جامعة بيرزيت
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- Field Excitation
  - Separately excited DC machine
  - Shunt excited DC machine
  - Series excited DC machine
  - Compound DC machine
  - Permanent magnet DC machine (PMDC)

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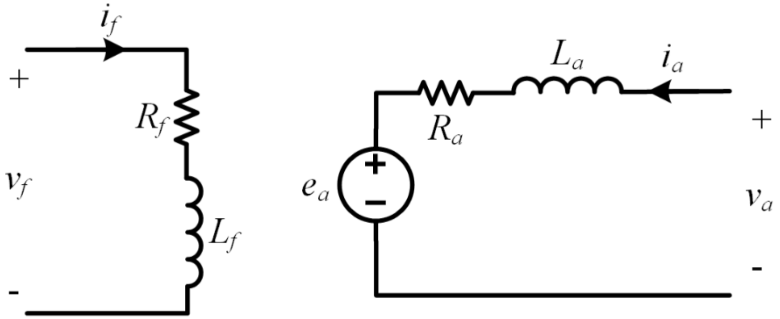
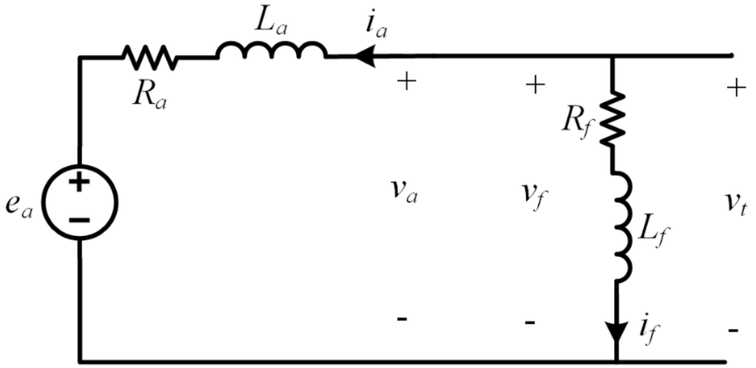
Steady state torque-speed relationship

- Separately and shunt excited DC machines



Separately



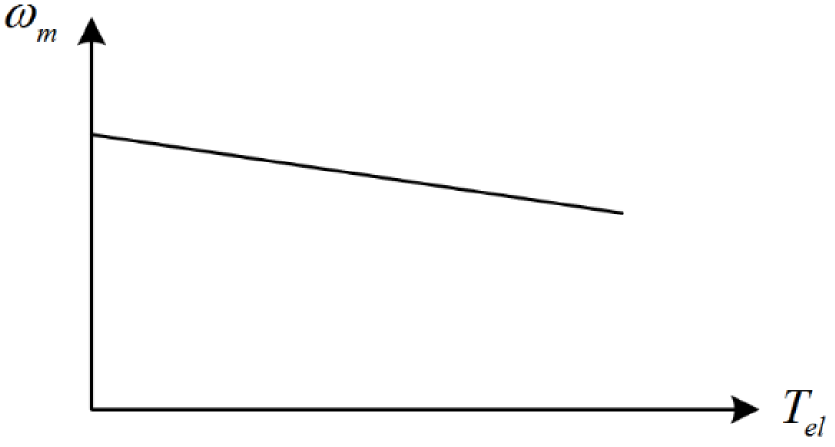
Shunt

Dr. Mahran Quraan

$$v_a = R_a i_a + e_a; \quad e_a = K\phi_f \omega_m \Rightarrow v_a = R_a i_a + K\phi_f \omega_m$$

$$T_{el} = K\phi_f i_a \Rightarrow i_a = \frac{T_{el}}{K\phi_f}$$

$$v_a = R_a \frac{T_{el}}{K\phi_f} + K\phi_f \omega_m \Rightarrow \omega_m = \frac{v_a}{K\phi_f} - \frac{R_a}{\left(K\phi_f\right)^2} T_{el}$$



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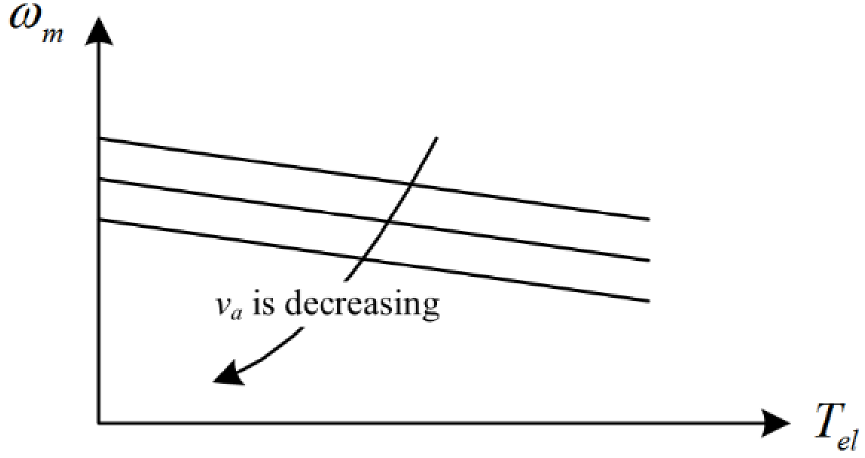
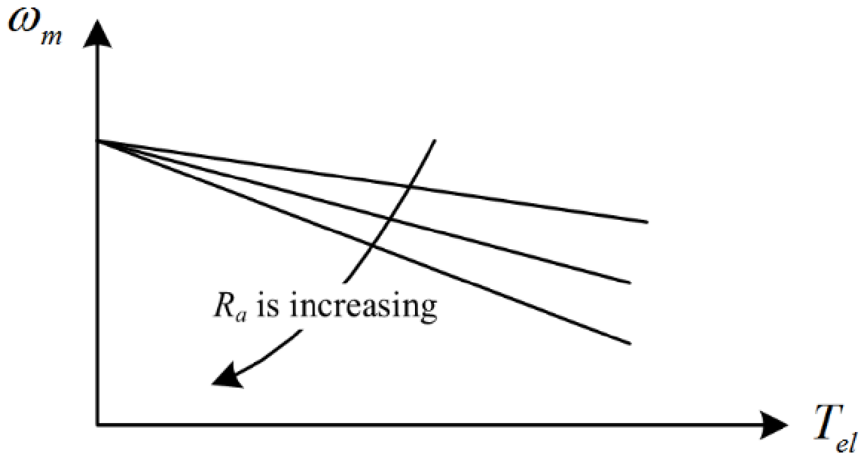
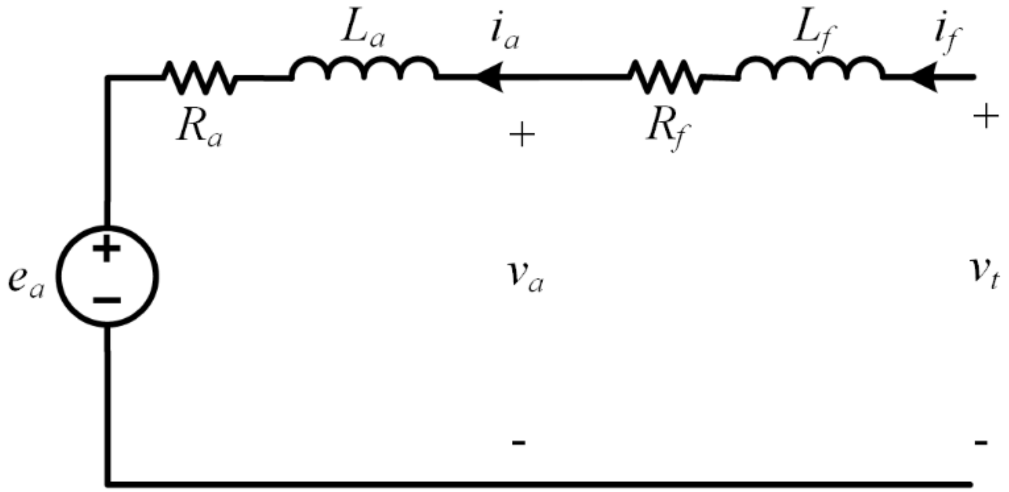
- Methods of speed control
  - v_a control
  - R_a control





- Series excited DC machines



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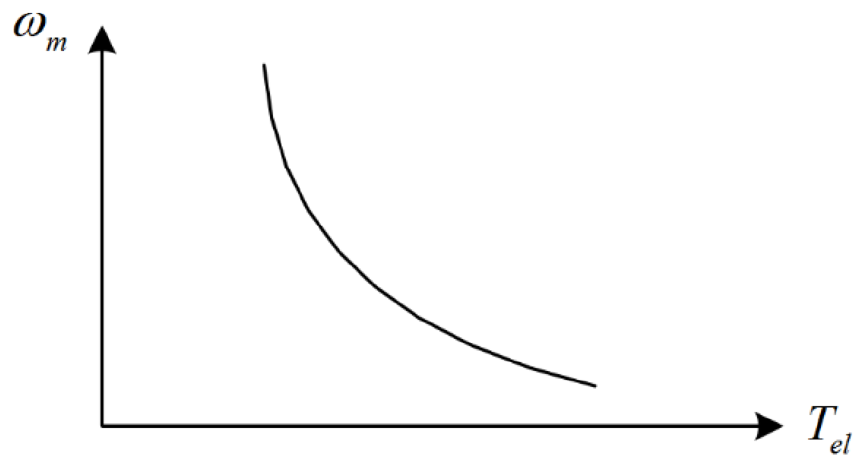
$$v_t = \left(R_a + R_f\right) i_a + e_a; \quad e_a = K\phi_f \omega_m; \quad \phi_f = C i_f; \quad i_f = i_a$$

$$\Rightarrow v_t = R i_a + KC\, i_a \omega_m$$

$$T_{el} = K\phi_f i_a \Rightarrow T_{el} = KC\, i_a^{\ 2} \Rightarrow i_a = \sqrt{\frac{T_{el}}{KC}}$$

$$v_t = \frac{R}{\sqrt{KC}}\sqrt{T_{el}} + \sqrt{KC}\sqrt{T_{el}}\,\omega_m \Rightarrow \omega_m = \frac{v_t}{\sqrt{KC}}\frac{1}{\sqrt{T_{el}}} - \frac{R}{KC}$$



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- Methods of speed control
  - v_t control
  - R control