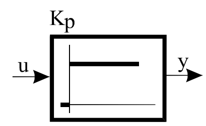
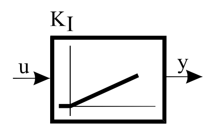
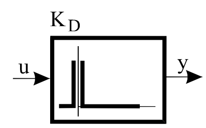
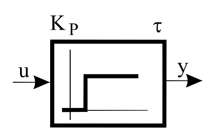
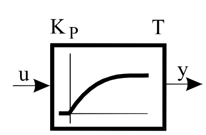
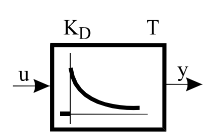
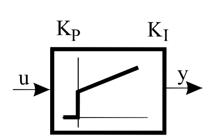
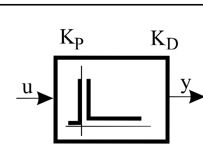
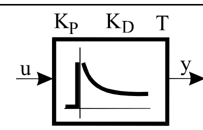
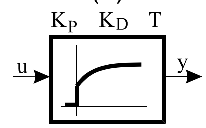
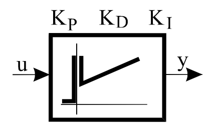
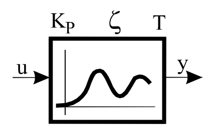
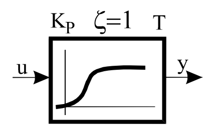
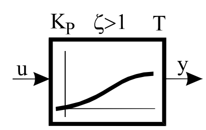
ELEMENTE DE TRANSFER TIPIZATE

Elementul de transfer (acronim)	**MM – II al ET** / **F.d.t.**	**Răspunsul indicial** $y_\sigma(t)$, $t > 0$	**Simbolizare prin răspuns indicial**
ET-P	$y = K_P u$ $H(s) = K_P$	$y_\sigma(t) = K_P$	
ET-I	$y = K_I \cdot \int u dt$ $H(s) = \frac{K_I}{s}$	$y_\sigma(t) = K_I \cdot t$	
ET-D	$y = K_D \dot{u}$ $H(s) = K_D \cdot s$	$y_\sigma(t) = K_D \cdot \delta(t)$	
ET-T_m	$y(t) = K_P \cdot u(t-\tau)$ $H(t) = K_P \cdot e^{-\tau s}$	$y_\sigma(t) = K_P \cdot \sigma(t-\tau)$	
ET-PT_1	$T\dot{y} + y = K_P u$ $H(s) = \frac{K_P}{Ts+1}$	$y_\sigma(t) = K_P \cdot (1 - e^{-\frac{t}{T}})$	
ET-DT_1	$T\dot{y} + y = K_D \dot{u}$ $H(s) = \frac{K_D s}{Ts+1}$	$y_\sigma(t) = \frac{K_D}{T} \cdot e^{-\frac{t}{T}}$	
ET-PI	$y = K_P u + K_I \int u \cdot dt$ $H(s) = K_P + \frac{K_I}{s}$	$y_\sigma(t) = K_P + K_I \cdot t$	
ET-PD	$y = K_P u + K_D \dot{u}$ $H(s) = K_P + K_D s$	$y_\sigma(t) = K_P + K_D \cdot \delta(t)$	

ET-PDT$_1$	$T\dot{y} + y = K_P u + K_D \dot{u}$ $H(s) = \dfrac{K_P + K_D s}{Ts+1}$	$y_\sigma(t) = K_P \cdot (1 - e^{-\frac{t}{T}}) + \dfrac{K_D}{T} \cdot e^{-\frac{t}{T}}$ sau $y_\sigma(t) = K_P \cdot \left[(1 - e^{-\frac{t}{T}}) + \dfrac{T_D}{T} \cdot e^{-\frac{t}{T}} \right]$ cu $T_D = \dfrac{K_D}{K_p}$	 (a)  (b)
ET-PID	$y = K_P u + K_I \int u \cdot dt + K_D \dot{u}$ $H(s) = K_P + \dfrac{K_I}{s} + K_D s$	$y_\sigma(t) = K_P + K_I \cdot t + K_D \cdot \delta(t)$	
ET-PT$_2$	$T^2 \ddot{y} + 2\zeta T \dot{y} + y = K_P u$ $H(s) = \dfrac{K_P}{T^2 s^2 + 2\zeta T s + 1}$	• $\zeta<1$ caz oscilant amortizat: $y_\sigma(t) = K_P \cdot \left[1 + \dfrac{e^{-\frac{\zeta}{T} t}}{\sqrt{1-\zeta^2}} \sin\left(\dfrac{\sqrt{1-\zeta^2}}{T} + \varphi \right) \right]$, cu $\varphi = \operatorname{arctg} \dfrac{\sqrt{1-\zeta^2}}{\zeta}$ • $\zeta=1$ caz aperiodic limită: $y_\sigma(t) = K_P \cdot \left[1 - \left(1 + \dfrac{t}{T} \right) \cdot e^{-\frac{t}{T}} \right]$ • $\zeta \geq 1$ cazul aperiodic $y_\sigma(t) = K_P \cdot \left(1 - \dfrac{T_1}{T_1 - T_2} e^{-\frac{t}{T_1}} + \dfrac{T_2}{T_1 - T_2} e^{-\frac{t}{T_2}} \right)$, cu $T_{1,2} = T(\zeta \pm \sqrt{\zeta^2 - 1})$	 (a)  (b)  (c)