of salt. Water containing 1 oz/gal of salt flows into Tank 1 at a rate of 1.5 gal/min. The mixture flows from Tank 1 to Tank 2 at a rate of 3 gal/min. Water containing 3 oz/gal of salt also flows into Tank 2 at a rate of 1 gal/min (from the outside). The mixture drains from Tank 2 at a rate of 4 gal/min, of which some flows back into Tank 1 at a rate of 1.5 gal/min, while the remainder leaves the system.

(a) Let \( Q_1(t) \) and \( Q_2(t) \), respectively, be the amount of salt in each tank at time \( t \). Write down differential equations and initial conditions that model the flow process. Observe that the system of differential equations is nonhomogeneous.

(b) Find the values of \( Q_1 \) and \( Q_2 \) for which the system is in equilibrium, that is, does not change with time. Let \( Q^E_1 \) and \( Q^E_2 \) be the equilibrium values. Can you predict which tank will approach its equilibrium state more rapidly?

(c) Let \( x_1 = Q_1(t) - Q^E_1 \) and \( x_2 = Q_2(t) - Q^E_2 \). Determine an initial value problem for \( x_1 \) and \( x_2 \). Observe that the system of equations for \( x_1 \) and \( x_2 \) is homogeneous.

22. Consider two interconnected tanks similar to those in Figure 7.1.6. Tank 1 initially contains 60 gal of water and \( Q^0_1 \) oz of salt, while Tank 2 initially contains 100 gal of water and \( Q^0_2 \) oz of salt. Water containing \( q_1 \) oz/gal of salt flows into Tank 1 at a rate of 3 gal/min. The mixture in Tank 1 flows out at a rate of 4 gal/min, of which half flows into Tank 2 while the remainder leaves the system. Water containing \( q_2 \) oz/gal of salt also flows into Tank 2 from the outside at the rate of 1 gal/min. The mixture in Tank 2 leaves the tank at a rate of 3 gal/min, of which 1 gal/min flows back into Tank 1, while the rest leaves the system.

(a) Draw a diagram that depicts the flow process described above. Let \( Q_1(t) \) and \( Q_2(t) \), respectively, be the amount of salt in each tank at time \( t \). Write down differential equations and initial conditions for \( Q_1 \) and \( Q_2 \) that model the flow process.

(b) Find the equilibrium values \( Q^E_1 \) and \( Q^E_2 \) in terms of the concentrations \( q_1 \) and \( q_2 \).

(c) Is it possible (by adjusting \( q_1 \) and \( q_2 \)) to obtain \( Q^E_1 = 60 \) and \( Q^E_2 = 50 \) as an equilibrium state?

(d) Describe which equilibrium states are possible for this system for various values of \( q_1 \) and \( q_2 \).