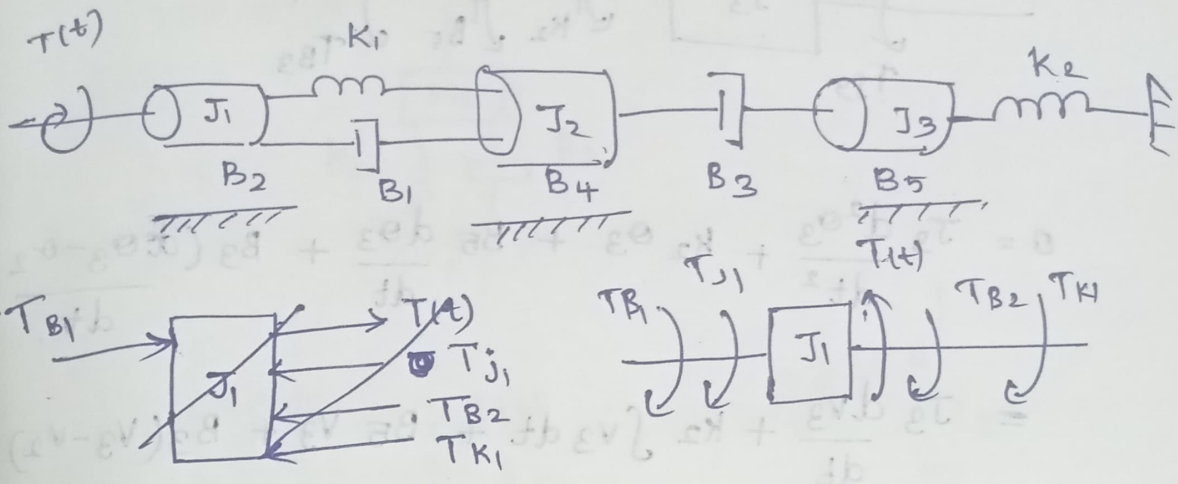
20/3/24

Tutorial - 2

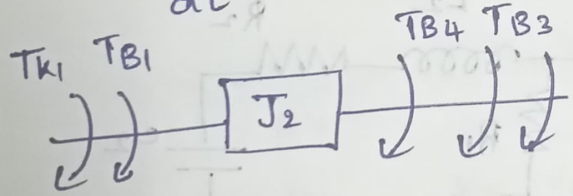
① 

$$T(t) = T_{j_1} + T_{B_2} + T_{K_1} + T_{B_1}$$

$$T(t) = J_1 \frac{d^2\theta_1}{dt^2} + B_2 \frac{d\theta_1}{dt} + K_1(\theta_1 - \theta_2) + B_1 \frac{d(\theta_1 - \theta_2)}{dt}$$

$$= J_1 \frac{dv_1}{dt} + B_2 (v_2) + K_1 \int (\theta_1 - \theta_2)\, dt + B_1 (v_1 - v_2)$$

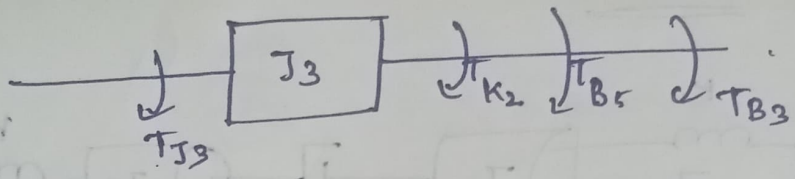
$$T(t) = J_1 \frac{dv_1}{dt} + B_2 v_2 + K_1 \int \theta_1 - \theta_2 \, dt + B_1 (v_1 - v_2)$$



$$0 = K_1(\theta_2 - \theta_1) + B_1 \frac{d(\theta_2 - \theta_1)}{dt} + B_4 \frac{d\theta_2}{dt} + B_3 \frac{d(\theta_2 - \theta_3)}{dt} + J_2 \frac{d^2\theta_2}{dt^2}$$

$$= K_1 \int (v_2 - v_1)\, dt + B_1 (v_2 - v_1) + B_4 v_2 + B_3 (v_2 - v_3) + J_2 \frac{dv_2}{dt}$$

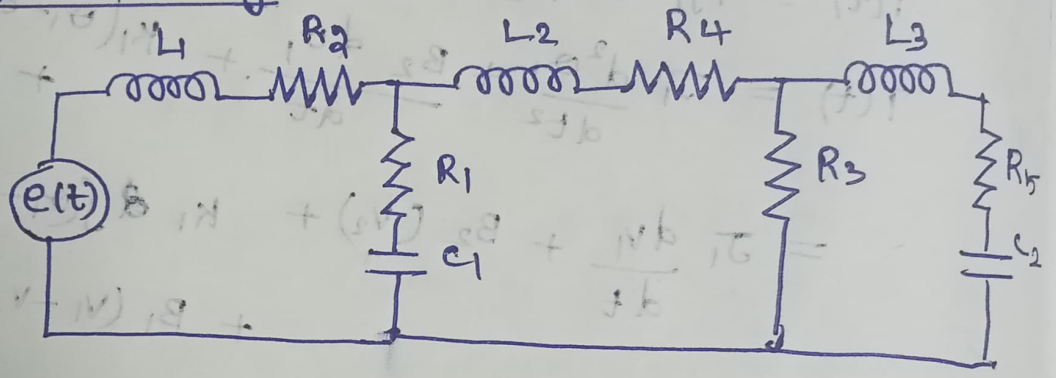
$$= K_1 \int (v_2 - v_1)\, dt + B_1 (v_2 - v_1) + B_4 v_2 + B_3 (v_2 - v_3) + J_2 \frac{dv_2}{dt}$$



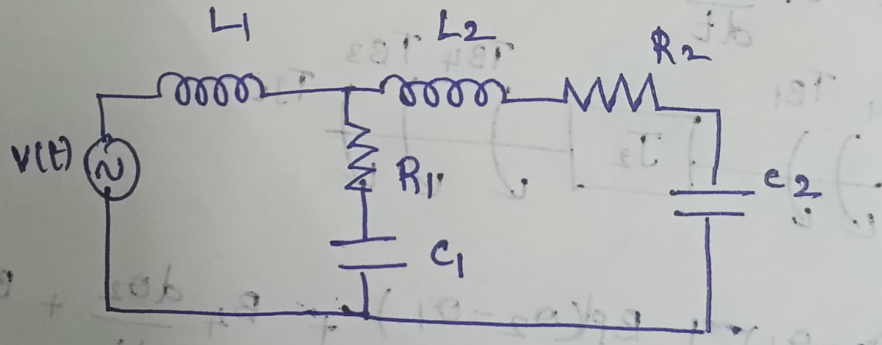
$$0 = J_3 \frac{d^2\theta_3}{dt^2} + K_2 \theta_3 + B_5 \frac{d\theta_3}{dt} + B_3 \left(\frac{d\theta_3 - \theta_2}{dt}\right)$$

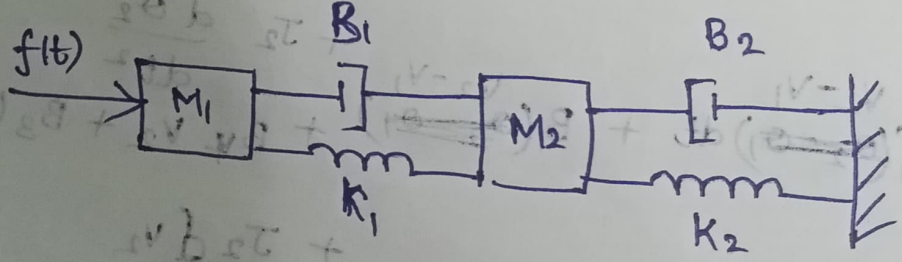
$$= J_3 \frac{dv_3}{dt} + K_2 \int v_3 \, dt + B_5 V_3 + B_3 (V_3 - V_2)$$

Torque to voltage:

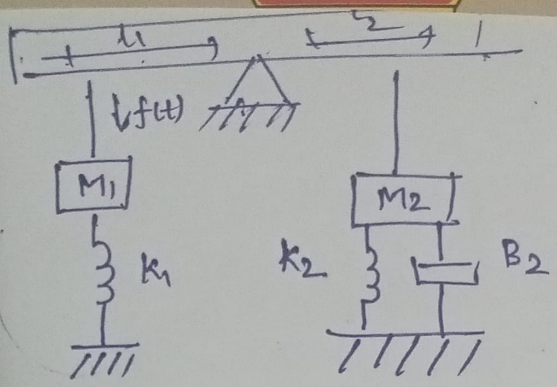


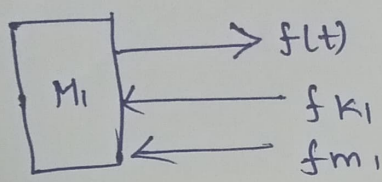
(2)

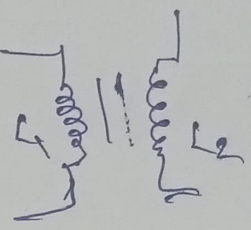




(3)



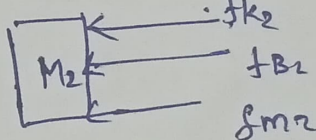




$$f(t) = f_{K_1} + f_{m_1}$$

$$f(t) = K_1 \int x_1 + M_1 \frac{d^2 x_1}{dt^2}$$

$$f(t) = K_1 \int v_1 dt + M_1 \frac{dv_1}{dt}$$



$$= f_{m_2} + f_{K_2} + f_{B_2}$$

$$= M_2 \frac{d^2 x_2}{dt^2} + K_2 x_2 + B_2 \frac{dx_2}{dt}$$

$$= M_2 \frac{dv_2}{dt} + K_2 \int v_2 dt + B_2 v_2$$