

Formelliste (identisk med formellisten i Reguleringssteknikk, 2. utgave)

$$e = y_{SP} - y \quad (\text{C.1})$$

$$\text{IAE} = \int_{t_{\text{start}}}^{t_{\text{slutt}}} |e(t)| dt \approx T_s \sum_{t_1=t_{\text{start}}}^{t_N=t_{\text{slutt}}} |e(t_k)| \quad (\text{C.2})$$

$$F_{2SP} = KF_1 \quad (\text{C.3})$$

$$y_d = \frac{b_{n-1}2^{n-1} + \dots + b_12^1 + b_02^0}{2^n - 1} (y_{a_{\text{maks}}} - y_{a_{\text{min}}}) + y_{a_{\text{min}}} \quad (\text{C.4})$$

$$R = \frac{y_{a_{\text{maks}}} - y_{a_{\text{min}}}}{2^n - 1} \quad (\text{C.5})$$

$$P = \frac{P_2 - P_1}{M_2 - M_1} (M - M_1) + P_1 \quad (\text{C.6})$$

$$T_f \dot{y}_{mf}(t) = y_m(t) - y_{mf}(t) \quad (\text{C.7})$$

$$y_{mf}(t_k) = (1 - a)y_{mf}(t_{k-1}) + ay_m(t_k) \quad (\text{C.8})$$

$$a = \frac{T_s}{T_f + T_s} \quad (\text{C.9})$$

$$\tau_{\text{rampe}} = T_f \quad (\text{C.10})$$

$$T_f \approx \frac{T_s}{2} \frac{1}{(\sigma_{y_{mf}}/\sigma_{y_m})^2} \quad (\text{C.11})$$

$$T_f \leq \frac{T_p}{10} \quad (\text{C.12})$$

$$T_f \leq \frac{\tau_p}{10} \quad (\text{C.13})$$

$$y_{mf}(t_k) = \frac{1}{N} \sum_{j=k-(N-1)}^{j=k} y_m(t_j) \quad (\text{C.14})$$

$$T_f \approx \frac{T_v}{2} \quad (\text{C.15})$$

$$u_{se} = \frac{u_{se2} - u_{se1}}{u_{fe2} - u_{fe1}} (u_{fe} - u_{fe1}) + u_{se1} \quad (\text{C.16})$$

$$\tau_{\text{DA-omsetter}} \approx \frac{T_s}{2} \quad (\text{C.17})$$

$$D = \frac{T_{\text{on}}}{T_p} \cdot 100\% = \frac{u_{\text{mean}}}{U_{\text{on}}} \cdot 100\% \quad (\text{C.18})$$

$$Q = K_v(z) \sqrt{\frac{p_v}{G}} \text{ eller } K_v \sqrt{\frac{p_v}{G}} \quad (\text{C.19})$$

$$K_v(z) = K_{v_{\text{max}}} z \quad (\text{C.20})$$

$$K_v(z) = K_{v_{\max}} R^{1-z} \quad (\text{C.21})$$

$$P_{\text{midlere}} = \frac{U_{\text{eff}}^2}{R} \quad (\text{C.22})$$

$$R_s = \frac{R}{L} \text{ [}\Omega/\text{m]} \quad (\text{C.23})$$

$$R \text{ [}\Omega] = \frac{u}{i} \quad (\text{C.24})$$

$$R = \frac{S}{2^n - 1} \quad (\text{C.25})$$

$$v_0(T_m) = v + v_0(T_r) \quad (\text{C.26})$$

$$T = \frac{\frac{R}{R_0} - 1}{a} \quad (\text{C.27})$$

$$L = \frac{vT_r}{2} \quad (\text{C.28})$$

$$p = \rho g(h + h_0) \quad (\text{C.29})$$

$$F = k\sqrt{\Delta p} \quad (\text{C.30})$$

$$v = k(t_{\text{mot}} - t_{\text{med}}) \quad (\text{C.31})$$

$$Q = Av \quad (\text{C.32})$$

$$F_v = \frac{F_m}{\rho} \quad (\text{C.33})$$

$$\Delta T = T_2 - T_1 = kF \quad (\text{C.34})$$

$$v(t_k) = \frac{ds(t_k)}{dt} \approx \frac{s(t_k) - s(t_{k-1})}{T_s} \quad (\text{C.35})$$

$$v(t_k) \approx \frac{s(t_{k+1}) - s(t_{k-1})}{2T_s} \quad (\text{C.36})$$

$$u_t = K_t v \quad (\text{C.37})$$

$$\frac{dm(t)}{dt} = \sum w_{\text{inn}}(t) - \sum w_{\text{ut}}(t) + \sum w_{\text{generert}}(t) \quad (\text{C.38})$$

$$m = \rho V \quad (\text{C.39})$$

$$\frac{dE}{dt} = \sum Q_{\text{inn}} - \sum Q_{\text{ut}} + \sum Q_{\text{generert}} \quad (\text{C.40})$$

$$E = cmT = c\rho VT = CT \quad (\text{C.41})$$

$$m\dot{v} = m\ddot{x} = ma = \sum F \quad (\text{C.42})$$

$$J\dot{\omega} = J\ddot{\theta} = \sum T \quad (\text{C.43})$$

$$T = Fl \quad (\text{C.44})$$

$$b = \theta r \quad (\text{C.45})$$

$$u = Ri \quad (\text{C.46})$$

$$P = ui = Ri^2 = \frac{u^2}{R} \quad (\text{C.47})$$

$$P_{\text{midlere}} = U_{\text{eff}} I_{\text{eff}} = R I_{\text{eff}}^2 = \frac{U_{\text{eff}}^2}{R} \quad (\text{C.48})$$

$$I_{\text{eff}} = \frac{I_{\text{maks}}}{\sqrt{2}} \quad (\text{C.49})$$

$$U_{\text{eff}} = \frac{U_{\text{maks}}}{\sqrt{2}} \quad (\text{C.50})$$

$$u = u_t + u_f \quad (\text{C.51})$$

$$K = \frac{y_2 - y_1}{u_2 - u_1} = \frac{\Delta y}{\Delta u} \quad (\text{C.52})$$

$$T\dot{y} = Ku - y \quad (\text{C.53})$$

$$T\dot{y} = K_1 u_1 + K_2 u_2 - y \quad (\text{C.54})$$

$$\dot{y} = K_i u \quad (\text{C.55})$$

$$y(t) = K_i \int_0^t u(\tau) d\tau \quad (\text{C.56})$$

$$y(t) = u(t - \tau) \quad (\text{C.57})$$

$$u(t) = u_{\text{man}} + K_p e(t) + \frac{K_p}{T_i} \int_0^t e(\tau) d\tau + K_p T_d \frac{de(t)}{dt}$$

$$e = y_{SP} - y_{mf} \quad (\text{C.58})$$

Tabell C.1:

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

$$PB = \frac{100}{K_p} \quad (C.59)$$

$$u(t_k) = u_{\text{man}} + u_p(t_k) + u_i(t_k) + u_d(t_k) \quad (C.60)$$

$$u_p(t_k) = K_p e(t_k) \quad (C.61)$$

$$u_i(t_k) = \frac{K_p T_s}{T_i} [e(t_0) + e(t_1) + \dots + e(t_{k-1}) + e(t_k)] \quad (C.62)$$

$$= u_i(t_{k-1}) + \frac{K_p T_s}{T_i} e(t_k) \quad (C.63)$$

$$u_d(t_k) = K_p T_d \frac{e(t_k) - e(t_{k-1})}{T_s} \quad (C.64)$$

$$\text{“Opp-Ned”} \implies \text{Revers} \equiv K_p > 0 \quad (C.65)$$

$$\text{“Opp-Opp”} \implies \text{Direkte} \equiv K_p < 0 \quad (C.66)$$

$$u = \left\{ \begin{array}{l} u_{\text{maks}} \text{ når } e \geq d_e \\ u_{\text{min}} \text{ når } e < -d_e \end{array} \right\} \quad (C.67)$$

$$K_p = 0,32K_{pu}, \quad T_i = P_u \quad (C.68)$$

$$K_p = 0,45K_{p0}, \quad T_i = \frac{P_{u0}}{1,2} \quad (C.69)$$

$$K_{p_u} = \frac{\text{Ut-amplitude}}{\text{Inn-amplitude}} = \frac{\frac{4A}{\pi}}{E} = \frac{4A}{\pi E} \approx 1,27 \frac{A}{E} \quad (\text{C.70})$$

$$A = \frac{u_{\text{maks}} - u_{\text{min}}}{2} \quad (\text{C.71})$$

$$K_p = 0,8K_{GG}, \quad T_i = 1,5T_{ou} \quad (\text{C.72})$$

$$K_p = \frac{1}{K_i(T_C + \tau)}, \quad T_i = 2(T_C + \tau) \quad (\text{C.73})$$

$$T_C = \tau, \quad K_p = \frac{1}{2K_i\tau}, \quad T_i = 4\tau \quad (\text{C.74})$$

$$K_p = \frac{1}{K_i T_c}, \quad T_i = 2T_c \quad (\text{C.75})$$

$$T_d = T_{\text{aktuator}} \quad (\text{C.76})$$

$$\ddot{y} = K_{ii}u$$

$$K_p = K_{pp} = \frac{2}{K_{ii} T_C^2} \quad (\text{C.77})$$

$$T_i = T_{ip} = 4T_C \quad (\text{C.78})$$

$$T_d = T_{dp} = T_C \quad (\text{C.79})$$

Bokstav- kode	1. bokstav	Etterfølgende modifikator til 1. bokstav	Etterfølgende bokstav
A	Analysis		Alarm
B	Burner, Combustion		
C	User's choice		Control
D	User's choice	Differential	
E	Voltage		Sensor, Primary element
F	Flow rate	Ratio	
G	User's choice		Glass, Gauge
H	Hand		High
I	Current (electrical)		Indicate
J	Power		
L	Level		Low
P	Pressure		
Q	Quantity	Integrate, Totalize	
R	Radiation		Record
S	Speed, Frequency		Switch
T	Temperature		Transmit
V	Vibration		Valve
W	Weight, Force		
Y			Computation
Z	Position	Safety Instrumented System (Interlock)	

Bokstavkode	Utstyr
C	Column (norsk: kolonne, f.eks. destillasjonskol.)
D	Drum (kar, fat, dunk)
F	Furnace (ovn)
H	Heat exchanger (varmeveksler)
K	Compressor
M	Motor
P	Pump
R	Reactor
T	Tank
V	Valve, vessel (ventil, beholder)