Lecture 19

Tuesday, 26 March 2024 3:34 PM

EE114 - Power Engineering 1

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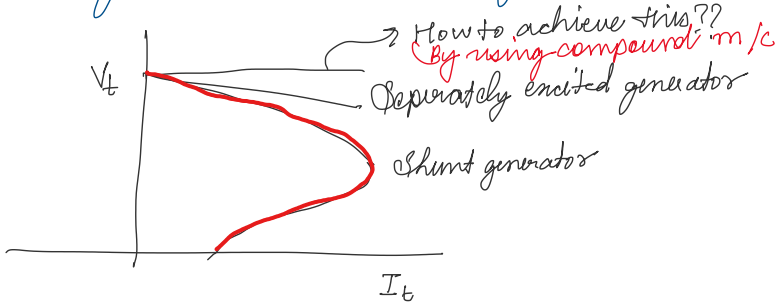
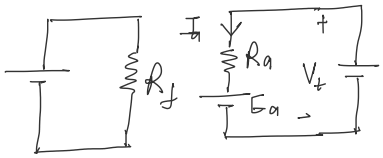
* Seperately excited DC machine
  - If
  - Armature → O/C
    $I_a = 0$

Core losses are combined in Rotational loss or mechanical loss

* Lap winding - $a = p$; Wave winding — $a = 2$



* DC Motor :-



Seperately excited DC motor

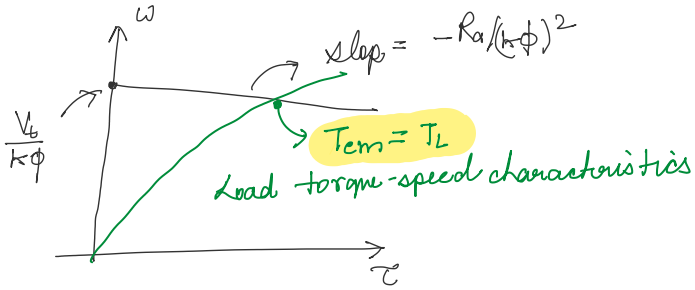
Shunt DC motor has nearly the same characteristics. So we will only focus on seperately excited motor.

$$V_t - I_a R_a = E_a$$

$$T_{em} = k\phi I_a$$
$$E_a = k\phi\omega$$

$$V_t - \frac{T_e}{k\phi} R_a = k\omega\phi$$

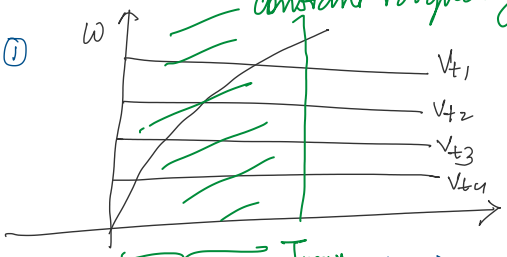
$$\omega = \frac{V_t}{k\phi} - \frac{R_a}{(k\phi)^2} T_e$$



Load characteristics of fan, water pump $T \propto \omega^2$
Friction $T \approx$ const

Now suppose we change the speed of motor

Method ①



$\omega = \frac{V_t}{k\phi} - \frac{R_a}{(k\phi)^2} T$

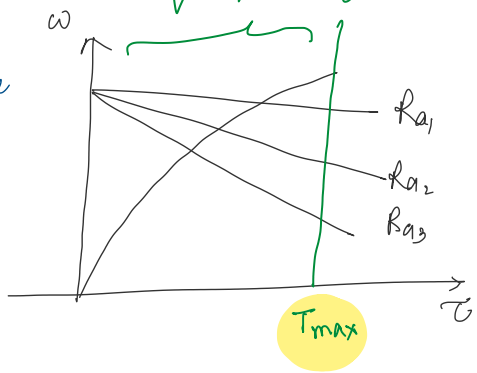
V_t is nearly proportional to speed.

Safe operating area

$T_{max} = ?$

Method ②

Inject Resistance in armature winding

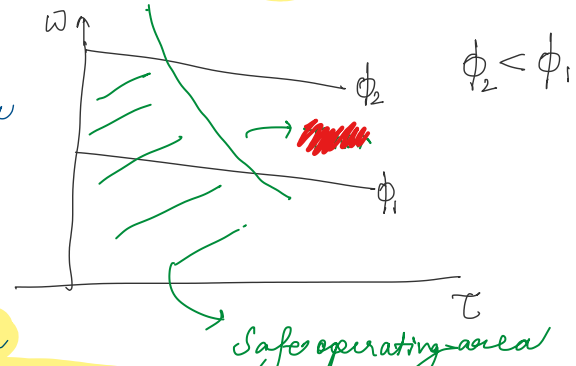


$R_{a3} > R_{a2} > R_{a1}$

Method ③

Have a variable flux

Flux or field weakening



$\phi_2 < \phi_1$

Constant power region

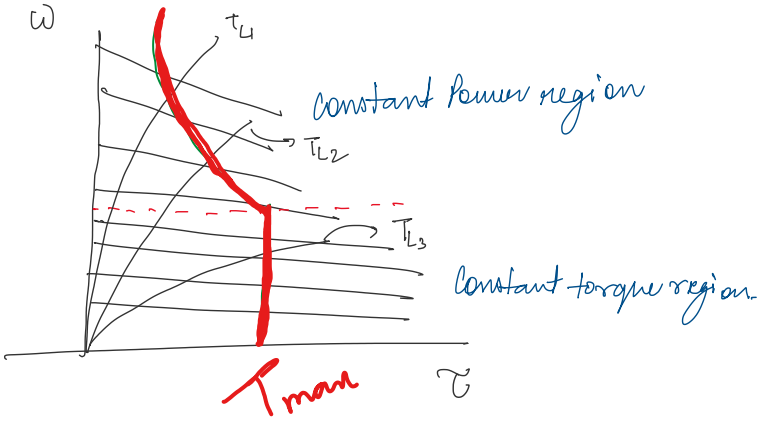
↳ Safe operating region is limited by max power.

At base speed → V_t → nominal, ϕ → rated, Rated Load

At start → ϕ → ϕ_{rated}
V_t → very small

At base speed → ϕ → ϕ_{rated}
V_t → $V_{t\,rated}$

At above base speed → $\phi < \phi_{rated}$
V_t → $V_{t\,rated}$.



W2 = power