

1 buah pers. diff order ke n

$$a_n \frac{d^n x(t)}{dt^n} + a_{n-1} \frac{d^{n-1} x(t)}{dt^{n-1}} + a_{n-2} \frac{d^{n-2} x(t)}{dt^{n-2}} + \dots + a_1 \frac{dx(t)}{dt} + a_0 x(t) = u(t)$$

n buah pers. diff order pertama

$$\begin{aligned} x(t) &= x_1 \\ \frac{dx(t)}{dt} &= x_2 = \frac{dx_1}{dt} \\ \frac{d^2 x(t)}{dt^2} &= x_3 = \frac{dx_2}{dt} \end{aligned}$$

$$\frac{d^{n-2} x(t)}{dt^{n-2}} = x_{n-1} = \frac{dx_{n-2}}{dt}$$

$$\frac{d^{n-1} x(t)}{dt^{n-1}} = x_n = \frac{dx_{n-1}}{dt}$$

$$a_n \frac{d^n x(t)}{dt^n} = -a_{n-1} \frac{d^{n-1} x(t)}{dt^{n-1}} - a_{n-2} \frac{d^{n-2} x(t)}{dt^{n-2}} - \dots - a_1 \frac{dx(t)}{dt} - a_0 x(t) + u(t)$$

$$\begin{aligned} \frac{d^n x(t)}{dt^n} &= \frac{dx_n}{dt} = -\frac{a_{n-1}}{a_n} x_n - \frac{a_{n-2}}{a_n} x_{n-1} - \frac{a_{n-3}}{a_n} x_{n-2} \\ &\quad - \dots - \frac{a_1}{a_n} x_2 - \frac{a_0}{a_n} x_1 + \frac{1}{a_n} u(t) \end{aligned}$$

$$\begin{bmatrix} \frac{dx_1}{dt} \\ \frac{dx_2}{dt} \\ \vdots \\ \frac{dx_{n-1}}{dt} \\ \frac{dx_n}{dt} \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & \dots & 0 \\ 0 & 0 & 1 & \dots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \dots & 1 \\ -\frac{a_0}{a_n} & -\frac{a_1}{a_n} & \dots & -\frac{a_{n-1}}{a_n} & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_{n-1} \\ x_n \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \vdots \\ 0 \\ \frac{1}{a_n} \end{bmatrix} u(t)$$

$$\frac{dx_1}{dt}$$

$$\frac{dx_2}{dt}$$

$$\frac{dx_3}{dt}$$

$$\frac{dx_4}{dt}$$

$$\frac{dx_5}{dt}$$

$$\frac{dx_6}{dt}$$

$$\frac{dx_{n-1}}{dt}$$

$$\frac{dx_n}{dt}$$

n buah pers. diff order pertama