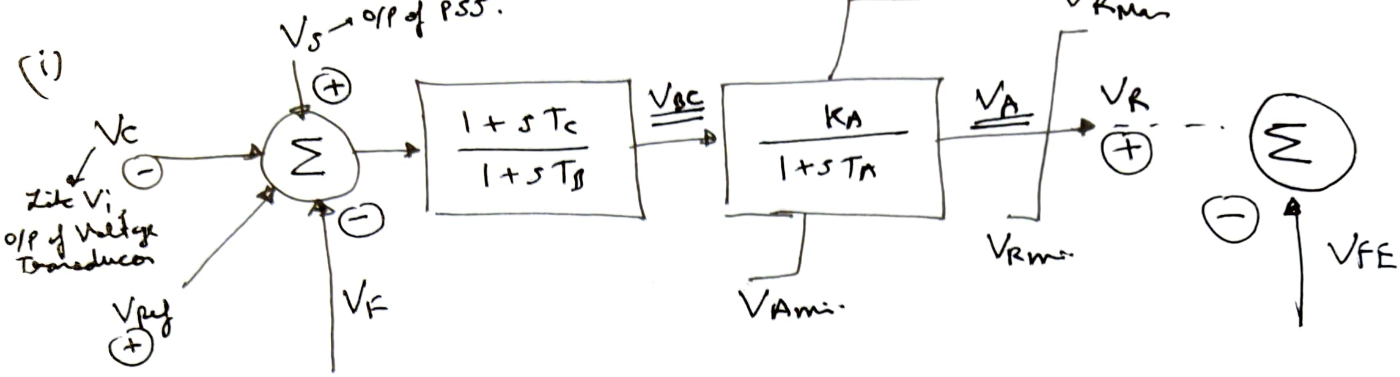
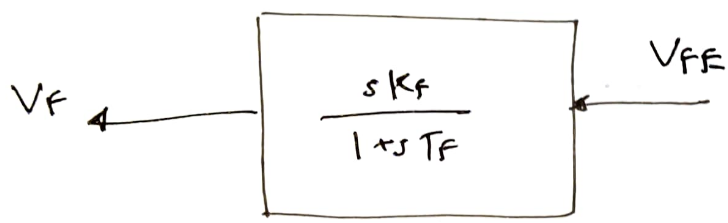
3.1

Type AC1A model:

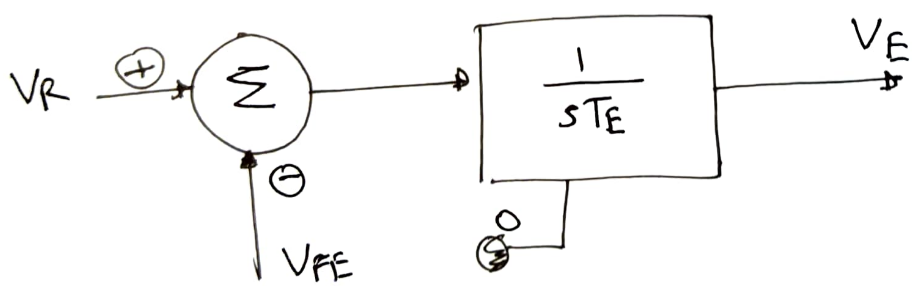
(i)



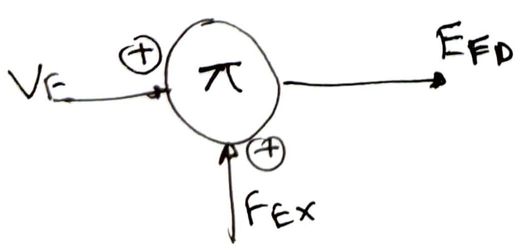
(ii)



(iii)

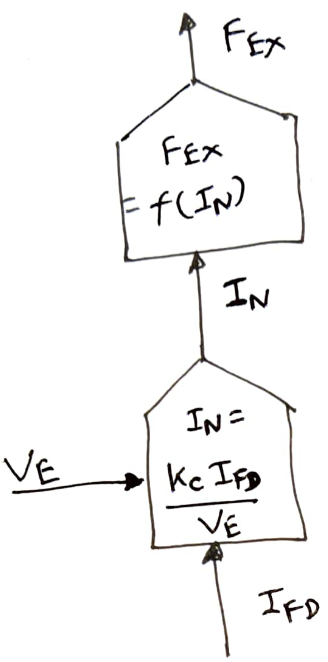


(iv)

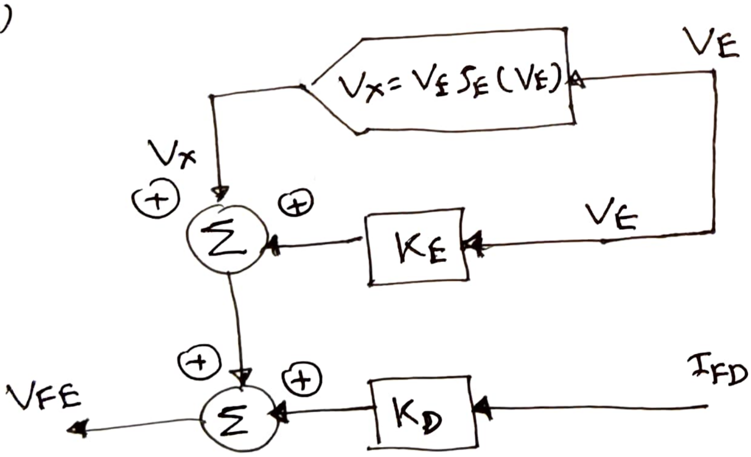


3.2

(v)


FEX
FEX
= f(IN)
IN
IN =
KC IFD
VE
VE
IFD

(vi)


VE
Vx = VE SE (VE)
Vx
+
+
Σ
KE
VE
+
+
VFE
Σ
KD
IFD

(i) $(V_S + V_{ref} - V_C - V_F)\cdot(1+sT_C) = V_{BC}\cdot(1+sT_B)$

Assuming that V_S, V_{ref} are constant here:

or $(V_S + V_{ref} - V_C - V_F) - T_C(\dot{V}_C + \dot{V}_F) = V_{BC} + T_B\dot{V}_{BC}$

or (a)

$$\boxed{\dot{V}_{BC} = \frac{1}{T_B}\left\{-V_{BC} + (V_S + V_{ref} - V_C - V_F) - T_C(\dot{V}_C + \dot{V}_F)\right\}}$$

~~$V_{BC}(1+sT_A) = K_A V_A$~~

$V_{BC} K_A = V_A(1+sT_A)$

or

$$\boxed{V_{A}\text{-dot} = \frac{1}{T_A}\left\{-V_A + K_A V_{BC}\right\}}$$

(b)

$$\boxed{\dot{V}_A = \begin{cases} 0 & V_A > V_{Amax} \text{ \& } V_A\text{-dot} > 0 \\ 0 & V_A < V_{Amin} \text{ \& } V_A\text{-dot} < 0 \\ V_A\text{-dot} & \text{else} \end{cases}}$$

$$\boxed{V_R = \begin{cases} V_{Rmax} & V_A > V_{Rmax} \\ V_{Rmin} & V_A < V_{Rmin} \\ V_A & \text{else} \end{cases}}$$

We could also call V_A as some V_{RO}. (like we did introduce V_A-dot).

(ii) $V_F\cdot(1+sT_F) = sK_F V_{FE}$

or $sV_F = \frac{1}{T_F}(-V_F + sK_F V_{FE})$

or (c)

$$\boxed{\dot{V}_F = \frac{1}{T_F}\left\{-V_F + K_F\dot{V}_{FE}\right\}}$$

(iii) $(V_R - V_{FE}) \cdot 1 = s T_E V_E$

or

$$\boxed{V_{E\text{-}dot} = \frac{1}{T_E}\{V_R - V_{FE}\}}$$

(d)
$$\boxed{\dot{V_E} = \begin{cases} 0 & V_E < 0 \text{ and } V_{E\text{-}dot} < 0 \\ V_{E\text{-}dot} & \text{else} \end{cases}}$$

(iv) $$\boxed{E_{FD} = F_{EX} \cdot V_E}$$

(v) $$\boxed{I_N = \frac{K_C I_{FD}}{V_E}}$$

$$\boxed{F_{EX} = f(I_N) = f\left(\frac{K_C I_{FD}}{V_E}\right)}$$

(vi) $$\boxed{V_X = V_E S_E(V_E)}$$

$$\boxed{V_{FE} = K_D I_{FD} + K_E V_E + V_X}$$

State Variables: (Four state variables)

- V_C (it is V_i), basically — Here since it is an I/P, we do not have an equation for its derivative and so we'll assume it to be a constant.
- (1) (a) V_{BC}
- (2) (b) V_R (with $V_{RO} \to V_A$ and $V_{RO\text{-}dot} \to V_{A\text{-}dot}$)
- (3) (c) V_F
- (4) (d) V_E