

Høgskolen i Buskerud

Formelliste for EMAR2101 Reguleringsystemer 1

Formlene nedenfor vil bli oppgitt som vedlegg til eksamen 12. desember 2008.

På eksamen må du selv velge hvilke(n) av formlene som er aktuelle i den enkelte oppgave.

$$\frac{dm(t)}{dt} = \sum_i w_i(t) \quad (1)$$

$$m\dot{v}(t) = m\ddot{x}(t) = ma(t) = \sum_i F_i(t) \quad (2)$$

$$x^{(n)} + a_{n-1}x^{(n-1)} + \dots + a_1\dot{x} + a_0x = b_1u_1 + b_2u_2 \quad (3)$$

$$\dot{x}_1 = f_1() \quad (4)$$

\vdots

$$\dot{x}_n = f_n() \quad (5)$$

$$y_1 = g_1() \quad (6)$$

\vdots

$$y_m = g_m() \quad (7)$$

$$\dot{\underline{x}} = A\underline{x} + B\underline{u} \quad (8)$$

$$\underline{y} = C\underline{x} + D\underline{u} \quad (9)$$

$$y(s) = H(s)u(s) \quad (10)$$

$$h(s) = \frac{K(s-z_1)(s-z_2)\cdots(s-z_r)}{(s-p_1)(s-p_2)\cdots(s-p_n)} \quad (11)$$

$$\underbrace{\mathcal{L}\{u(t)\}}_{u(s)} = \int_0^\infty e^{-st}u(t) dt \quad (12)$$

$$y_s = \lim_{t \rightarrow \infty} y(t) = \lim_{s \rightarrow 0} s \cdot y(s) \quad (13)$$

$$H_s \equiv \frac{y_s}{u_s} = \lim_{s \rightarrow 0} H(s) \quad (14)$$

$$y(t) = Ku(t) \iff y(s) = \underbrace{K}_{H(s)} \cdot u(s) \quad (15)$$

$$y(t) = K \int_0^t u d\tau \iff y(s) = \underbrace{\frac{K}{s}}_{H(s)} u(s) \quad (16)$$

$$y(s) = \underbrace{\frac{K}{Ts+1}}_{H(s)} u(s) \quad (17)$$

$$y(t) = u(t - \tau) \iff y(s) = \underbrace{e^{-\tau s}}_{H(s)} u(s) \quad (18)$$

$$k_1 F_1(s) + k_2 F_2(s) \iff k_1 f_1(t) + k_2 f_2(t) \quad (19)$$

$$F(s)e^{-\tau s} \iff f(t - \tau) \quad (20)$$

$$s^n F(s) \iff \overset{(n)}{f}(t) \quad (21)$$

$$\frac{k}{s} \iff k \quad (\text{sprang med høyde } k) \quad (22)$$

$$\frac{k}{s^2} \iff kt \quad (\text{rampe med stigningstall } k) \quad (23)$$

$$\frac{k}{Ts+1} \iff \frac{ke^{-t/T}}{T} \quad (24)$$

$$\frac{k}{(Ts+1)s} \iff k(1 - e^{-t/T}) \quad (25)$$

$$e = r - y \quad (26)$$

$$u = u_0 + \underbrace{K_p e}_{u_p} + \underbrace{\frac{K_p}{T_i} \int_0^t e d\tau}_{u_i} + \underbrace{K_p T_d \frac{de}{dt}}_{u_d} \quad (27)$$

$$P_B = \frac{100\%}{K_p} \quad (28)$$

| | K_p | T_i | T_d |
|---------------|--------------|-------------------|---------------------------------|
| P-regulator | $0,5K_{pk}$ | ∞ | 0 |
| PI-regulator | $0,45K_{pk}$ | $\frac{T_p}{1,2}$ | 0 |
| PID-regulator | $0,6K_{pk}$ | $\frac{T_p}{2}$ | $\frac{T_p}{8} = \frac{T_i}{4}$ |