$$\frac{d\,[\text{Per}_\text{m}]}{dt} = \frac{\text{V}_\text{tP} \times \text{A}_1 \times [\text{CC}_\text{n}]}{\text{A}_1 \times [\text{CC}_\text{n}] + (\text{R}_1 \times [\text{PT}_\text{n}])^d + (\text{RR}_1 \times [\text{P}_\text{n}])^d + 1} - \frac{\text{D}_\text{Pm} \times [\text{Per}_\text{m}]}{[\text{Per}_\text{m}] + \text{K}_\text{Pm}} - \text{D}_\text{m} \times [\text{Per}_\text{m}]$$

$$\frac{d\,[\text{P}_\text{n}]}{dt} = \frac{\text{D}_\text{Tn} \times [\text{PT}_\text{n}]}{[\text{PT}_\text{n}] + \text{K}_\text{Tn}} - \frac{\text{D}_\text{Pn} \times [\text{P}_\text{n}]^c}{\text{K}_\text{Pn}{}^c + [\text{P}_\text{n}]^c} - \text{D}_\text{n} \times [\text{P}_\text{n}]$$

$$\frac{d\,[\text{CC}_\text{c}]}{dt} = \text{V}_\text{CC} \times [\text{CLK}_\text{c}] - \text{V}_\text{dCC} \times [\text{CC}_\text{c}] - \frac{\text{D}_\text{CCc} \times [\text{CC}_\text{c}]}{[\text{CC}_\text{c}] + \text{K}_\text{CCc}} - \text{D}_\text{p} \times [\text{CC}_\text{c}] - \frac{\text{Nc} \times [\text{CC}_\text{c}]^e}{\text{K}_\text{Nc}{}^e + [\text{CC}_\text{c}]^e}$$

$$\frac{d\,[\text{TIM}]}{dt} = \text{T}_\text{T} \times [\text{Tim}_\text{m}] - \frac{\text{D}_\text{Tc} \times [\text{TIM}]}{[\text{TIM}] + \text{K}_\text{Tc}} - \text{D}_\text{p} \times [\text{TIM}] - \text{V}_\text{PT} \times [\text{PD}] \times [\text{TIM}] + \text{V}_\text{dPT} \times [\text{PT}_\text{c}]$$

$$\frac{d\,[\text{CC}_\text{n}]}{dt} = \frac{\text{Nc} \times [\text{CC}_\text{c}]^e}{\text{K}_\text{Nc}{}^e + [\text{CC}_\text{c}]^e} - \frac{\text{D}_\text{CC} \times [\text{CC}_\text{n}]}{[\text{CC}_\text{n}] + \text{K}_\text{CC}} - \text{D}_\text{n} \times [\text{CC}_\text{n}]$$

$$[\text{All}_\text{P}\text{ER}] = [\text{PER}] + [\text{PD}] + [\text{PT}_\text{c}] + [\text{PT}_\text{n}] + [\text{P}_\text{n}]$$

$$[\text{All}_\text{C}\text{LK}] = [\text{CLK}_\text{c}] + [\text{CC}_\text{c}] + [\text{CC}_\text{n}]$$

$$\frac{d\,[\text{PER}]}{dt} = \text{T}_\text{P} \times [\text{Per}_\text{m}] - \frac{\text{D}_\text{Pc} \times [\text{PER}]}{[\text{PER}] + \text{K}_\text{Pc}} - \text{D}_\text{p} \times [\text{PER}] - \text{V}_\text{PD} \times [\text{PER}] + \text{V}_\text{dPD} \times [\text{PD}]$$

$$\frac{d\,[\text{Clk}_\text{m}]}{dt} = \frac{\text{V}_\text{tClk}(\text{CT} + \text{K}_\text{c1} \times [\text{PDP}_\text{n}])}{\text{CT} + \text{K}_\text{c3} \times [\text{PDP}_\text{n}] + \left(\frac{\text{CR} \times [\text{VRI}_\text{n}]}{1 + \text{K}_\text{c2} \times [\text{PT}_\text{n}]}\right)^f + 1} - \frac{\text{D}_\text{Cm} \times [\text{Clk}_\text{m}]}{[\text{Clk}_\text{m}] + \text{K}_\text{Cm}} - \text{D}_\text{m} \times [\text{Clk}_\text{m}]$$

$$\frac{d\,[\text{Tim}_\text{m}]}{dt} = \frac{\text{V}_\text{tT} \times \text{A}_2 \times [\text{CC}_\text{n}]}{\text{A}_2 \times [\text{CC}_\text{n}] + (\text{R}_2 \times [\text{PT}_\text{n}])^d + (\text{RR}_2 \times [\text{P}_\text{n}])^d + 1} - \frac{\text{D}_\text{Tm} \times [\text{Tim}_\text{m}]}{[\text{Tim}_\text{m}] + \text{K}_\text{Tm}} - \text{D}_\text{m} \times [\text{Tim}_\text{m}]$$

$$\frac{d\,[\text{Vri}_\text{m}]}{dt} = \frac{\text{V}_\text{tV} \times \text{A}_3 \times [\text{CC}_\text{n}]}{\text{A}_3 \times [\text{CC}_\text{n}] + (\text{R}_3 \times [\text{PT}_\text{n}])^d + (\text{RR}_3 \times [\text{P}_\text{n}])^d + 1} - \frac{\text{D}_\text{Vm} \times [\text{Vri}_\text{m}]}{[\text{Vri}_\text{m}] + \text{K}_\text{Vm}} - \text{D}_\text{m} \times [\text{Vri}_\text{m}]$$

$$\frac{d\,[\text{PT}_\text{n}]}{dt} = \frac{N\,[\text{PT}_\text{c}]^b}{\text{K}_\text{N}{}^b + [\text{PT}_\text{c}]^b} - \frac{\text{D}_\text{Tn} \times [\text{PT}_\text{n}]}{[\text{PT}_\text{n}] + \text{K}_\text{Tn}} - \text{D}_\text{n} \times [\text{PT}_\text{n}]$$

$$\frac{d\,[\text{PD}]}{dt} = \text{V}_\text{PD} \times [\text{PER}] - \text{V}_\text{dPD} \times [\text{PD}] - \frac{\text{D}_\text{PD} \times [\text{PD}]^a}{\text{K}_\text{PD}{}^a + [\text{PD}]^a} - \text{D}_\text{p} \times [\text{PD}] - \text{V}_\text{PT} \times [\text{PD}] \times [\text{TIM}] + \text{V}_\text{dPT} \times [\text{PT}_\text{c}]$$

$$\frac{d\,[\text{VRI}_\text{n}]}{dt} = \text{T}_\text{V} \times [\text{Vri}_\text{m}] - \frac{\text{D}_\text{Vn} \times [\text{VRI}_\text{n}]}{[\text{VRI}_\text{n}] + \text{K}_\text{Vn}} - \text{D}_\text{n} \times [\text{VRI}_\text{n}]$$

$$\frac{d\,[\text{Pdp}_\text{m}]}{dt} = \frac{\text{V}_\text{tPDP} \times \text{A}_4 \times [\text{CC}_\text{n}]}{\text{A}_4 \times [\text{CC}_\text{n}] + (\text{R}_4 \times [\text{PT}_\text{n}])^d + (\text{RR}_4 \times [\text{P}_\text{n}])^d + 1} - \frac{\text{D}_\text{PDPm} \times [\text{Pdp}_\text{m}]}{[\text{Pdp}_\text{m}] + \text{K}_\text{PDPm}} - \text{D}_\text{m} \times [\text{Pdp}_\text{m}]$$

$$\frac{d\,[\text{PDP}_\text{n}]}{dt} \;=\; \text{T}_\text{PDP} \times [\text{Pdp}_\text{m}] - \frac{\text{D}_\text{PDPn} \times [\text{PDP}_\text{n}]}{[\text{PDP}_\text{n}] + \text{K}_\text{PDPn}} - \text{D}_\text{n} \times [\text{PDP}_\text{n}]$$

$$[\text{All}_\text{T}\text{IM}] \;=\; [\text{TIM}] + [\text{PT}_\text{c}] + [\text{PT}_\text{n}]$$

$$\frac{d\,[\text{PT}_\text{c}]}{dt} \;=\; \text{V}_\text{PT} \times [\text{PD}] \times [\text{TIM}] - \text{V}_\text{dPT} \times [\text{PT}_\text{c}] - \frac{N\,[\text{PT}_\text{c}]^{b}}{\text{K}_\text{N}{}^{b} + [\text{PT}_\text{c}]^{b}} - \text{D}_\text{p} \times [\text{PT}_\text{c}]$$

$$\frac{d\,[\text{CLK}_\text{c}]}{dt} \;=\; \text{T}_\text{C} \times [\text{Clk}_\text{m}] - \frac{\text{D}_\text{CLKc} \times [\text{CLK}_\text{c}]}{[\text{CLK}_\text{c}] + \text{K}_\text{CLKc}} - \text{D}_\text{p} \times [\text{CLK}_\text{c}] - \text{V}_\text{CC} \times [\text{CLK}_\text{c}] + \text{V}_\text{dCC} \times [\text{CC}_\text{c}]$$