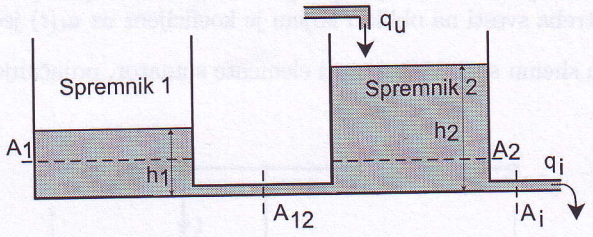
A1

Na slici je prikazan sustav skladištenja fluida u dva spojena spremnika (spremnik 1, spremnik 2). Razina fluida u spremnicima regulira se promjenom ulaznog protoka $q_u(t)$. Potrebno je:



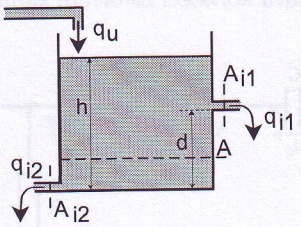
1. Napisati diferencijalne jednadžbe koje opisuju ponašanje razine fluida u spremnicima 1 i 2.
2. Skicirati blokovsku shemu sustava skladištenja fluida koristeći elemente sumator, pojačanje, integrator, matematički blok `sqrt`.

Napomena: Prilikom rješavanja zadatka pretpostaviti da vrijedi A_i, $A_{12} \ll A_1$, A_2 te $h_2 > h_1$.

$$
\begin{aligned}
q_u - q_i - q_{12} &= \rho A_2 \frac{dh_2}{dt} \\
q_{12} &= \rho A_1 \frac{dh_1}{dt} \\
q_i &= A_i \rho \sqrt{2gh_2} \\
q_{12} &= A_{12} \rho \sqrt{2g(h_2 - h_1)} \\
\frac{dh_2}{dt} &= \frac{1}{\rho A_2} q_u - \frac{A_i}{A_2} \sqrt{2gh_2} - \frac{A_{12}}{A_2} \sqrt{2g(h_2 - h_1)} \\
\frac{dh_1}{dt} &= \frac{A_{12}}{A_1} \sqrt{2g(h_2 - h_1)}
\end{aligned}
$$

A2

Na slici je prikazan sustav skladištenja fluida u spremniku. Razina fluida u spremniku regulira se promjenom ulaznog protoka $q_u(t)$. Potrebno je:



1. Napisati diferencijalnu jednadžbu koja opisuje ponašanje razine fluida u spremniku.
2. Skicirati blokovsku shemu sustava skladištenja fluida koristeći elemente sumator, pojačanje, integrator, matematički blok `sqrt`.

Napomena: Prilikom rješavanja zadatka pretpostaviti da vrijedi A_{i1}, $A_{i2} \ll A$ te $h > d$.

$$
\begin{aligned}
q_u - q_{i1} - q_{i2} &= \rho A \frac{dh}{dt} \\
q_{i1} &= A_{i1} \rho \sqrt{2g(h - d)} \\
q_{i2} &= A_{i2} \rho \sqrt{2gh} \\
\frac{dh}{dt} &= \frac{1}{\rho A} q_u - \frac{A_{i1}}{A} \sqrt{2g(h - d)} - \frac{A_{i2}}{A} \sqrt{2gh}
\end{aligned}
$$

1. IZLAZNI TEST
GRUPA A1

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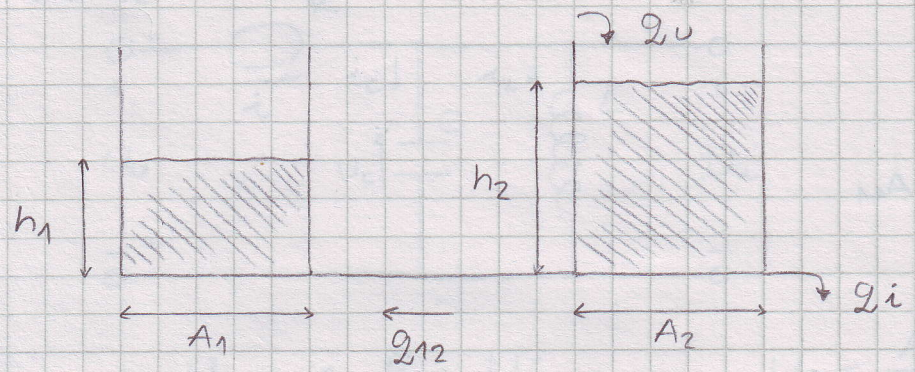
0036428227
3. AUT 1



(1) $$q_{12} = A_1 \rho \frac{dh_1}{dt}$$

$$\frac{dh_1}{dt} = \frac{A_{12}}{A_1}\sqrt{2g}\sqrt{h_2 - h_1}$$

$$q_{12} = A_{12}\rho v_{12}$$

$$q_{12} = A_{12}\rho\sqrt{2g}\sqrt{h_2 - h_1}$$

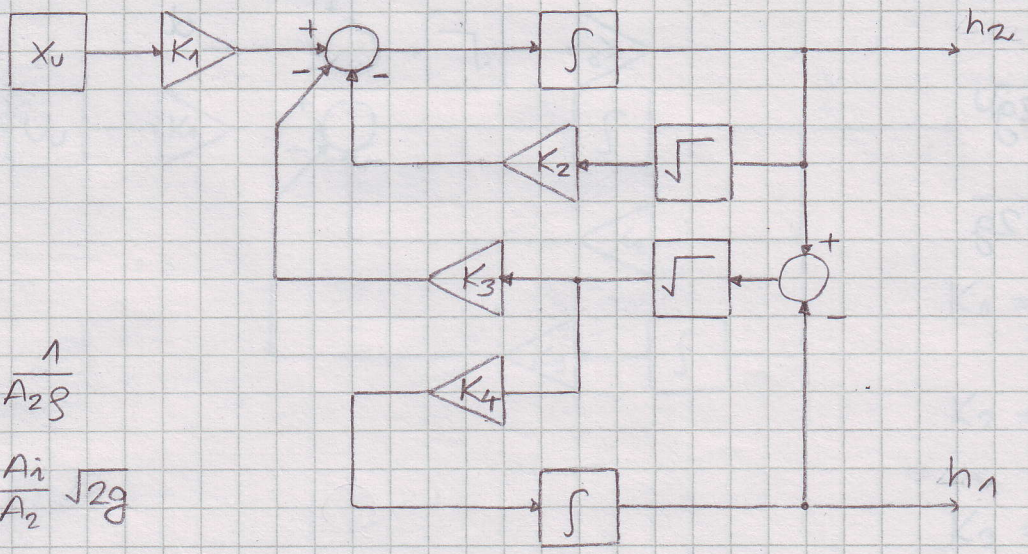
(2) $$q_u - (q_i + q_{12}) = A_2 \rho \frac{dh_2}{dt}$$

$$q_i = A_i \rho v_i$$

$$q_i = A_i \rho \sqrt{2g}\sqrt{h_2}$$

$$q_u - A_i\rho\sqrt{2g}\sqrt{h_2} - A_{12}\rho\sqrt{2g}\sqrt{h_2 - h_1} = A_2\rho\frac{dh_2}{dt}$$

$$\frac{dh_2}{dt} = \frac{q_u}{A_2\rho} - \frac{A_i}{A_2}\sqrt{2g}\sqrt{h_2} - \frac{A_{12}}{A_2}\sqrt{2g}\sqrt{h_2 - h_1}$$



$$K_1 = \frac{1}{A_2\rho}$$

$$K_2 = \frac{A_i}{A_2}\sqrt{2g}$$

$$K_3 = \frac{A_{12}}{A_2}\sqrt{2g}$$

$$K_4 = \frac{A_{12}}{A_1}\sqrt{2g}$$

1. IZLAZNI TEST
GRUPA A2

MARKO GULIN
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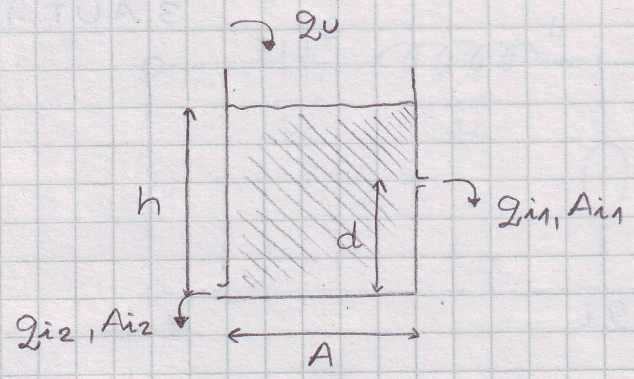
3. AUT 1



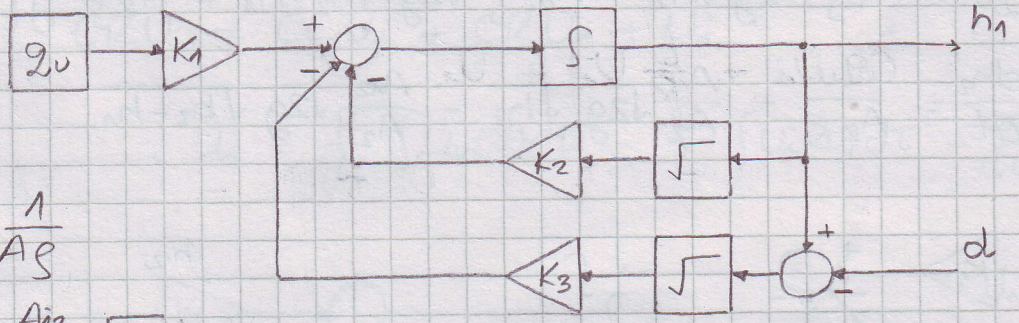
$$Q_u - (Q_{i1} + Q_{i2}) = A\rho \frac{dh}{dt}$$

$$Q_{i1} = A_{i1}\rho\sqrt{2g}\sqrt{h-d}$$

$$Q_{i2} = A_{i2}\rho\sqrt{2g}\sqrt{h}$$

$$Q_u - A_{i1}\rho\sqrt{2g}\sqrt{h-d} - A_{i2}\rho\sqrt{2g}\sqrt{h} = A\rho\frac{dh}{dt}$$

$$\frac{dh}{dt} = \frac{Q_u}{A\rho} - \frac{A_{i1}}{A}\sqrt{2g}\sqrt{h-d} - \frac{A_{i2}}{A}\sqrt{2g}\sqrt{h}$$



$$K_1 = \frac{1}{A\rho}$$

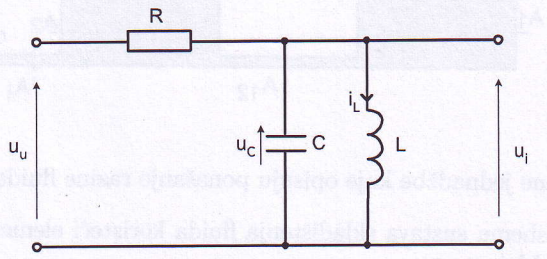
$$K_2 = \frac{A_{i2}}{A}\sqrt{2g}$$

$$K_3 = \frac{A_{i1}}{A}\sqrt{2g}$$

B1

Na slici je prikazana shema električnog kruga. Potrebno je:

1. Napisati diferencijalnu jednadžbu koja opisuje ovisnost izlaznog napona $u_i(t)$ o ulaznom naponu $u_u(t)$. Jednadžbu treba svesti na oblik u kojem je koeficijent uz $u_i(t)$ jednak 1.
2. Skicirati blokovsku shemu sustava koristeći elemente sumator, pojačanje i integrator.

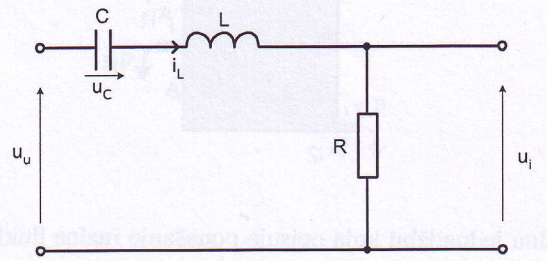


$$u_u = iR + u_i$$
$$i = i_C + i_L$$
$$i_C = C\frac{dui}{dt}$$
$$i_L = \frac{1}{L}\int_0^t u_i d\tau + i_{L0}$$
$$u_u = RC\frac{du_i}{dt} + \frac{R}{L}(\int_0^t u_i d\tau + i_{L0}) + u_i \quad /\frac{d}{dt} \quad /\frac{L}{R}$$
$$\frac{L}{R}\frac{du_u}{dt} = LC\frac{d^2u_i}{dt^2} + \frac{L}{R}\frac{du_i}{dt} + u_i$$

B2

Na slici je prikazana shema električnog kruga. Potrebno je:

1. Napisati diferencijalnu jednadžbu koja opisuje ovisnost izlaznog napona $u_i(t)$ o ulaznom naponu $u_u(t)$. Jednadžbu treba svesti na oblik u kojem je koeficijent uz $u_i(t)$ jednak 1.
2. Skicirati blokovsku shemu sustava koristeći elemente sumator, pojačanje i integrator.



$$u_u = \frac{1}{C}\int_0^t i d\tau + u_{C0} + L\frac{di}{dt} + u_i \quad /\frac{d}{dt}$$
$$i = \frac{u_i}{dt}$$
$$\frac{du_u}{dt} = \frac{1}{RC}u_i + \frac{L}{R}\frac{d^2u_i}{dt^2} + \frac{du_i}{dt} \quad /RC$$
$$RC\frac{du_u}{dt} = LC\frac{d^2u_i}{dt^2} + RC\frac{du_i}{dt} + u_i$$

1. IZLAZNI TEST
GRUPA B1

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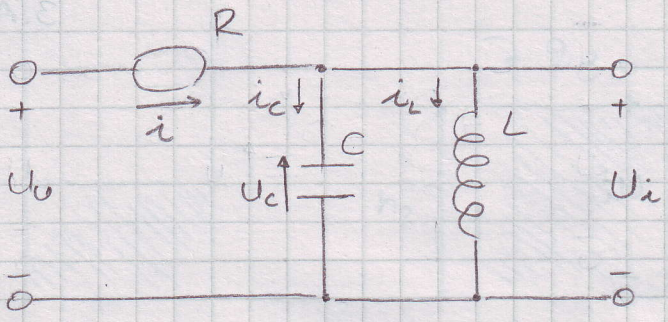
3. AUT 1



$$U_u = i \cdot R + U_i \qquad U_C = \frac{1}{C}\int i_C(\tau)\,d\tau$$

$$i_C = C\dot{U}_C$$

$$i = i_C + i_L$$

$$U_L = L\frac{di_L}{dt}$$

$$i = C\dot{U}_i + \frac{1}{L}\int U_i(\tau)\,d\tau \qquad i_L = \frac{1}{L}\int U_L(\tau)\,d\tau$$

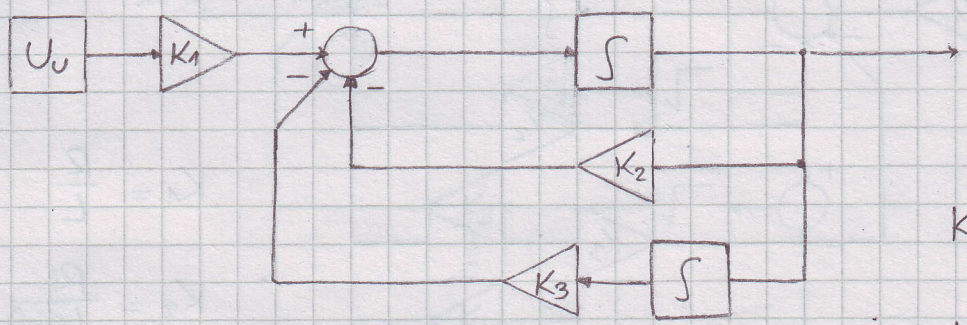
$$U_i = U_C = U_L$$

$$U_u = \left(C\dot{U}_i + \frac{1}{L}\int U_i(\tau)\,d\tau\right)R + U_i \Big/ \frac{d}{dt}$$

$$\dot{U}_u = CR\ddot{U}_i + \frac{R}{L}U_i + \dot{U}_i \Big/ \cdot\frac{L}{R}$$

$$\frac{L}{R}\dot{U}_u = CL\ddot{U}_i + \frac{L}{R}\dot{U}_i + U_i$$

$$U_i = \frac{1}{RC}\int U_u(\tau)\,d\tau - \frac{1}{RC}\int U_i(\tau)\,d\tau - \frac{1}{LC}\iint U_i(\tau)\,d\tau\,d\tau$$



$$K_1 = \frac{1}{RC}$$

$$K_2 = \frac{1}{RC}$$

$$K_3 = \frac{1}{LC}$$

1. IZLAZNI TEST
GRUPA B2

MARKO GULIN
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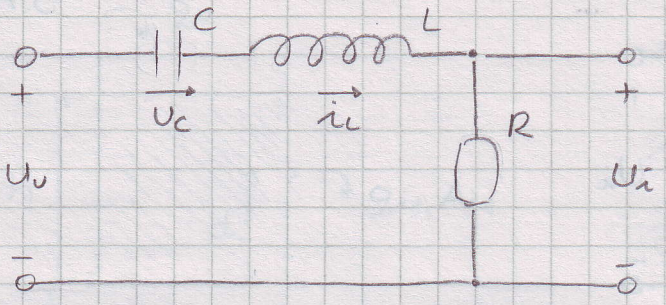
3.AUT 1



$$U_u = U_C + U_L + U_i$$

$$U_i = i_L \cdot R \rightarrow i_L = \frac{1}{R} U_i$$

$$(i_L)' = \frac{1}{R}\dot{U}_i \quad , \quad (i_L)'' = \frac{1}{R}\ddot{U}_i$$

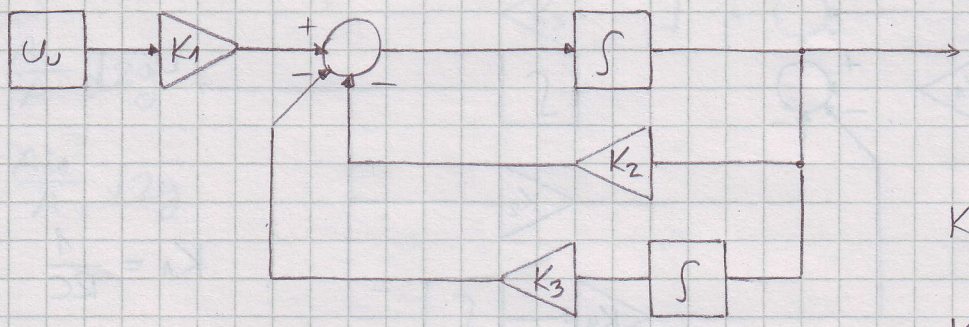
$$U_u = \frac{1}{C}\int i_L(\tau)\,d\tau + L\frac{di_L}{dt} + U_i \Big/ \frac{d}{dt}$$

$$\dot{U}_u = \frac{1}{C} i_L + L\frac{d^2 i_L}{dt^2} + \dot{U}_i$$

$$\dot{U}_u = \frac{1}{CR} U_i + \frac{L}{R}\ddot{U}_i + \dot{U}_i$$

$$CR\dot{U}_u = CL\ddot{U}_i + CR\dot{U}_i + U_i$$

$$U_i = \frac{R}{L}\int U_u(\tau)\,d\tau - \frac{R}{L}\int U_i(\tau)\,d\tau - \frac{1}{CL}\iint U_i(\tau)\,d\tau\,d\tau$$



$$K_1 = \frac{R}{L}$$

$$K_2 = \frac{R}{L}$$

$$K_3 = \frac{1}{CL}$$