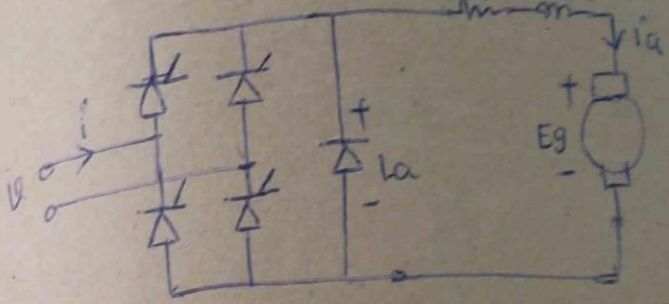

$e_g = K_a \phi \omega_m$

$\phi = \phi_a + \phi_{res}$

$\phi_a = K_f i_a$

$e_g = K_a (K_f i_a + \phi_{res}) \omega_m$

$= K_a K_f i_a \omega_m + K_a \phi_{res} \omega_m$

$= K_a f i_a \omega_m + K_{res} \omega_m$

$E_g = K_a f I_a \omega_m + K_{res} \omega_m$

developed torque $T = K_a \phi i_a$

$T \simeq K_a f i_a^2$

Average torque $T = K_a f i_a^2$ |average

$= K_a f I_{ar}^2$

I_{ar} = rms armature current

$e_a = R_a i_a + L_a \frac{di_a}{dt} + e_g$

$E_a = R_a I_a + E_g$

$E_a = \frac{2\sqrt{2} V_0}{\pi} \cos\alpha = R_a I_a + K_a f I_a \omega_m + K_{res} \omega_m$