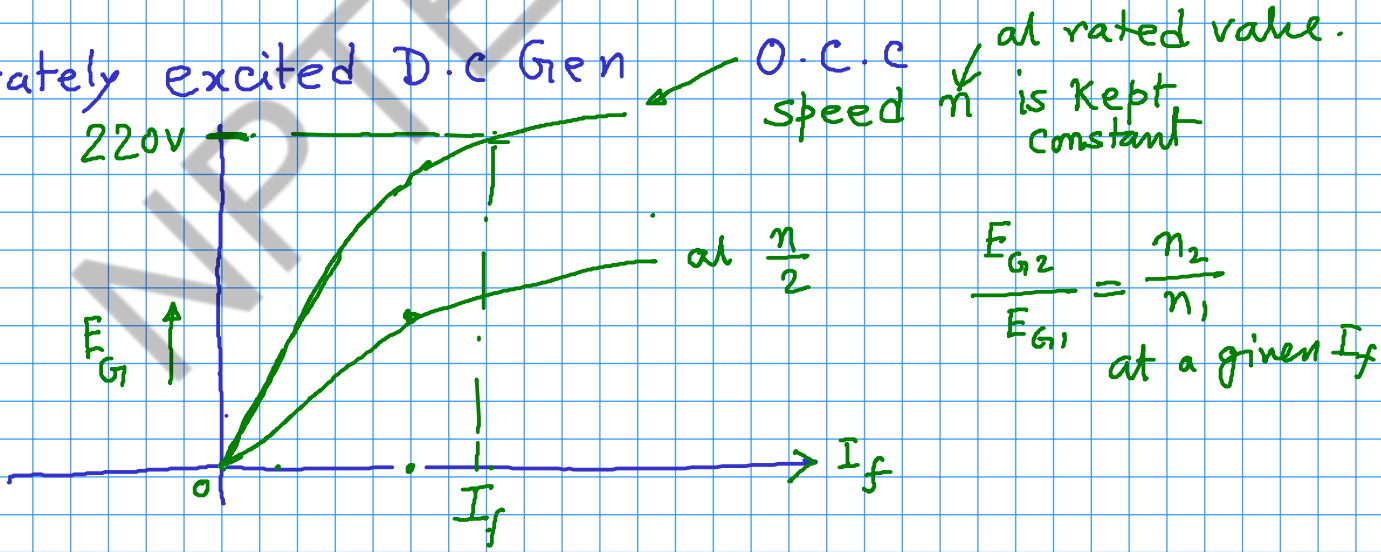
$$T_e = \frac{pZ}{2\pi a} \phi I_a$$

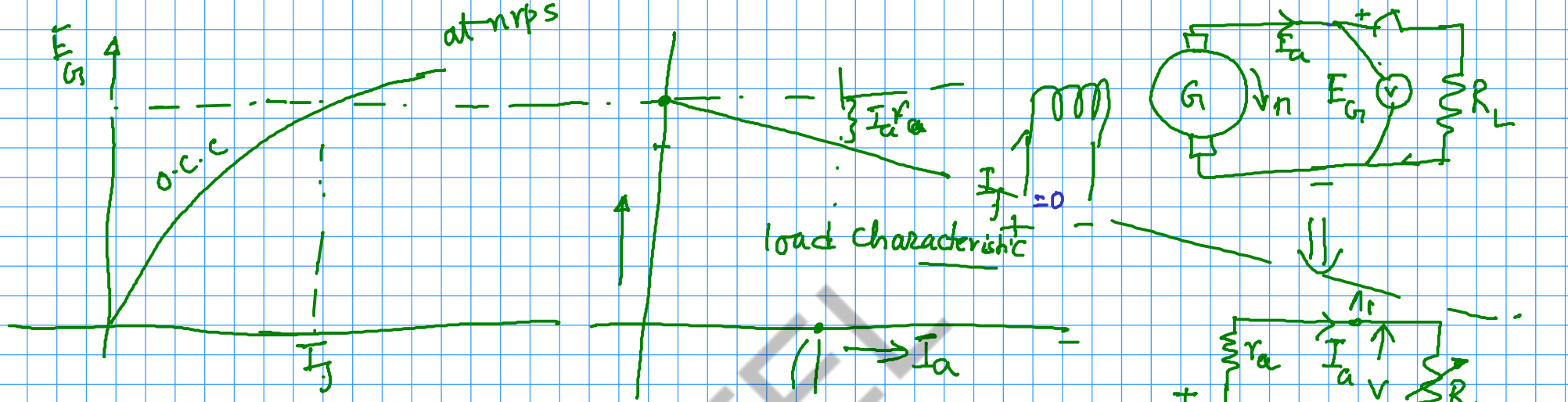


Shunt generator

Separately excited D.C Gen

220V D.C Gen





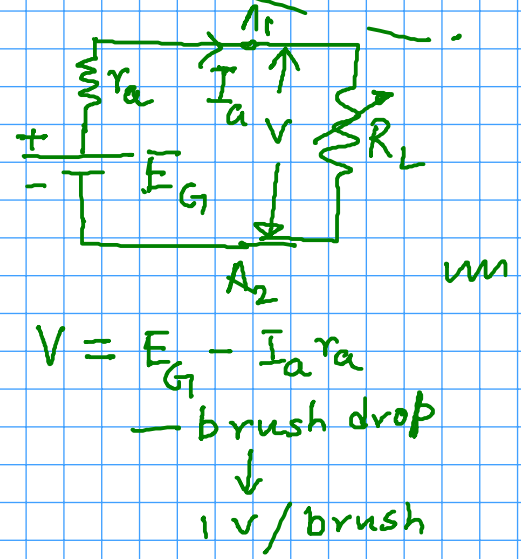
Separately excited generator

if armature is short circuited

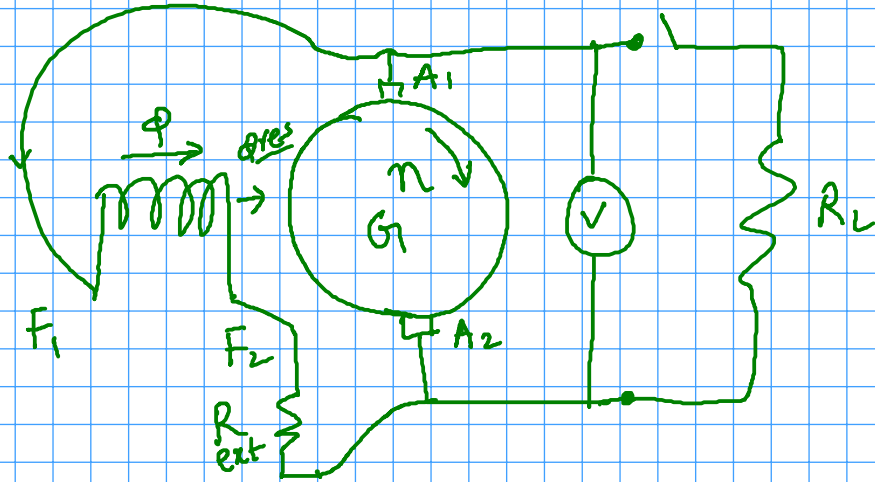
$I_a = \frac{E_g}{r_a}$ will be very large

$$V = E_g - I_a r_a$$

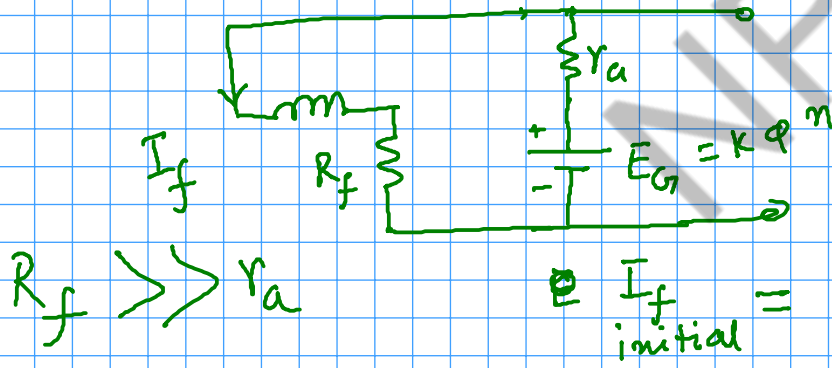
$$R_L = 0$$



Shunt Generator



$\Phi_{\text{residual}} = 0$ at $t=0$



$R_f \gg r_a$

$$I_{f \text{ initial}} = \frac{E_{G \text{ res}}}{r_a + R_f} \approx \frac{E_{G \text{ res}}}{R_f}$$

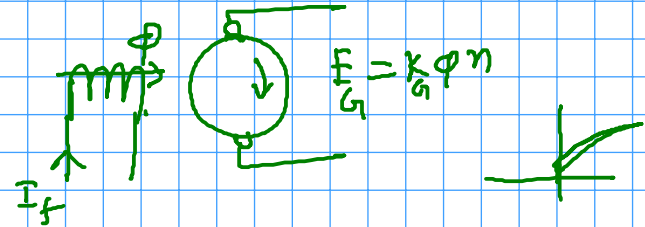
Initially
Gen voltage

$$\frac{pZ}{a} \Phi_{\text{res.}} n$$

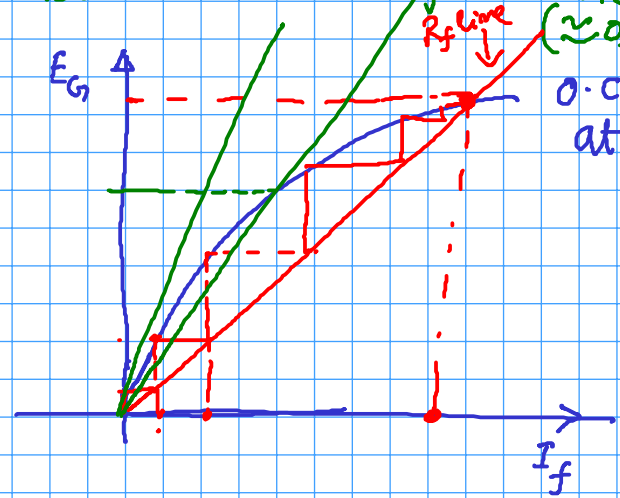
Presidual is
a must

$$\text{Let } R_f = \text{total field ckt resistance} = R_{f \text{ coil}} + R_{\text{ext}}$$

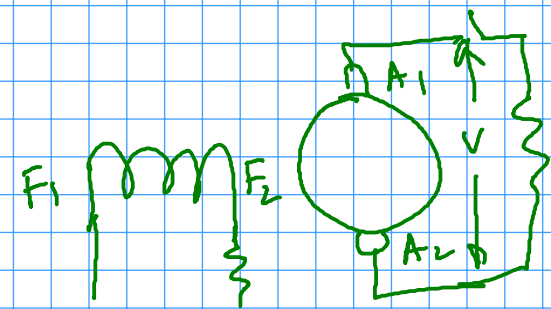
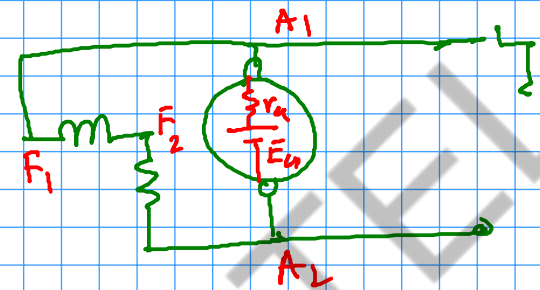
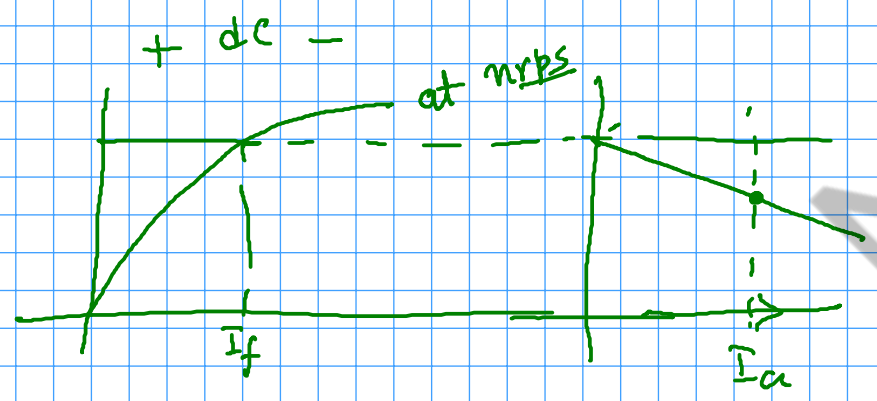
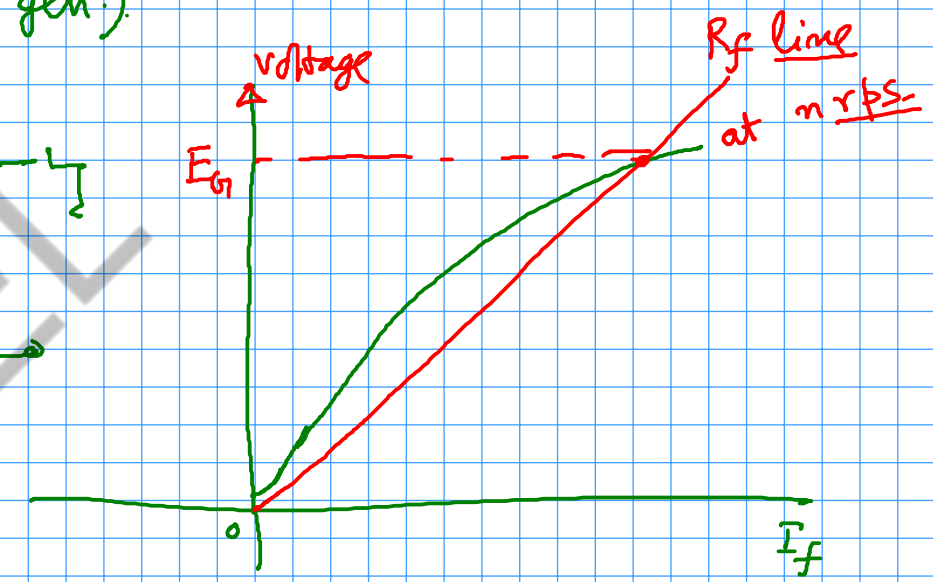
Lec 65

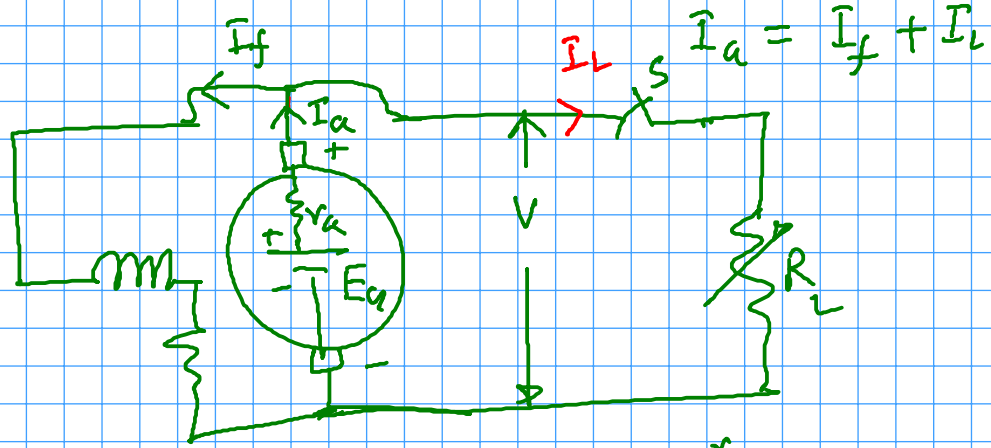


Suppose The m/c has
some residual flux $\Phi_{\text{residual}} (\approx 0)$
o.c.c at n rps

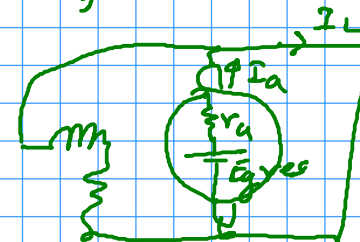


D.C Gen $\begin{cases} \text{Separately excited} \\ \text{Self excited (or shunt gen.)} \end{cases}$





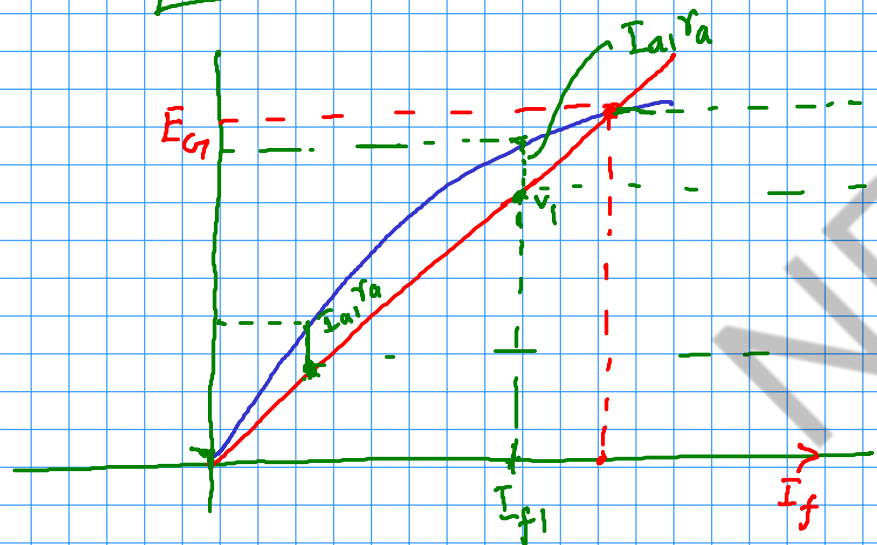
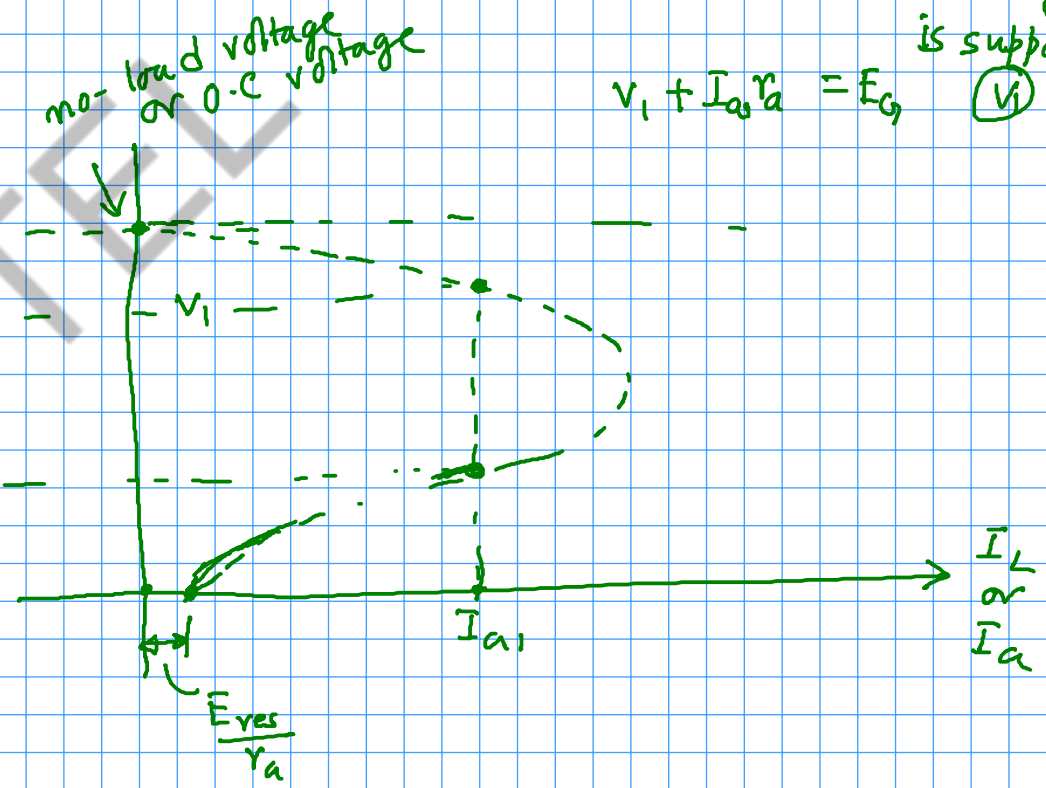
$R_L = 0; V = 0$

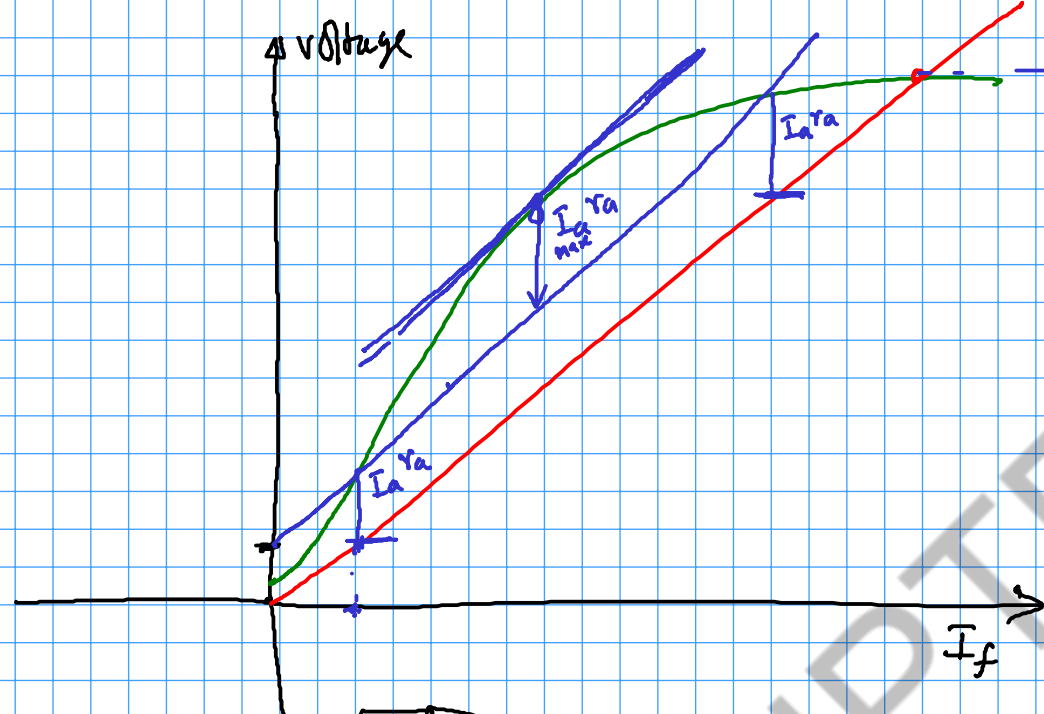
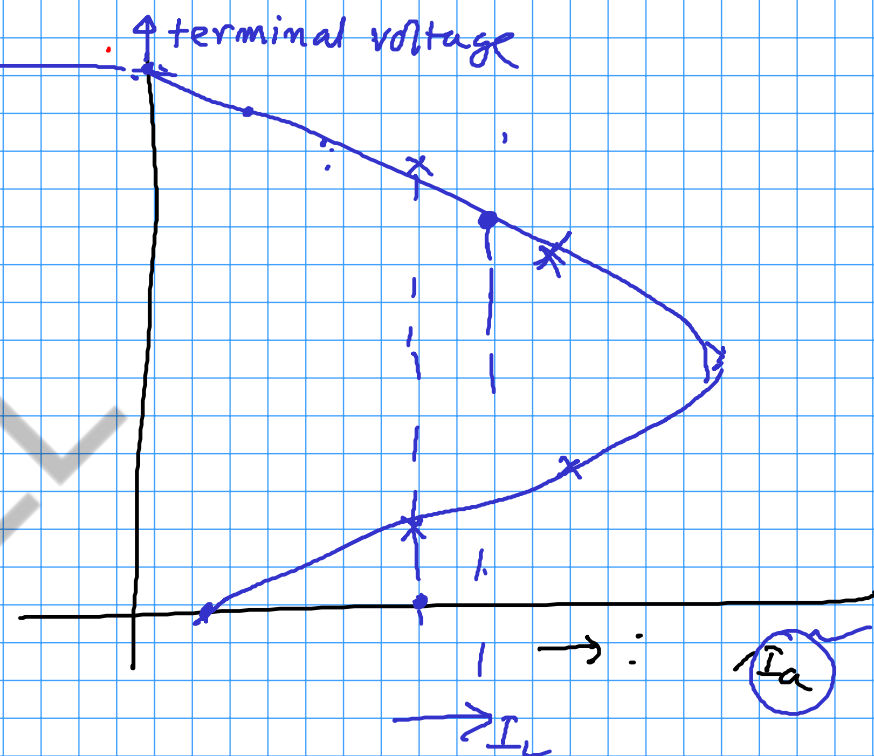
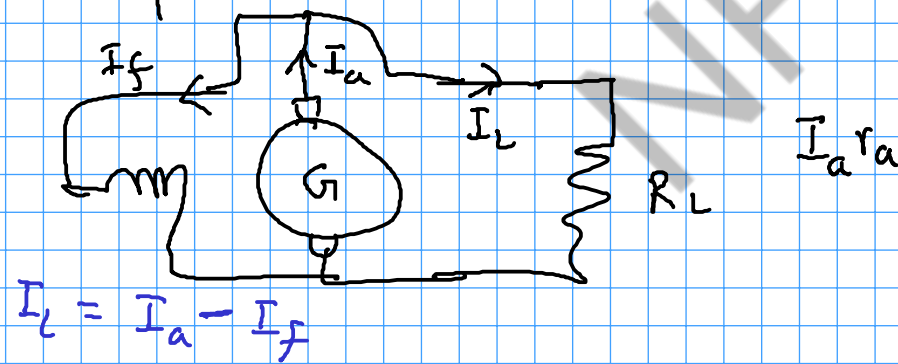


$I_a = I_L$

I_{a1} chosen & terminal $I_{a1} r_a$ voltage is supplied

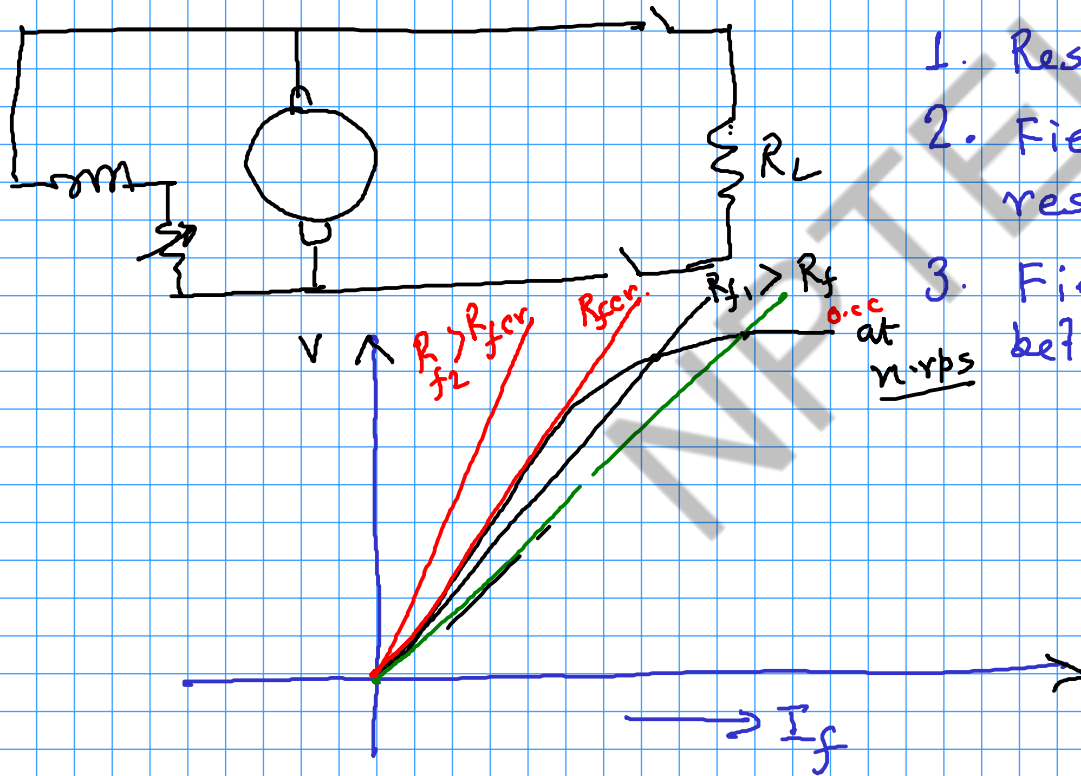
$V_1 + I_{a1} r_a = E_g$ (V)





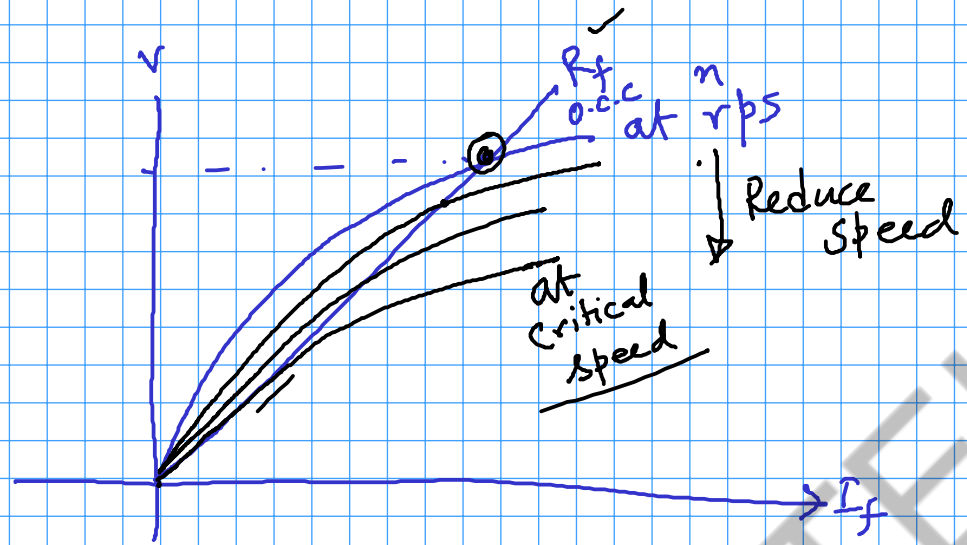
No-load & load Characteristics of Separately & Shunt excited Generators.

for Sh. Genr The conditions to be fulfilled to generate voltage.

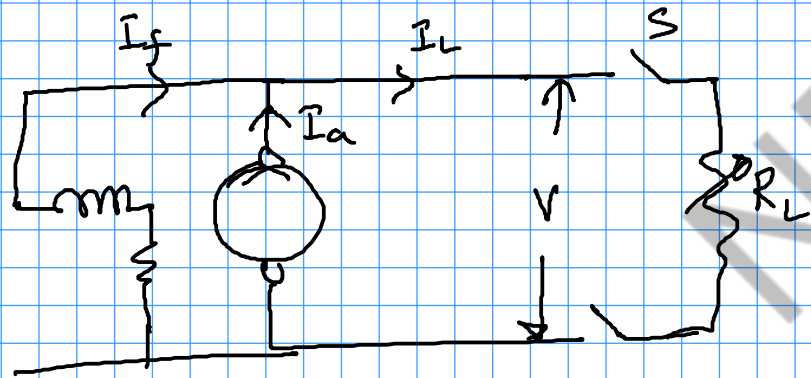


1. Residual field must be present
2. Field current must assist the residual field
3. Field circuit resistance must be below a critical value. $R_{f, critical}$

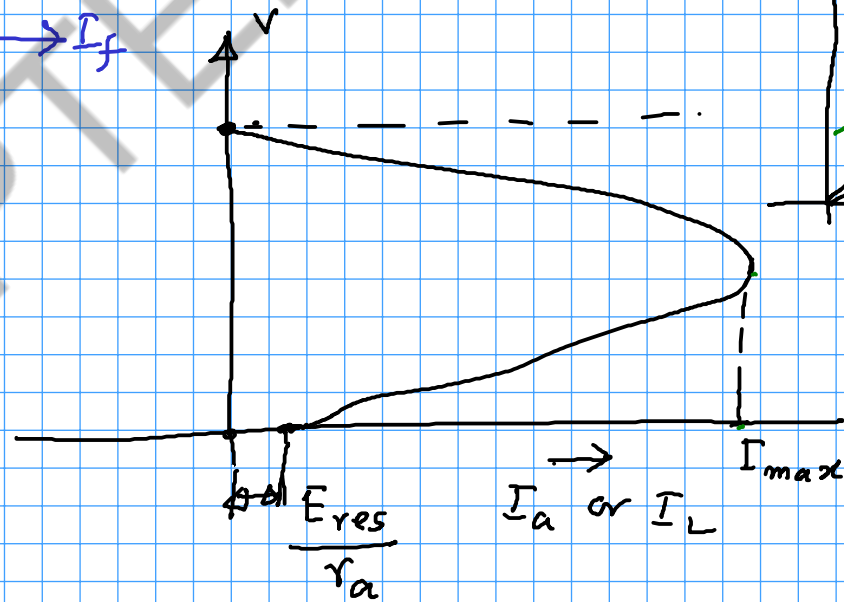
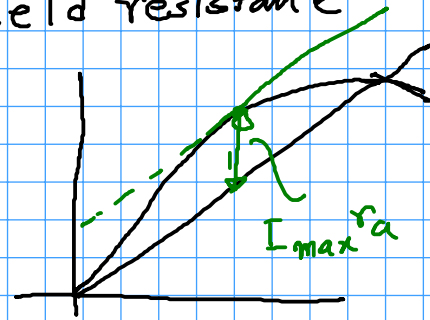
④ speed of Generator should be greater than a critical speed.



Keeping R_f same if speed is being reduced a time will come when the R_f will be the critical field resistance



$$I_L = I_a - I_f$$



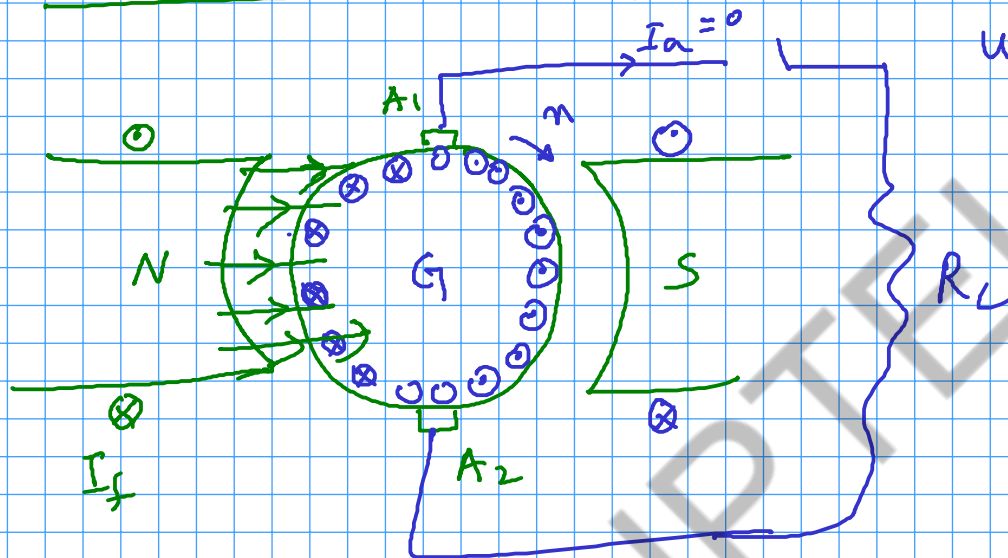
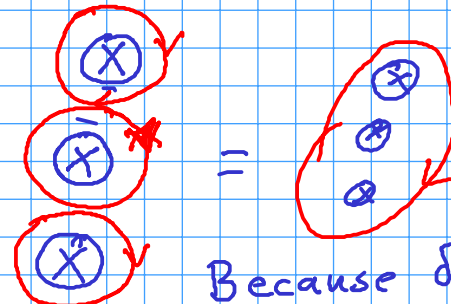
Armature Reaction: qualitatively

$$\frac{\phi_z}{a} \neq n$$

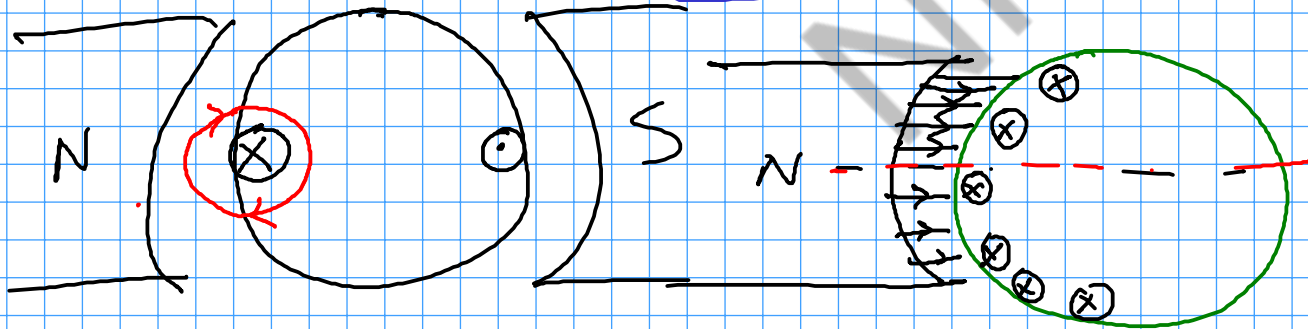
under no load condition

$$I_a = 0$$

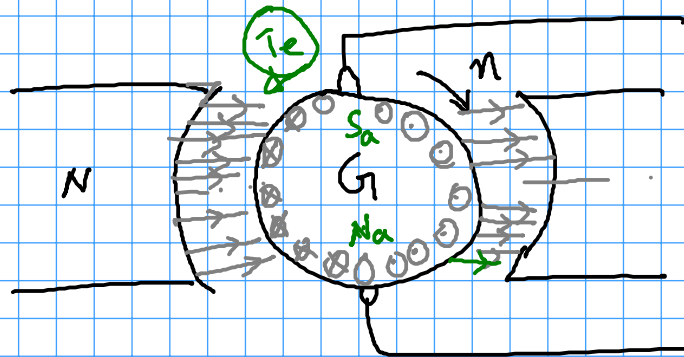
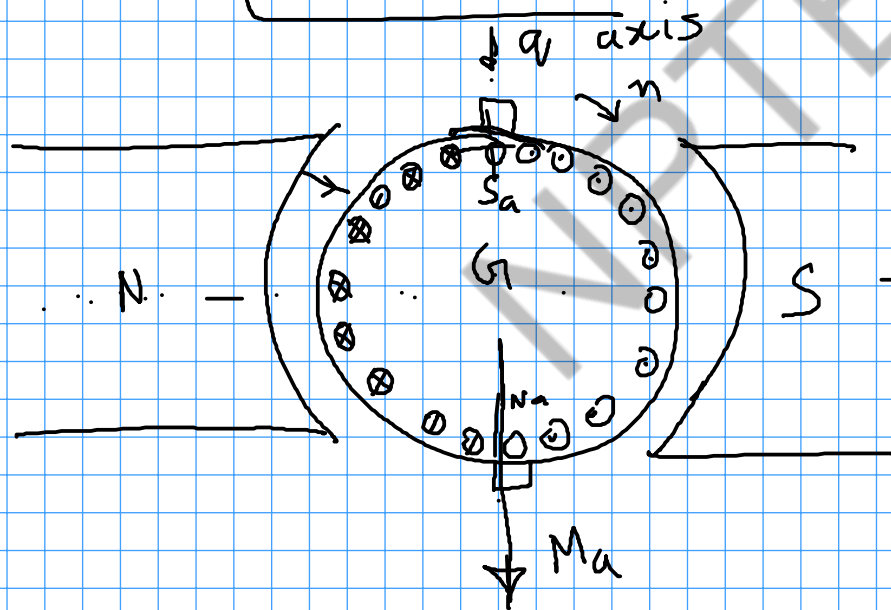
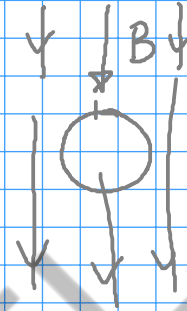
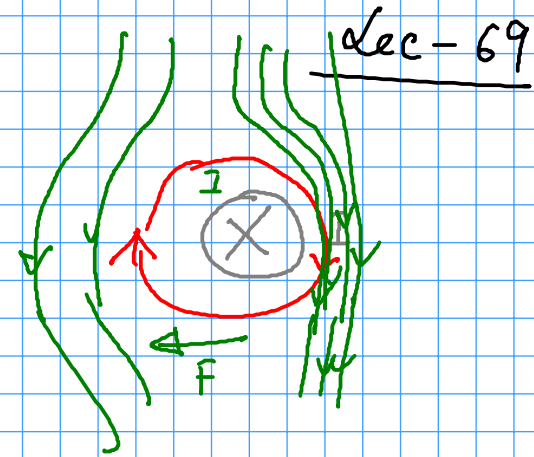
ϕ = flux/pole
decided by I_f



Because of I_a flux will increase in one half of the pole and will decrease in the other half. This will perhaps (!) keep the flux per pole unchanged



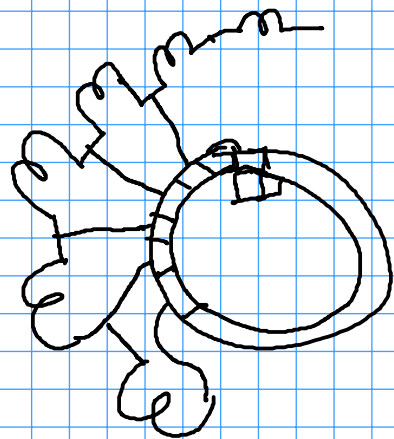
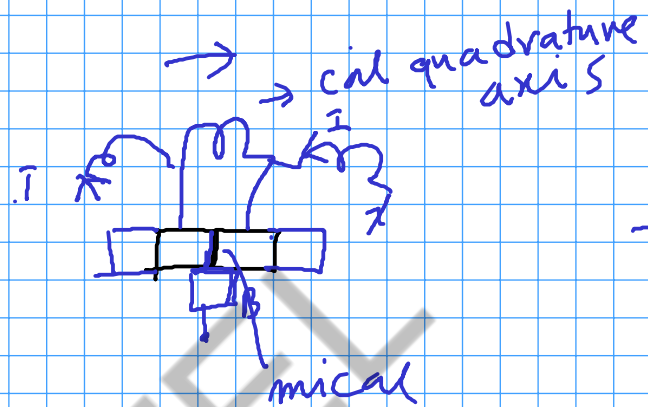
Armature reaction :-



$I_a = 0$, no flux in the

Commutation of Current @ axis

d axis



$+I$ to $-I$

Lec-70

