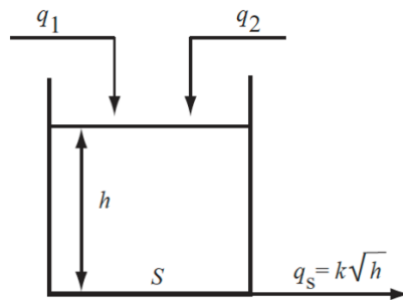


Series 4

Exercise 1

Consider a mixing tank with inlet volume flow rates q_1 and q_2 and with outlet flow rate $q_s(t) = k\sqrt{h(t)}$ where $h(t)$ represents the level of the liquid in the tank. Knowing that the densities (volumetric mass) of the liquids in the feed are equal and constant, calculate the transfer function $Q_s(s)/Q_1(s)$.



Exercise 2

A dynamic process is tested using the following input:

$$u(t) = \begin{cases} 0 & t < 0 \\ A \sin(\omega t) & 0 \leq t < \frac{\pi}{\omega} \\ 0 & t \geq \frac{\pi}{\omega} \end{cases}$$

Calculate $U(s)$.

Exercise 3

Determine the Laplace transform of the following signals:

$$\text{a) } f(t) = \begin{cases} 0 & t < 0 \\ 1 + e^{\alpha t} & 0 \leq t < T \\ -e^{\alpha t} & t \geq T \end{cases}$$

Where $\alpha \in \mathbb{R}$

$$\text{b) } f(t) = t \sin(\omega t) \quad t \geq 0$$