Hints for Problem 6.4, p. 198 in the Text.

First of all, the problem should have also included the output $y = Cx$, where $C \neq 0$.

Next, in systems theoretic terms, the problem is to show that the DC gain of the closed-loop transfer function from the disturbance d to the output y is 0.

Hints: Start by writing down the system

$$\dot{x} = Ax + Bu + Fd \tag{0.1}$$
$$\dot{z} = Cx \tag{0.2}$$

Since the pair $\begin{pmatrix} A & 0 \\ C & 0 \end{pmatrix}, \begin{pmatrix} B \\ 0 \end{pmatrix}$ is controllable, there exists a state feedback law

$$u = -K_1 x - K_2 z$$

such that the closed-loop system

$$\dot{x} = Ax - BK_1 x - BK_2 z + Fd \tag{0.3}$$
$$\dot{z} = Cx \tag{0.4}$$

with input d and output y is asymptotically stable.

1. Compute the closed-loop transfer function $G(s)$.
2. G has its poles in the LHP, and
3. G(s) has a factor of s in its numerator.

To understand the formula for G, I found it useful to write out the eigenvalue equation

$$\begin{pmatrix} A - BK_1 & -BK_2 \\ C & 0 \end{pmatrix} \begin{pmatrix} v_1 \\ v_2 \end{pmatrix} = \lambda \begin{pmatrix} v_1 \\ v_2 \end{pmatrix}$$

in terms of v_1, by eliminating v_2.