Lecture Module - Electrical Systems

ME3050 - Dynamic Modeling and Controls

Mechanical Engineering

Tennessee Technological University

Topic 4 - Mechatronics Applications

Electrical Systems

- What is Mechatronics?
- Example: DC Motor
- Governing Equations
- Model Derivation
- Response Equation

What is Mechatronics?

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Example: DC Motor

Armature Controlled Brushed DC Motor

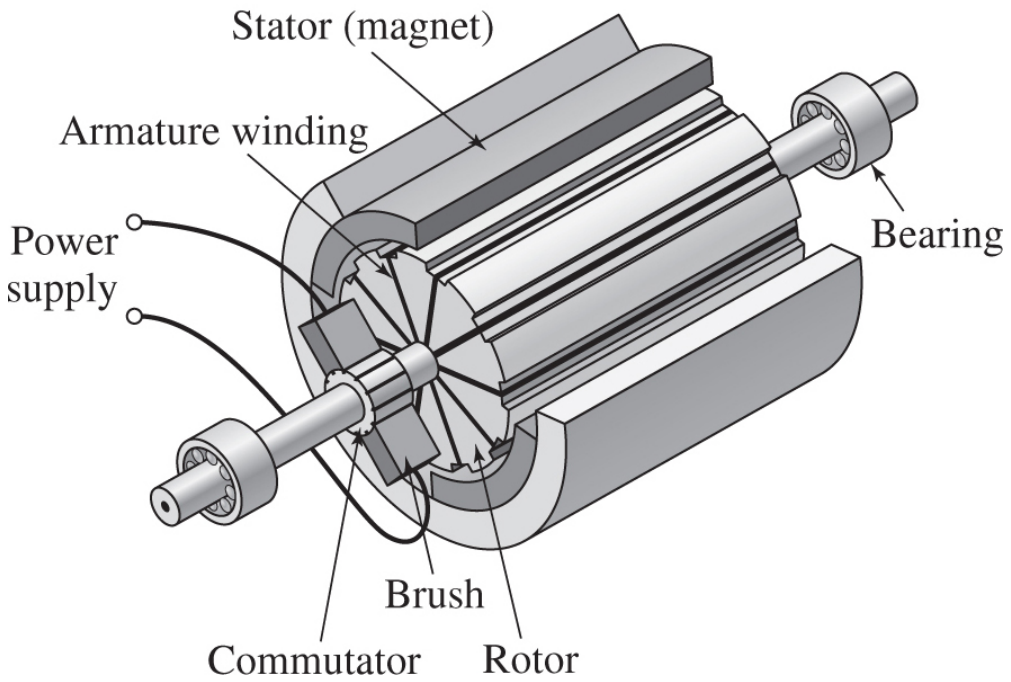
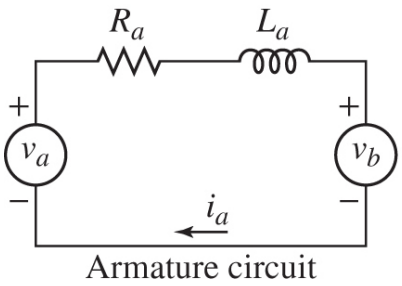
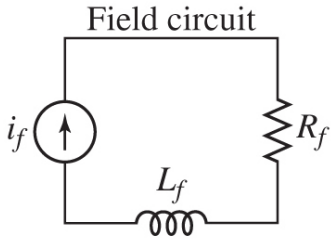


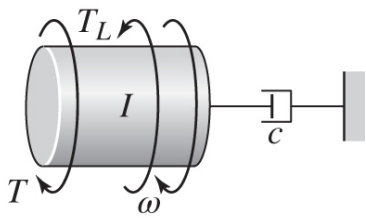
Image: System Dynamics, Palm, 4^{th}, Pg. 376-378

Example: DC Motor

Armature Controlled Brushed DC Motor







v_a : armature voltage (input)

R_a : armature resistance

Torque on armature

$$T = (nBLi_a)\, r = (nBLr)\, i_a = K_T i_a$$

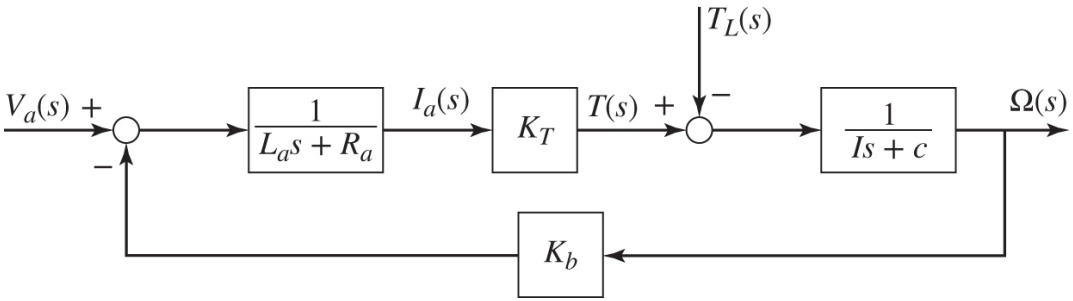
Back EMF (electromotive force) voltage

$$v_b = nBLv = (nBLr)\, \omega = K_b \omega$$

Image: System Dynamics, Palm, 4^{th}, Pg. 376-378

Example: DC Motor

Armature Controlled Brushed DC Motor



Kirchoff's Voltage Law

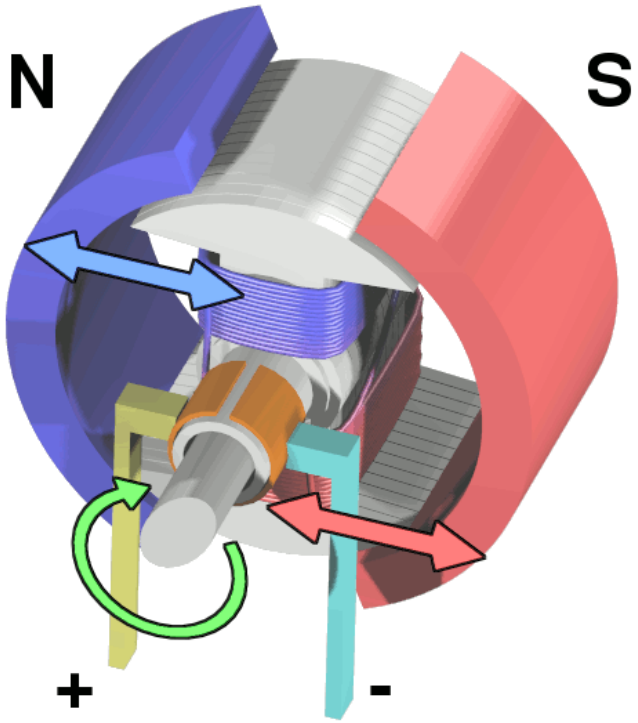
$$v_a - R_a i_a - L_a \frac{di_a}{dt} - K_b \omega = 0$$

Newtons's Second Law

$$I \frac{d\omega}{dt} = T - c\omega - T_L = K_T i_a - c\omega - T_L$$

Image: System Dynamics, Palm, 4^{th}, Pg. 376-378

Example: DC Motor



Animation on Web

source: wikipedia

Governing Equations

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Model Derivation

Response Equation