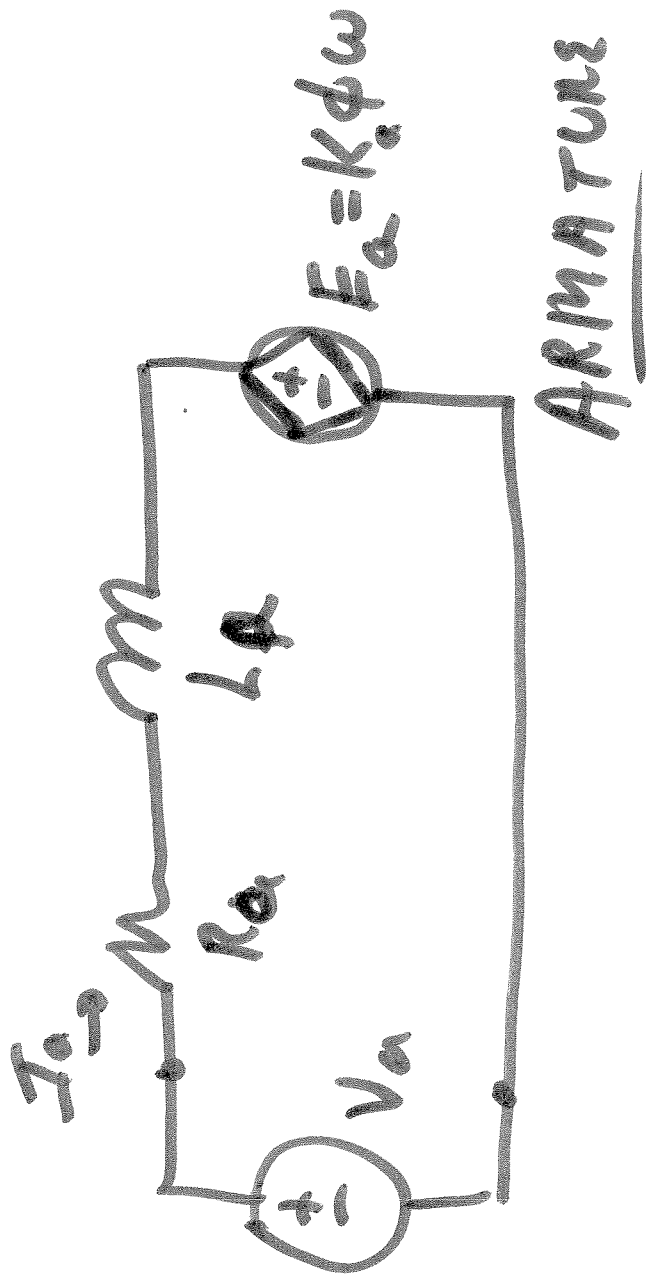


ECE 320 & ECE 329

ENERGY SYSTEMS I  
BACKGROUND STUDY IN ENERGY SYSTEMS

SESSION no. 20



$$T_e = K_a \phi_d I_a$$

↑ Torque    ↑ const Flux    ↑ Armature Current

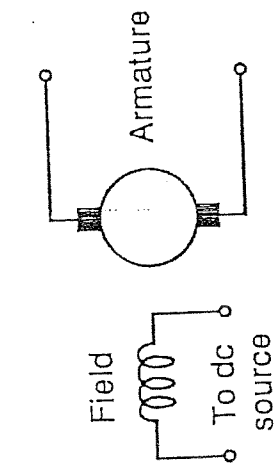
$$E_g = K_a \phi_d \omega$$

↑ Voltage    Angular Velocity

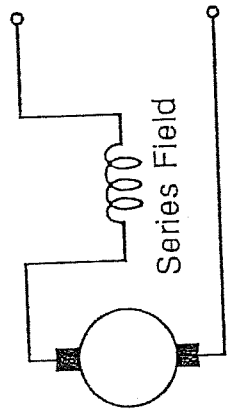
$$V_a = E_a + R_a I_a + L_a \frac{dI_a}{dt}$$

$$P_m = T_c \omega = E_a I_a$$

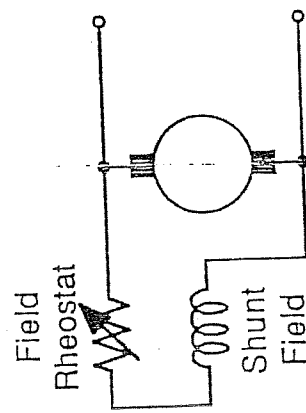
## DC Machine Field Connections



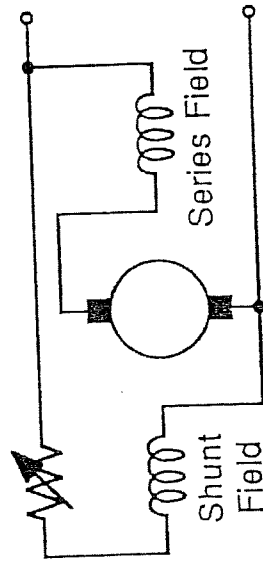
Separate Excitation



Series Field Connection



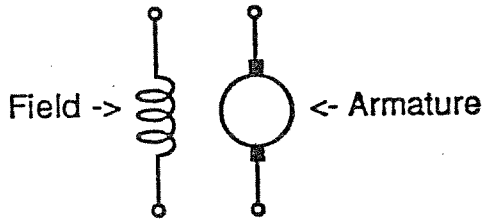
Shunt Field Connection



Compound Connection

# DC Machine Fundamentals

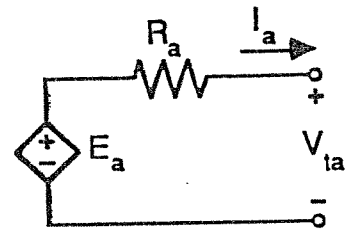
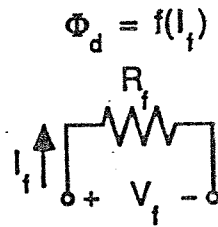
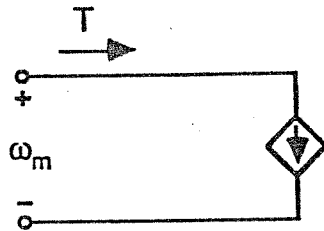
## Wiring Diagram Symbols



## Field Winding Connections

- Separately excited
- Shunt
- Series
- Compound

## Equivalent Circuit Model (Generator Polarities)



## Relationships

Torque Equation

$$T = K_a \Phi_d I_a$$

$$\omega_m = \frac{2\pi n}{60}$$

Field Equation

$$\Phi_d = f(I_f)$$

$$V_f = I_f R_f$$

$$K_a = \frac{P C_a}{2\pi m}$$

Voltage Equation

$$E_a = K_a \Phi_d \omega_m$$

$$V_{ta} = E_a - I_a R_a$$

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DC Machines Guest Experts