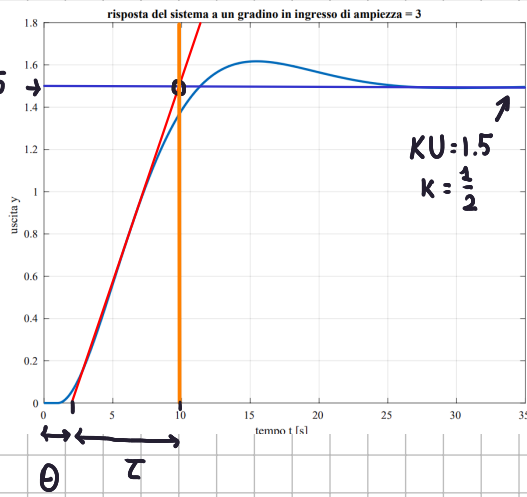


# Es 1)



Applico il primo metodo di Ziegler-Nichols, trovando

$$\theta \approx 1.87 \quad \tau \approx 8.13 \quad K = \frac{1}{2}$$

$$P_m(s) = \frac{e^{-1.87s}}{2 + 16.02s}$$

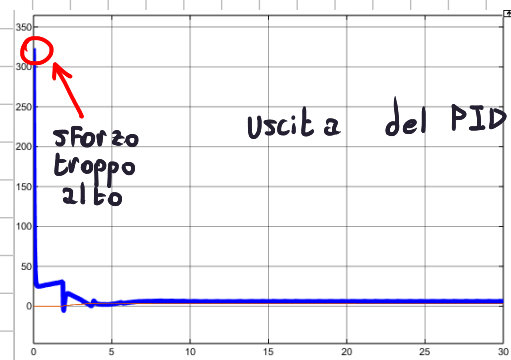
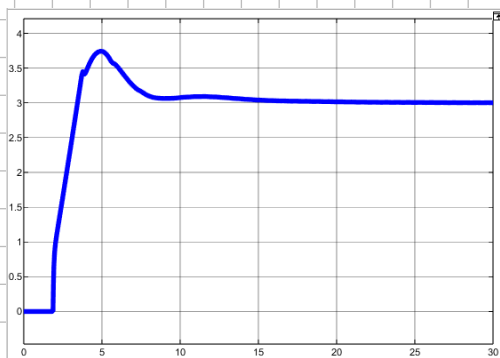
Considero un regolatore PI, i guadagni sono:

$$\frac{1}{2} K_p = 0.9 \left( \frac{8.13}{1.87} \right) \Rightarrow K_p \approx 7.82$$

$$\frac{1}{8.13} T_i = 3.33 \left( \frac{1.87}{8.13} \right) \Rightarrow T_i \approx 6.22 \Rightarrow K_i = \frac{K_p}{T_i} = 1.25$$

Con questi parametri la risposta del modello  $P_m$  non e' terribile, il transitorio e' simile a quello del sistema ma la sovraelevazione e' maggiore

Aggiungo quindi un'azione derivativa (filtrata in banda) con coefficienti  $K_p = 4$   $N = 25$ , la risposta e'



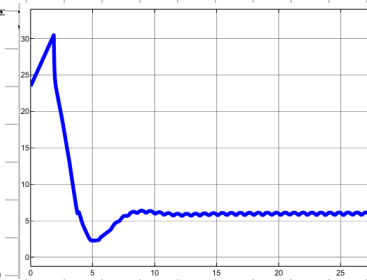
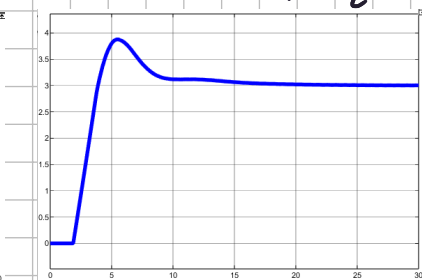
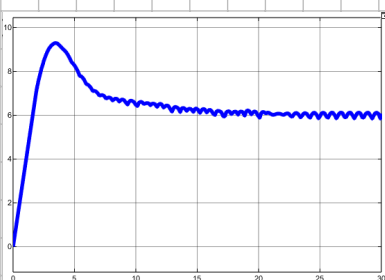
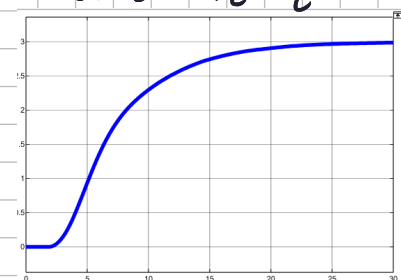
Decido di applicare l'azione PD o D esclusivamente sull'uscita misurata.

uscita  $PID_c^*$

sforzo di controllo

uscita  $PID_c^*$

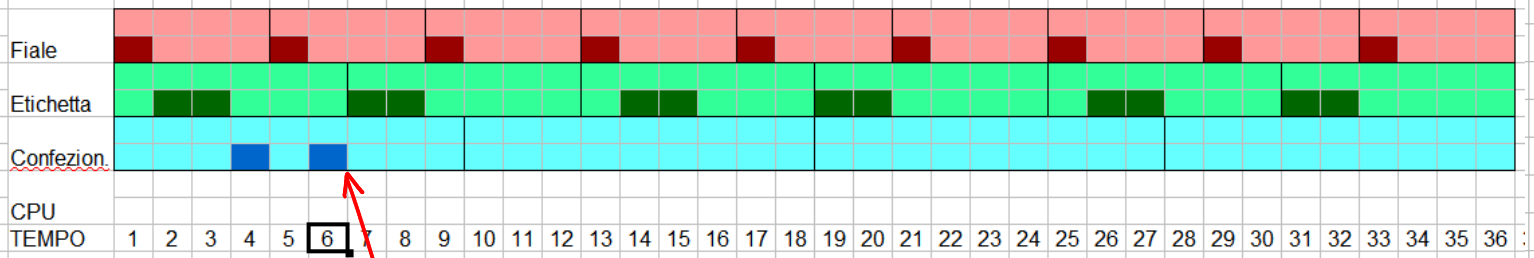
sforzo di controllo



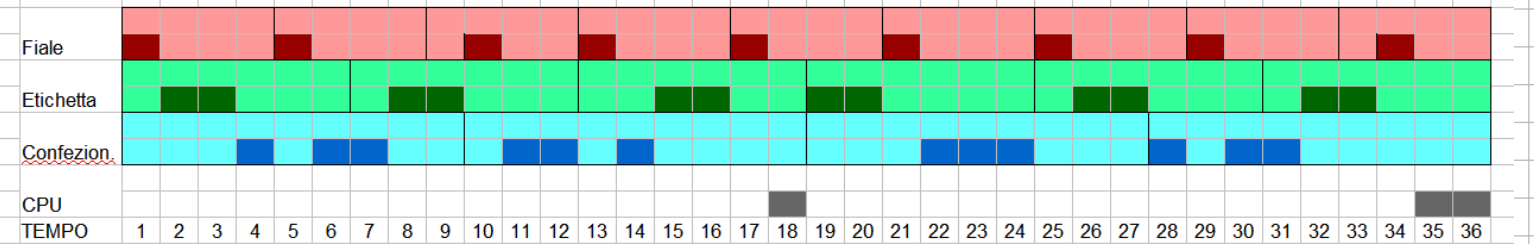
il passo di campionamento deve essere almeno il doppio della massima freq. del segnale per evitare aliasing. I guadagni del PID in un'implementazione digitale vanno riconsiderati.

**Es 2)** Si ha che  $U = \frac{1}{4} + \frac{2}{6} + \frac{3}{9} = \frac{9+12+12}{36} = \frac{33}{36} \approx 0,916 < 1 \Rightarrow \text{EDF lo schedula}$

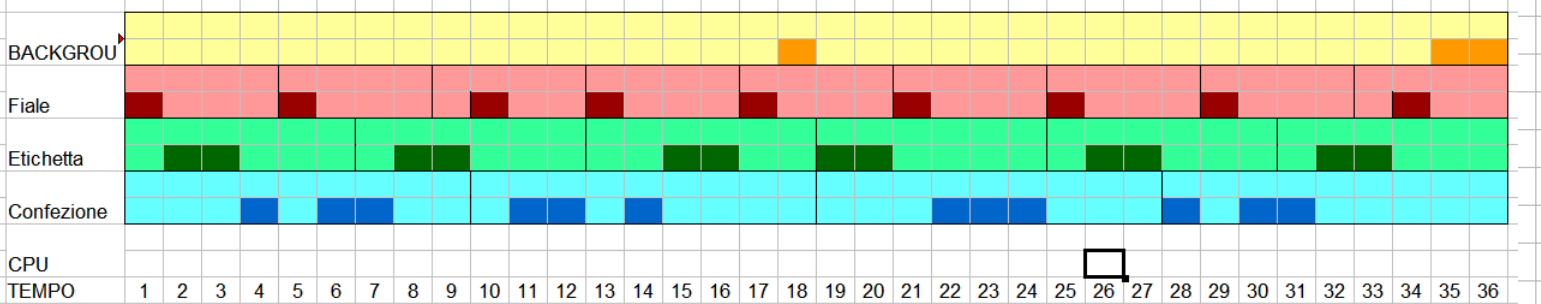
Non ci sono rel. armoniche e  $U > 3(2^{1/3} - 1) > \ln(2)$ . Provo RMPO



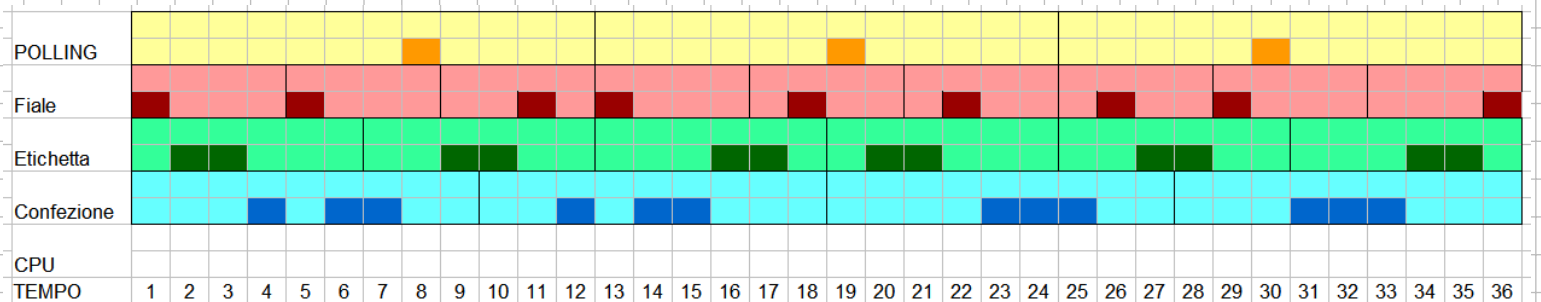
RMPO non lo schedula, eseguo quindi EDF



Provo ora a schedulare hrt il processo aperiodico.

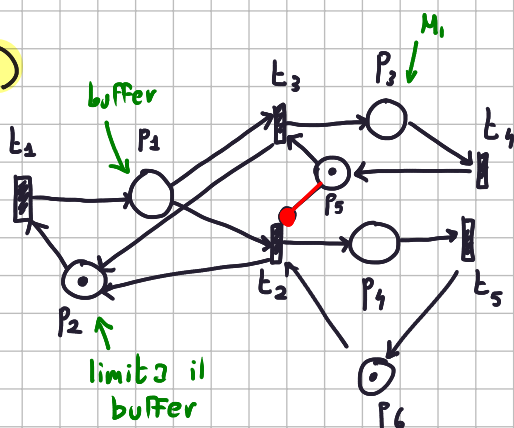


$$U' = \frac{1}{4} + \frac{2}{6} + \frac{3}{9} + \frac{1}{12} = 1$$



Polling e Deferring sono identici e riescono a schedulare tutti entro la deadline.

**Es 3)**



In ogni istante  $\alpha(p_3) = 1 - \alpha(p_5)$

$t_2$  può scattare se  $\alpha(p_5) = 0 \Leftrightarrow \alpha(p_3) = 1 \Leftrightarrow M_1$  e' occupato.

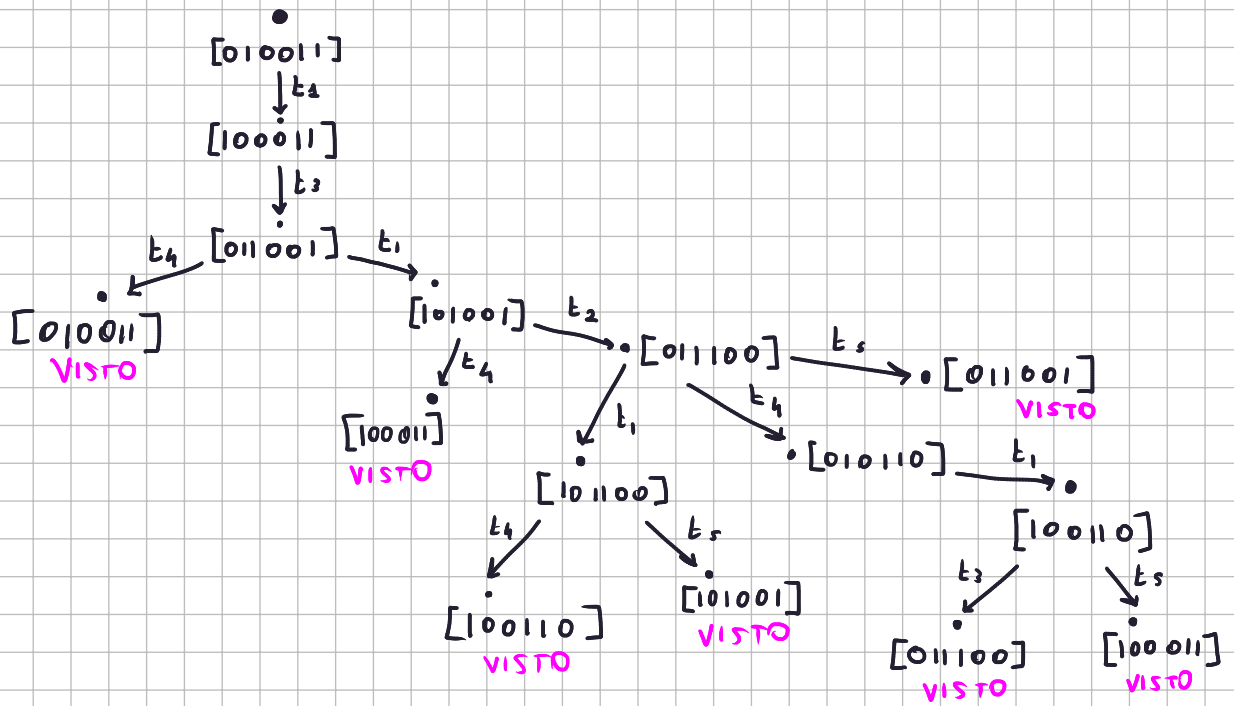
$$I = \begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \end{bmatrix}$$

$$C = \begin{bmatrix} 1 & -1 & -1 & 0 & 0 \\ -1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & -1 & 0 \\ 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & -1 & 1 & 0 \\ 0 & -1 & 0 & 0 & 1 \end{bmatrix}$$

Posso ancora usare le regole della dinamica delle reti per costruire l'albero

$$f(x, t_j) = x + C_j \quad \text{se } x \geq I_j \wedge e_j \neq 2$$

$$f(x, t_j) = x + C_j \quad \text{se } x \geq I_j \wedge e_j = 2 \wedge x(p_3) = 0$$



$$R(PN) = \left\{ \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{bmatrix} \right\}$$

Dall'albero si osserva che la rete e' limitata, viva e reversibile.

Modifico la rete per aggiungere la terza macchina:

