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Sub - ELECTRICAL MACHINES-I

BRANCH - EEE - 2nd YEAR



## SECTION-2

Q. 1

Ans 1. The electromechanical-energy-conversion devices operate with electrical system on one side and mechanical system on the other side.

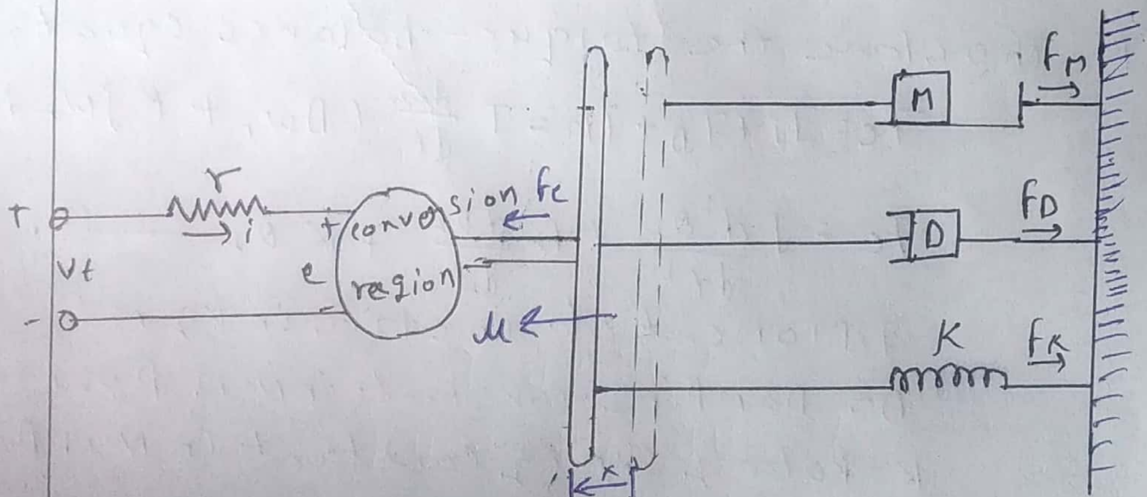
2. simple models of singly excided electro-mechanical system.

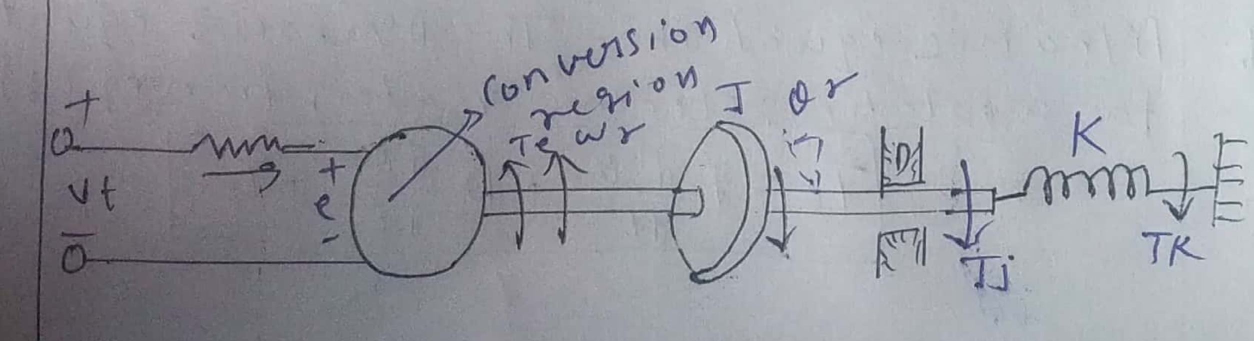
3. voltage equation:- The voltage equation for the electrical system:-

$$V_t = ir + \frac{d\phi}{dt} = ir + \frac{d}{dt}(Li)$$

$$= ir + L\frac{di}{dt} + i\left(\frac{dL}{d\theta_r}\right)\frac{d\theta_r}{dt}$$

$$= ir + L\frac{di}{dt} + i\left(\frac{dL}{d\theta_r}\right)\omega_r$$



4. Force equation:- In fig (a) the magnetic force $f_e$ is opposed by intertia force $f_M$, damping force $f_D$ and restraining spring force $f_K$. Therefore the force balance equation is

$$f_e = f_M + f_D + f_K = M\frac{dv}{dt} + Dv + K\int v\,dt$$

$$f_e = M\frac{d^2x}{dt^2} + D\frac{dx}{dt} + Kx$$

M = Mass in kgs

D = Coefficient of friction N/m/sec.

K = Linear spring constant in N/m.

5. Torque equation:- If fig (b) the magnetic torque $T_e$ is oppesed by inertia torque $T_i$, damping torque $T_D$ and restraining spring torque $T_K$ Therefore the torque-balance equation is

$$T_e = T_i + T_D + T_K = J\frac{d\omega_r}{dt} + D\omega_r + K\int \omega_r\,dt$$

$$T_e = J\frac{d^2\theta_r}{dt^2} + D\frac{d\theta_r}{dt} + K\theta_r \quad \text{—— (3)}$$

J = Moment of inetia in kg $m^2$

D = Damping constant in N-m per rad/sec

K = Rotary spring constant in N-m per ra

6. Dynamic equation:- The Dyanamic equation for a rotating electric motor from eq (3).

$$\boxed{T_e = J\frac{d^2\theta}{dt^2} + D\frac{d\theta_r}{dt} + T_L}$$