* Servo posisi : $x_3 = \theta(t)$ [rad] → 1 derajat = $\frac{\pi}{180}$ rad

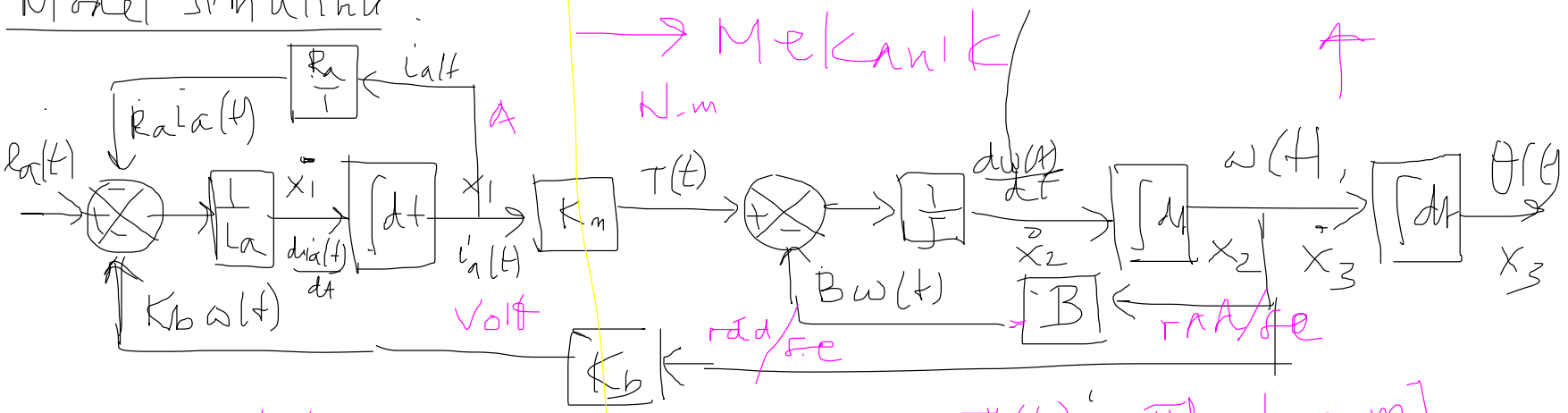
$\dot{x}_3 = \frac{d\theta(t)}{dt} = \omega(t)$

1 rad = $\frac{180}{\pi}$ derajat

$$\begin{cases} \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -\frac{R_a}{L_a} & -\frac{K_b}{L_a} & 0 \\ K_m/J & -B/J & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} \frac{1}{L_a} \\ 0 \\ 0 \end{bmatrix} u \\ y = \begin{bmatrix} 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \end{cases}$$

1 RPM = $\frac{2\pi}{60}$ rad/sec

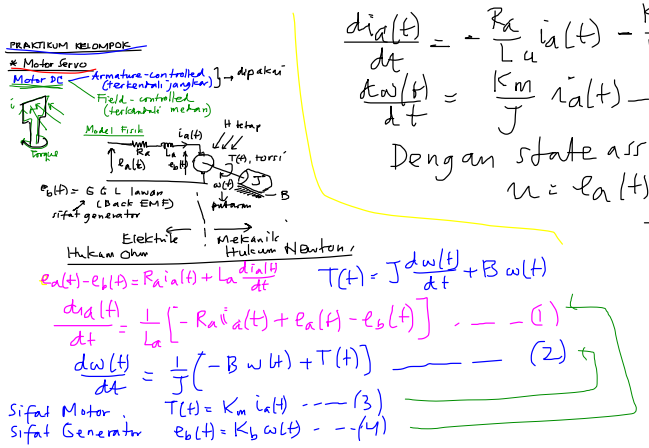
Model simulink :



T(t) = [Newton.m] → kg m/sec²

kg ~ lb

m ~ ft



$$\frac{di_a(t)}{dt} = -\frac{R_a}{L_a} i_a(t) - \frac{K_b}{L_a} \omega(t) + \frac{1}{L_a} e_a(t)$$

$$\frac{d\omega(t)}{dt} = \frac{K_m}{J} i_a(t) - \frac{B}{J} \omega(t)$$

Dengan state assignment :

$u = e_a(t)$ $x_1 = i_a(t)$ $x_2 = \omega(t)$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \underbrace{\begin{bmatrix} -\frac{R_a}{L_a} & -\frac{K_b}{L_a} \\ \frac{K_m}{J} & -\frac{B}{J} \end{bmatrix}}_{A} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \underbrace{\begin{bmatrix} \frac{1}{L_a} \\ 0 \end{bmatrix}}_{B} u$$

* Servo kecepatan

$y = \omega(t) = x_2 \rightarrow y = \underbrace{\begin{bmatrix} 0 & 1 \end{bmatrix}}_{C} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$