NAME :- AKASH KUMAR
ROLL NO :- 19041402190 01
B.TECH 2ND YEAR
BRANCH :- EEE

Section - 02

Q.1

Ans:- The electro mechanical - energy - Conversion devicies operate with electrical system on one side and mechanical System on the other side.

2. Simple models of singly excited electro - mechanical system are shown in fig.

3. Voltage equations :- The voltage equation for the electrical system of both fig.

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

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

$$= ir + L\frac{di}{dt} + i\left(\frac{dL}{d\theta_r}\right)\omega_r \quad - \text{eqn (1)}$$

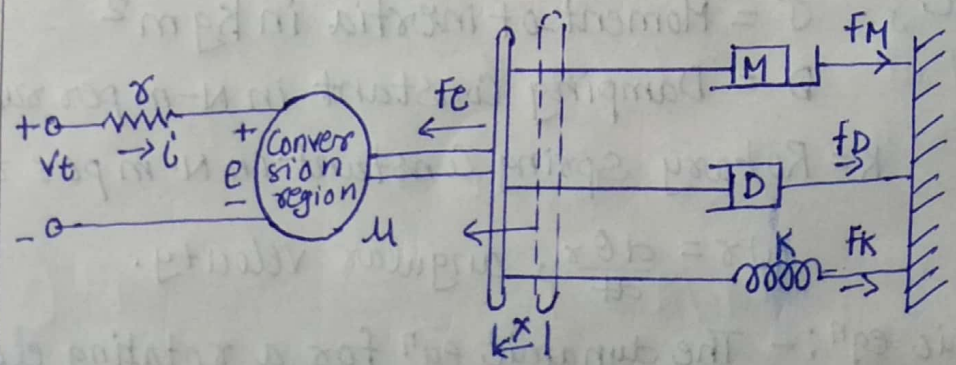

Fig (a)

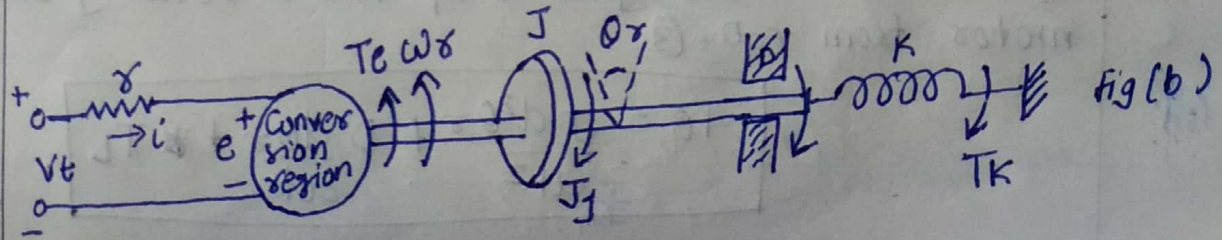

Fig (b)

4. Force equation:- In fig (a). the Magnetic force f_e is opposed by inertia force f_M, damping force f_D and restraining spring force f_K. therefore the force balance eqn is :-

$$f_e = f_M + f_D + f_K = M\frac{du}{dt} + Du + K\int u\,dt$$

or $$f_e = M\frac{d^2x}{dt^2} + D\frac{dx}{dt} + Kx \quad \text{eqn-(2)}$$

M = Mass in Kg.
D = Coefficient of friction N/m/sec.
K = Linear Spring Constant in N/m

5. Torque equation:- In fig (b). the Magnetic torque T_e is opposed by inertia torque T_j, damping torque T_D and restraining spring torque T_k.

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

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

where, J = Moment of inertia in $Kg\,m^2$
D = Damping Constant in N-m per rad/sec
K = Rotary Spring Constant in N-m per radian
$\omega_r = \frac{d\theta_r}{dt}$, angular velocity.

6. Dynamic eqn:- The dynamic eqn for a rotating electric motor from eqn-(3)

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