Lecture 20

Friday, 5 April 2024 3:38 PM

EE114 - Power Engineering 1

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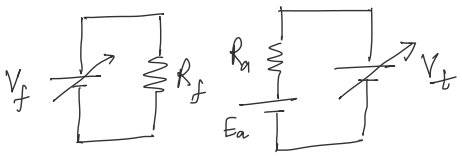
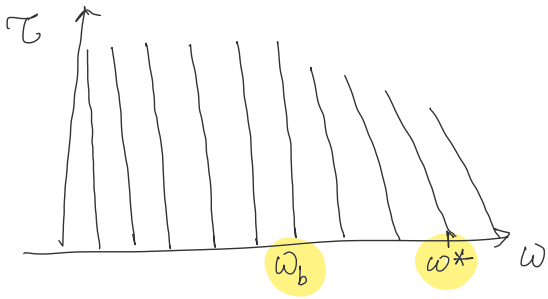
Scribe: Saurabh Singh





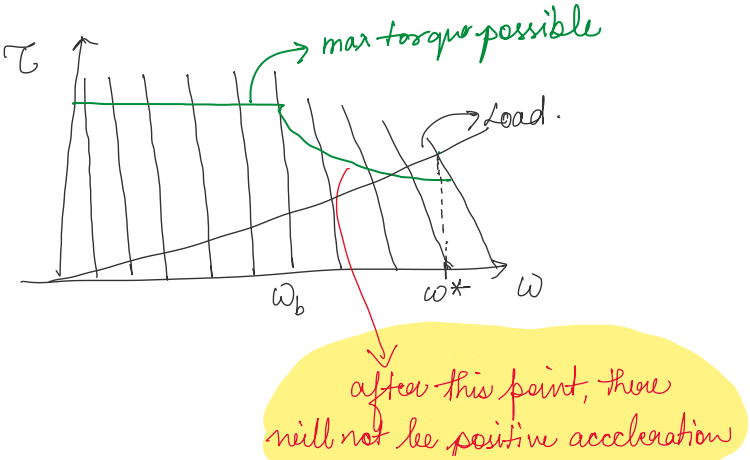
Suppose we want to control the speed of motor to some target ω^* which greater than ω_{base}.

Step 1 :- Increase the V_f so that we have rated flux in the machine. If we don't have flux the machine will not produce any torque & the machine will not rotate.

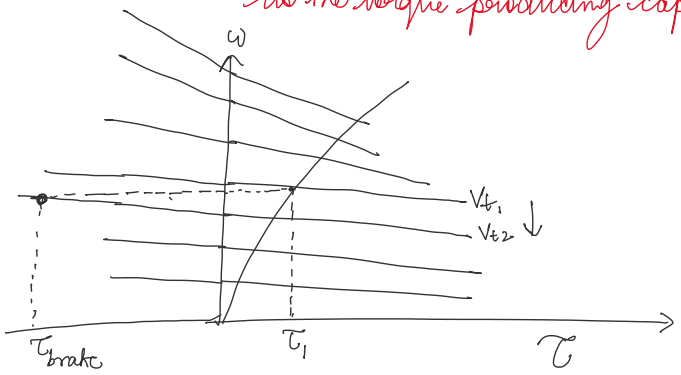
Step 2 :- Increase the voltage V_t slowly. As V_t increases slowly. I_a is generated. Motor rotates due to torque generated. E_b is generated due to ω. The current I_a reduces. Again V_t is increased until we reach V_{rated}.

Step 3 :- $V_t = V_{rated}$.

Step 4 :- V_f is then reduced to have flux weakening mode of operation.



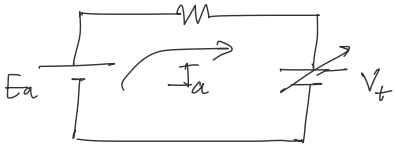
as the torque producing capability reduces.



How to brake?

How to generate negative torque

Reduce V_t, the speed doesn't decrease immediately. So at that speed, the torque now produced will be negative. As speed reduces, we again reduce the voltage V_t



As V_t reduces the direction of current reverses, T becomes negative, and power is fed back to the source. ⇒ Regenerative braking.

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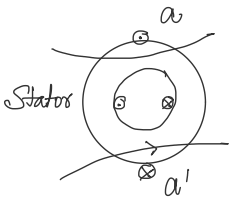
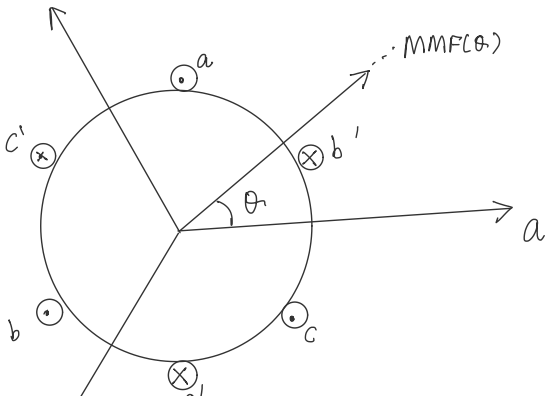
* Induction motor:



If the current through aa' is AC, flux changes direction.



$F_a = N i_a, \quad F_b = N i_b, \quad F_c = N i_c$

$MMF_{net}(\theta) = F(\theta) = F_a \cos\theta + F_b \cos(\theta - 120) + F_c \cos(\theta + 120)$

$= N I_m \left[\cos\theta \cos\omega t + \cos(\theta - 120)\cos(\omega t - 120^\circ) + \cos(\omega t - 240)\cos(\theta - 240) \right]$

$= N \frac{I_m}{2} \left[\cos(\theta + \omega t) + \cos(\theta - \omega t) + \cos(\theta + \omega t - 240) + \cos(\theta - \omega t) + \cos(\omega t + \theta - 480) + \cos(\theta - \omega t) \right]$

$MMF_{net}(\theta) = \frac{3}{2} N I_m \cos(\omega t - \theta)$