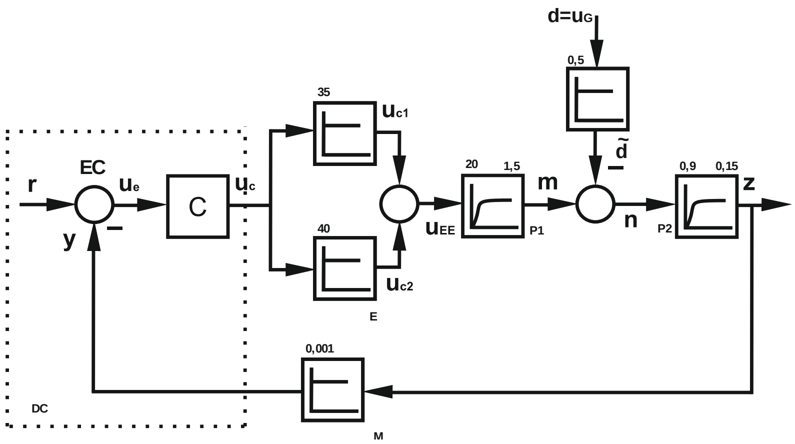
Let the control system be characterized by the block diagram given in Fig. 1, where the reference input is r*(t)* and the control error is $u_e(t)$. Two versions of controllers (C) are considered:

(1) $C(s) = k_C(1+\frac{1}{T_i s})$

(2) $C(s) = \frac{k_C(1+T_d s)}{1+T_f s}$



1. Considering only the controlled process, calculate the transfer functions of the controlled process $H_{y,uc}(s) = \left.\frac{y(s)}{u_c(s)}\right|_{d(s)=0}$ and $H_{y,d}(s) = \left.\frac{y(s)}{d(s)}\right|_{r(s)=0}$.
2. Calculate the transfer characteristics, i.e., the transfer function with respect to the reference input $H_{z,d}(s)$ and the transfer function $H_{z,r}(s)$ with respect to the disturbance input *d(t)* for:
   - Row 1: k_c=5, T_i=2 sec.
   - Row 2: k_c=5, T_d=2 sec, T_f=10 sec.
3. Investigate the stability of the control system considering the controller parameter values given at point 2.
4. For:
   - Row 1: T_i=2 sec,
   - Row 2: T_d=2 sec, T_f=10 sec,

   find the values of k_C>0 for which the control system is stable.
5. For r_∞=6.3 and d_∞=1500, calculate the steady-state values {$u_{e\infty}$, $u_{c\infty}$, $u_{c1\infty}$, $u_{c2\infty}$, $u_{EE\infty}$, m_∞, n_∞, z_∞, $n_{y\infty}$} considering the controller parameter values given at point 2; and accepting that the system is stable.
6. Find the static coefficients k_{zr} and k_{zd} which enable the following expression to be written: $z_\infty = k_{zr} * r_\infty + k_{zd} * d_\infty$.
7. Conduct the stability analysis of the discrete-time linear system with the transfer function: $H(z) = \frac{11z^2 - 3z + 0.5}{z^3 + 3z^2 + 4z + 0.5}$.