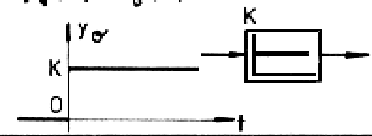
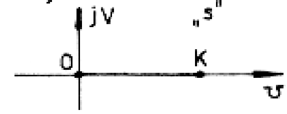
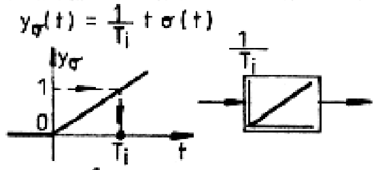
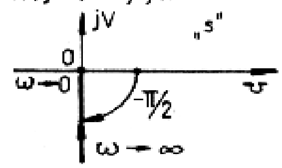
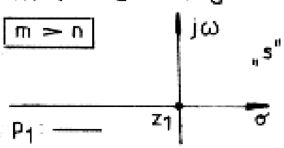
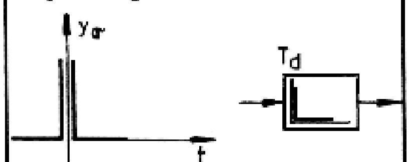
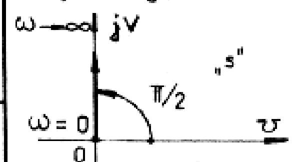
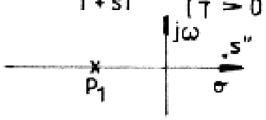
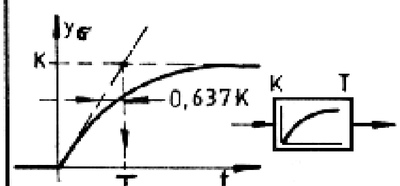
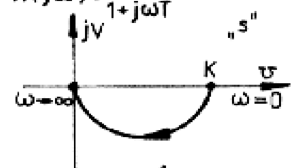
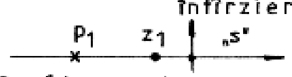
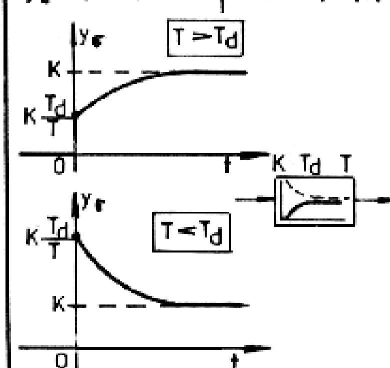
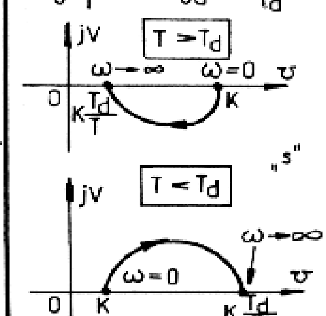
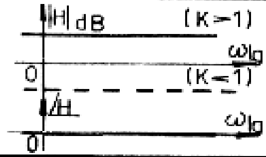
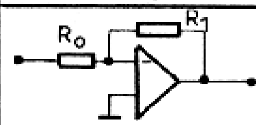
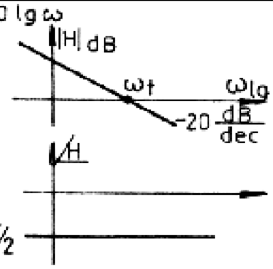
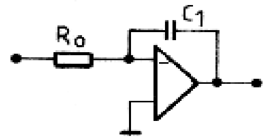
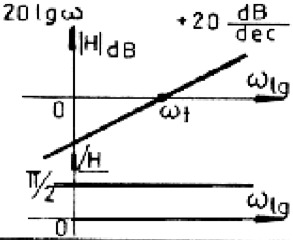
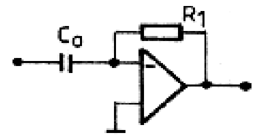
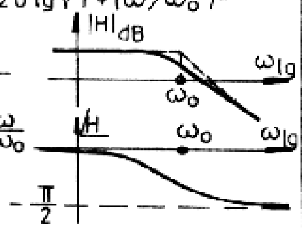
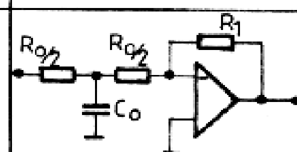
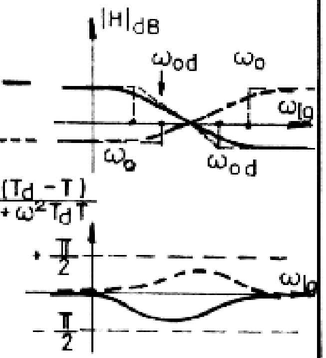
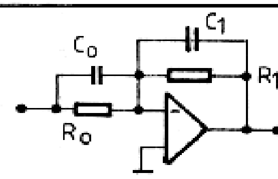
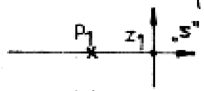
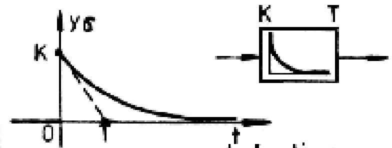
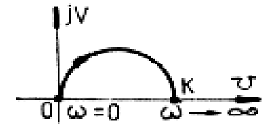
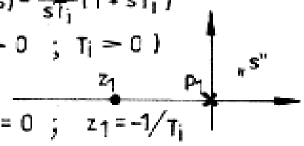
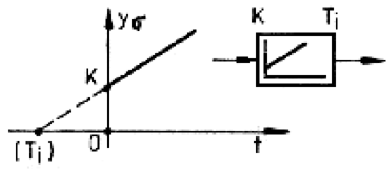
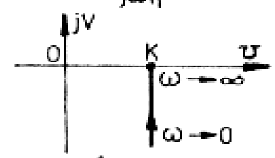
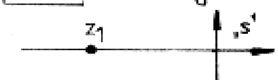
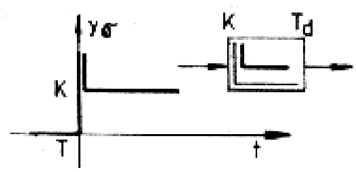
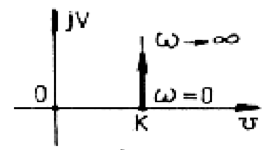
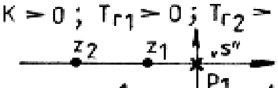
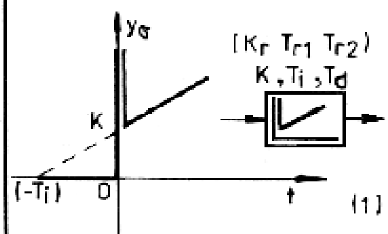
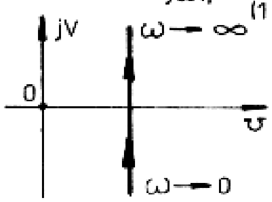
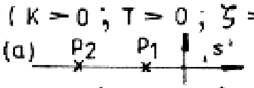
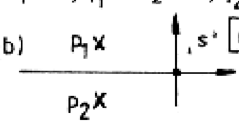
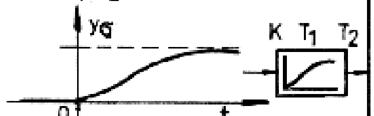
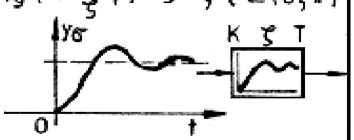
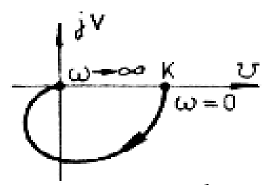
Elemente de transfer tipizate.

Nr.crt. Tipul ET	ECUAȚIE DIFERENȚIALĂ F.d.t. $H(s)$ amplasare poli-zerouri	RĂSPUNS INDICIAL $y_\sigma(t)$ SIMBOLIZARE	F.r.p. HODOGRAF $h_+\{H\}$
0	1	2	3
1 P	$y(t)=K\,u(t)$ $(K>0)$ $H(s)=K$ ———	$y_\sigma(t)=K\sigma(t)$ 	$H(j\omega)=K$ 
2 I	$y(t)=K\int u(\tau)d\tau$ $(\dot y(t)=\frac{1}{T_i}u(t))$ $H(s)=\frac{1}{sT_i}$ $T_i>0$  $P_1=0$	$y_\sigma(t)=\frac{1}{T_i}t\,\sigma(t)$  $(T_i=\frac{1}{K})$ T_i= constanta de timp integratoare	$H(j\omega)=K/j\omega$  $\omega_{0i}=\omega_t=\frac{1}{T_i}$
3 D ET ideal (de calcul)	$y(t)=T_d\cdot\dot u(t)$ $H(s)=sT_d$ $(T_d>0)$ $\boxed{m>n}$  P_1: ——— $z_1=0$	$y_\sigma(t)=T_d\,\delta(t)$  T_d=const. de timp derivativă	$H(j\omega)=T_d\,j\omega$  $\omega_{od}=\omega_t=\frac{1}{T_d}$
4 PT1	$T\dot y(t)+y(t)=K\,u(t)$ $H(s)=\frac{K}{1+sT}$ $(K>0)$ $(T>0)$  $P_1=-1/T$	$y_\sigma(t)=K(1-e^{-t/T})\sigma(t)$ 	$H(j\omega)=\frac{K}{1+j\omega T}$  $\omega_0=\frac{1}{T}$
5 PDT1	$T\dot y+y=K(u+T_d\dot u)$ $H(s)=\frac{K(1+sT_d)}{1+sT}$ $(K>0\ ;\ T>0\ ;\ T_d>0)$ $T>T_d$: PDT1 cu întîrziere anticipare  $T<T_d$: PDT1 cu anticipare întîrziere  $p=-1/T$ $z=-1/T_d$	$y_\sigma(t)=K(1+\frac{T_d-T}{T}e^{-t/T})\sigma(t)$ 	$H(j\omega)=\frac{K(1+j\omega T_d)}{1+j\omega T}$ $\omega_0=\frac{1}{T}$ $\omega_{od}=\frac{1}{T_d}$ 

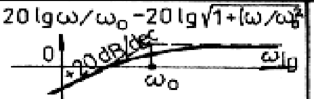
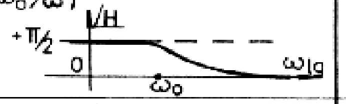
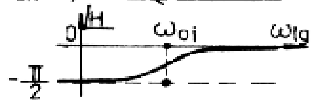
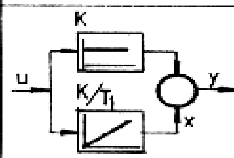
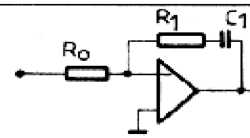
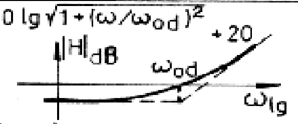
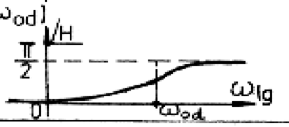
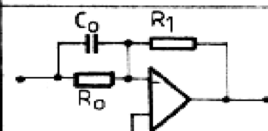
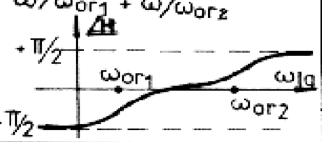
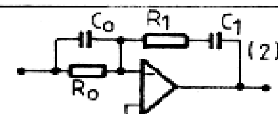
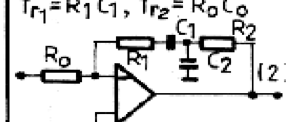
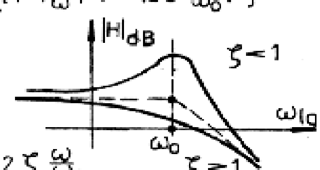
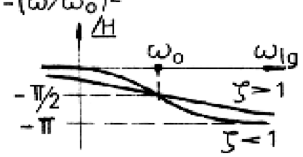
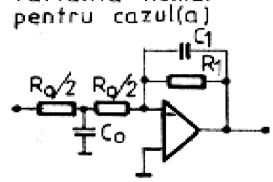
Elemente de transfer tipizate.

C.l.p. $\lvert H\rvert_{dB}$, $\angle H$	REALIZARE SISTEMICĂ	REALIZARE PRIN FA cu AO	COEF. EC. RECURENTE
4	5	6	7
$20\lg K$ 0  	———	 $K = R_1 / R_0$	$\beta_0 = K$
$20\lg K - 20\lg\omega$ $\omega_t = \frac{1}{T_i}$ $-\pi/2$  	$\dot{x} = \frac{1}{T_i}u$ $y = x$	 $T_i = R_0 C_1$	$\alpha_0 = -1$ $\beta_0 = \frac{KT_e}{2}$ $\beta_1 = \frac{KT_e}{2}$
$20\lg K + 20\lg\omega$ $\omega_t = \frac{1}{T_d}$ $+\pi/2$  	———	 $T_d = R_1 C_0$	$\alpha_0 = 1$ $\beta_0 = \frac{2T_d}{T_e}$ $\beta_1 = -\frac{2T_d}{T_e}$
$20\lg K - 20\lg\sqrt{1+(\omega/\omega_0)^2}$ $\omega_0 = \frac{1}{T}$ $-\mathrm{arctg}\,\frac{\omega}{\omega_0}$  	$\dot{x} = -\frac{1}{T}x + \frac{K}{T}u$ $y = x$	 $K = R_1/R_0$ $T = R_0 C_0/4$ (variantă)	$\alpha_0 = \frac{T_e - 2T}{T_e + 2T}$ $\beta_0 = \frac{KT_e}{T_e + 2T}$ $\beta_1 = \frac{KT_e}{T_e + 2T}$
$20\lg K + 20\lg\sqrt{1+(\omega/\omega_{0d})^2} -$ $- 20\lg\sqrt{1+(\omega/\omega_0)^2}$ $T > T_d$ —— $T < T_d$ - - - - $\mathrm{arctg}\,\frac{\omega(T_d - T)}{1+\omega^2 T_d T}$  	$\dot{x} = -\frac{1}{T}x + \frac{1}{T}u$ $y = K\left(1 - \frac{T_d}{T}\right)x + K\frac{T_d}{T}u$	 $K = R_1/R_0$ $T = R_1 C_1$ $T_d = R_0 C_0$	$\alpha_0 = \frac{T_e - 2T}{T_e - 2T}$ $\beta_0 = K\,\frac{T_e - 2T_d}{T_e + 2T}$ $\beta_1 = K\,\frac{T_e + 2T_d}{T_e + 2T}$

Elemente de transfer tipizate.

0	1	2	3
6 DT1	$T\dot{y} + y = KT\dot{u}$ $H(s) = \frac{KTs}{1+sT}$ $(K>0)$ $(T>0)$  $p_1 = -1/T$; $z_1 = 0$	$y_\sigma = K e^{-t/T} \cdot \sigma(t)$  $KT = T_d$ = ct. de timp derivativă	$H(j\omega) = \frac{KTj\omega}{1+j\omega T}$  $\omega_0 = 1/T$
7 PI	$y = K(u + \frac{1}{T_i}\int_0^t u(\tau)\,d\tau)$ $H(s) = \frac{K}{sT_i}(1+sT_i)$ $(K>0$; $T_i>0)$  $p_1 = 0$; $z_1 = -1/T_i$	$y_\sigma = K(1+\frac{t}{T})\,\sigma(t)$ 	$H(j\omega) = \frac{K}{j\omega T_i}(1+j\omega T_i)$  $\omega_{oi} = 1/T_i$
8 PD	$y = K(u + T_d\dot{u})$ $H(s) = K(1+sT_d)$ $\boxed{m>n}$ $(T_d>0)$  p_1: — z_1: $-1/T_d$	$y_\sigma = K[\sigma(t) + T_d\,\delta(t)]$ 	$H(j\omega) = K(1+j\omega T_d)$  $\omega_{od} = \frac{1}{T_d}$
9 PID	$y = K(u + \frac{1}{T_i}\int u\,d\tau + T_d\dot{u})$ $H(s) = K(1+\frac{1}{sT_i}+sT_d)$ (1) $(K>0$; $T_i>0$; $T_d>0)$ dacă $T_i > 4T_d$: $H(s) = \frac{K_r}{s}(1+sT_{r1})(1+sT_{r2})$ $(K>0$; $T_{r1}>0$; $T_{r2}>0)$  $p_1 = 0$, $z_1 = \frac{1}{T_{r1}}$, $z_2 = -\frac{1}{T_2}$ $\boxed{m>n}$	$y_\sigma = K(\sigma(t) + \frac{t}{T_i}\sigma(t) + T_d\,\delta(t))$  (1)	$H(j\omega) = K(1+\frac{1}{j\omega T_i}+j\omega T_d)$ (1)  $\omega_{oi} = \frac{1}{T_i}$ $\omega_{od} = \frac{1}{T_d}$ $\omega_{or1} = \frac{1}{T_{r1}}$, $\omega_{or2} = \frac{1}{T_{r2}}$
10 PT2	$T^2\ddot{y} + 2\zeta T\dot{y} + y = Ku$; $\zeta = D$ $H(s) = \frac{K}{1+2\zeta Ts+T^2s^2}$ $(K>0$; $T>0$; $\zeta>0)$ (a)  $\boxed{\zeta>1}$ $p_1 = -1/T_1$ $p_2 = -1/T_2$ (b)  $\boxed{0<\zeta<1}$ $p_{1,2} = -\frac{1}{T}(\zeta \pm j\sqrt{1-\zeta^2})$	(a) $y_\sigma = \frac{K}{T_1-T_2}(T_1 e^{-t/T_1} - T_2 e^{-t/T_2})\sigma(t)$  (b) $y_\sigma = K - \frac{K}{\sqrt{1-\zeta^2}}\sin(\frac{\sqrt{1-\zeta^2}}{T}t + \varphi)$ $tg\,\varphi = \frac{1}{\zeta}\sqrt{1-\zeta^2}$, $\varphi \in (0,\pi)$ 	$H(j\omega) = \frac{K\omega_0^2}{\omega_0^2 + 2\zeta\omega j\omega - \omega^2}$  $\omega_0 = \frac{1}{T}$

Elemente de transfer tipizate.

4	5	6	7
$20\lg K + 20\lg \omega/\omega_0 - 20\lg\sqrt{1+(\omega/\omega_0)^2}$  $\mathrm{arctg}(\omega_0/\omega)$ 	$\dot{x} = -\frac{1}{T}x + \frac{1}{T}u$ $y = -Kx + Ku$	 $K = R_1/R_0$ $T = R_0 \cdot C_0$	$\alpha_0 = \frac{T_e - 2T}{T_e + 2T}$ $\beta_0 = \frac{-2KT}{T_e + 2T}$ $\beta_1 = \frac{2KT}{T_e + 2T}$
$20\lg K - 20\lg \omega/\omega_{oi} + 20\lg\sqrt{1+(\omega/\omega_{oi})^2}$  $-\mathrm{arctg}(\omega_{oi}/\omega)$ 	 $\dot{x} = \frac{K}{T_i}u$ $y = x + Ku$	 $K = R_1/R_0$ $T_i = R_1 \cdot C_1$	$\alpha_0 = -1$ $\beta_0 = \frac{K(T_e - 2T_i)}{2T_i}$ $\beta_1 = \frac{K(T_e + 2T_i)}{2T_i}$
$20\lg K + 20\lg\sqrt{1+(\omega/\omega_{od})^2}$  $\mathrm{arctg}(\omega/\omega_{od})$ 	——— (se determină MM-ISI aferent unui ET-PDT1 cu $T_d >> T$)	 $K = R_1/R_0$ $T_d = R_0 \cdot C_0$	$\alpha_0 = 1$ $\beta_0 = K\left(1 - \frac{2T_d}{T_e}\right)$ $\beta_1 = 2K\frac{T_d}{T_e}$
$20\lg K - 20\lg\omega + 20\lg\sqrt{1+(\omega/\omega_{or1})^2} + 20\lg\sqrt{1+(\omega/\omega_{or2})^2}$ (2)  $-\mathrm{arctg}\frac{1-\omega^2/(\omega_{or1}\omega_{or2})}{\omega/\omega_{or1} + \omega/\omega_{or2}}$ 	——— (se determină MM-ISI aferent unui ET-PI-DT1 cu $T_d >> T$)	 (2) $K_r = 1/R_0C_1$ $T_{r1} = R_1C_1$, $T_{r2} = R_0C_0$  (2) $K_r = 1/R_0C_1$ $T_{r1} \cdot T_{r2} = R_1C_1 \cdot R_2C_2$ $T_{r1} + T_{r2} = R_1C_1 + R_2C_2 + R_2C_1$	se discretiz. f.d.t. aferentă unei conex. serie PDT1-PI
$20\lg K - 20\lg\{[1-(\frac{\omega}{\omega_0})^2]^2 + [2\zeta\frac{\omega}{\omega_0}]^2\}^{\frac{1}{2}}$  $\mathrm{arctg}\frac{2\zeta\frac{\omega}{\omega_0}}{1-(\omega/\omega_0)^2}$ 	(a) variantă: $\dot{x}_1 = -\frac{1}{T_1}x_1 + \frac{K}{T_1}u$ $\dot{x}_2 = +\frac{1}{T_2}x_1 - \frac{1}{T_2}x_2$ $y = x_2$ (b) variantă: $\dot{x}_1 = x_2$ $\dot{x}_2 = -\frac{1}{T^2}x_1 - \frac{2\zeta}{T}x_2 + \frac{1}{T^2}u$ $y = Kx_1$	varianta numai pentru cazul(a)  $K = R_1/R_0$ $T_1 = R_1 \cdot C_1$ $T_2 = R_0C_0/4$ $H(s) = \frac{K}{(1+sT_1)(1+sT_2)}$	$\alpha_0 = \frac{1 - \frac{T_e}{T} + (\frac{T_e}{2T})^2}{e}$ $\alpha = \frac{-1 + 2(\frac{T_e}{2T})^2}{e}$ $\beta_0 = \frac{K(\frac{T_e}{2T})^2}{e}$ $\beta_1 = \frac{2K(\frac{T_e}{2T})^2}{e}$ $\beta_2 = \beta_0$ $e = 1 + \zeta\frac{T_e}{T} + (\frac{T_e}{2T})^2$