Electric Drives

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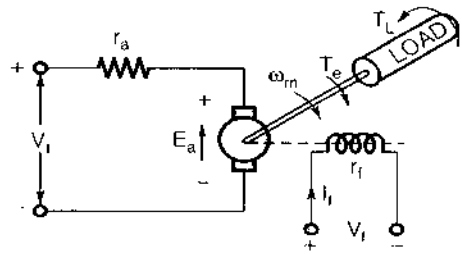
DC Drives

1. Separately-excited DC motor



- Voltage across field winding

For field circuit

$$V_f = I_f \cdot r_f$$

where, I_f = Field winding current, A

r_f = Field circuit resistance, Ω

- Motor terminal voltage

For armature circuit

$$V_t = E_a + I_a r_a$$

where, I_a = Armature current, A

r_a = Armature circuit resistance, Ω

E_a = Back emf, V

V_t = Armature terminal voltage, V

- Motor back emf

$$E_a = k_a \phi \omega_m = k_m \omega_m$$

where, ϕ = Field flux per pole, Wb

ω_m = Angular speed of motor, rad/sec.

$k_m = k_a \phi$ = torque constant, Nm/A

- Motor torque

$$T_e = k_m I_a$$

- Angular speed of motor

$$\omega_m = \frac{V_t - I_a r_a}{k_m}$$

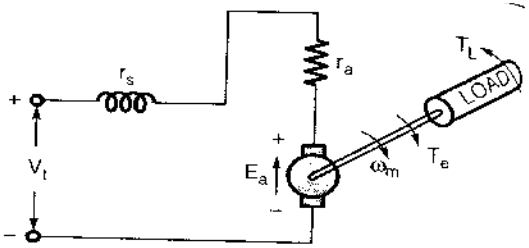
2. DC Series motor

- Motor terminal voltage

$$V_t = E_a + I_a(r_a + r_s)$$

- Motor torque

$$T_e = k_a \phi I_a$$



For no saturation in the magnetic circuit

- Field flux per pole

$$\phi = kI_a$$

- Motor torque

$$T_e = KI_a^2$$

where, $K = k_a k$ = constant, Nm/A^2

- Motor back emf

$$E_a = KI_a\omega_m$$

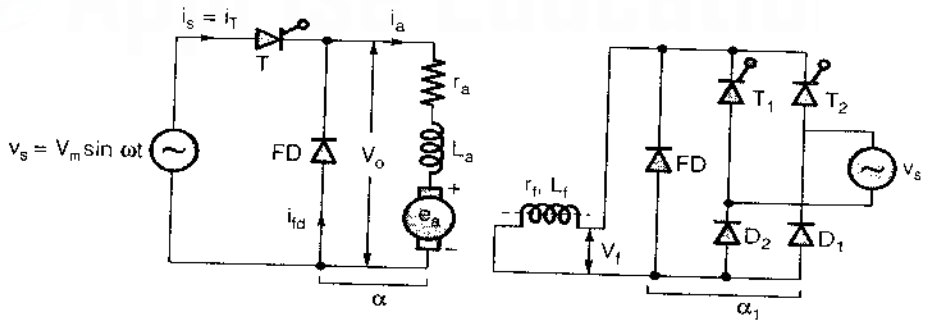
- Angular speed of motor

$$\omega_m = \frac{V_t}{KI_a} - \frac{(r_a + r_s)}{K}$$

where, r_s = Series-field resistance, Ω

Single Phase DC Drives

1. Single Phase Half Wave Converter Drives



- Average output voltage of converter

For $0 < \alpha < \pi$

$$V_o = V_t = \frac{V_m}{2\pi}(1 + \cos\alpha)$$

where V_m = Maximum value of source voltage, V

$V_o = V_t$ = Armature terminal voltage, V

For single-phase semiconverter in the field circuit

- Average output voltage

For $0 < \alpha_1 < \pi$

$$V_t = \frac{V_m}{\pi}(1 + \cos\alpha_1)$$

- RMS value of source current

$$I_{sr} = I_a\sqrt{\frac{\pi - \alpha}{2\pi}}$$

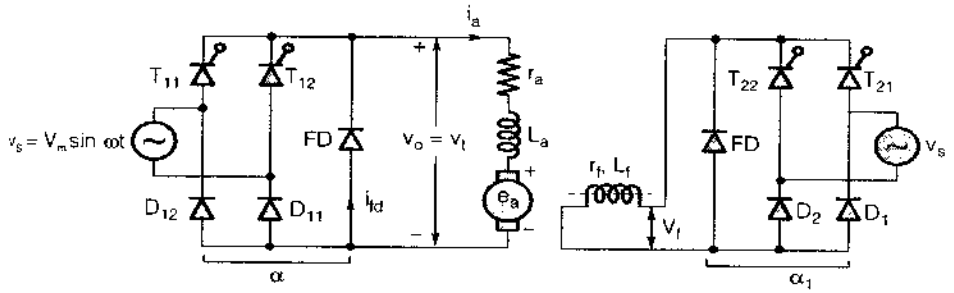
- Apparent input power

$$P_i = V_s I_{sr}$$

- Power delivered to motor

$$P = V_t I_a$$

2. Single phase semiconverter Drives



- Average output voltage

$$V_o = V_t = \frac{V_m}{\pi}(1 + \cos\alpha)$$

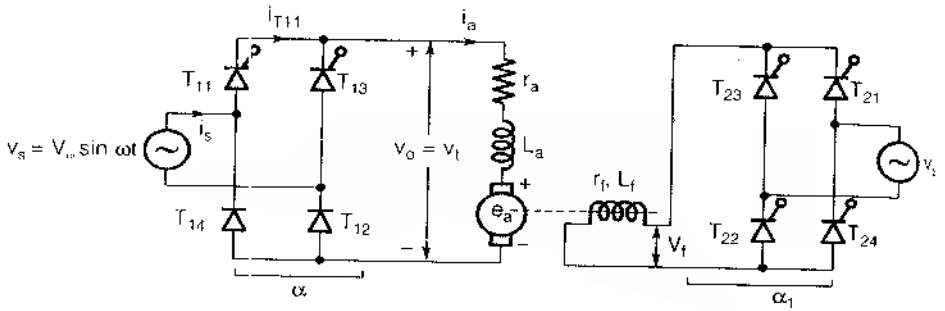
- For field circuit

$$V_f = \frac{V_m}{\pi}(1+\cos\alpha_1)$$

- RMS value of source current

$$I_{sr} = I_a\sqrt{\frac{\pi-\alpha}{\pi}}$$

3. Single Phase Full Converter Drives



For armature converter 1

$$V_0 = V_t = \frac{2V_m}{\pi}\cos\alpha \quad \text{..... for } 0 < a < p$$

For the field converter 2

$$V_f = \frac{2V_m}{\pi}\cdot\cos\alpha_1 \quad \text{..... for } 0 < a_1 < p$$

- RMS value of source current

$$I_{sr} = I_a$$

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