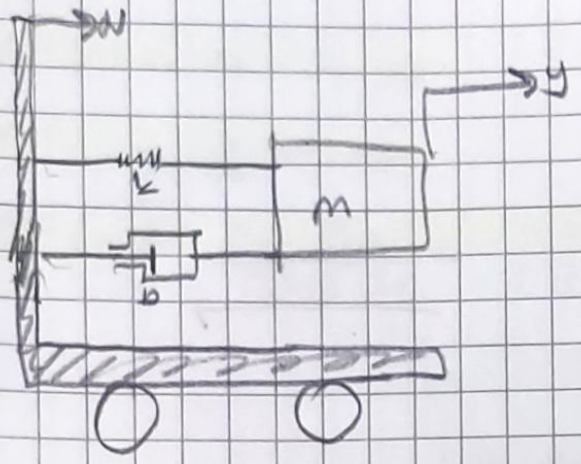
11.2



Consider the spring-mass-dashpot system mounted on a cart, as shown Figure. Here, w is the input displacement and y is the output displacement. To derive the transfer function of the system?

$$\Rightarrow ma = \Sigma F$$

$$m\frac{d^2y}{dt^2} = -b\left(\frac{dy}{dt} - \frac{dw}{dt}\right) - k(y-w)$$

T.F

$$m\frac{d^2y}{dt^2} + b\frac{dy}{dt} + ky = b\frac{dw}{dt} + kw$$

$$Y(s)\left(ms^2 + bs + k\right) = (bs+k)W(s)$$

$$T.F = \frac{Y(s)}{W(s)} = \frac{bs+k}{ms^2+bs+k}$$

$\Rightarrow$ $m = 10kg$, $b = 20\ N\text{-}s/m$, $k = 100\ N/m$

$$\frac{Y(s)}{W(s)} = \frac{2s+10}{s^2+12s+10}$$

Matlab

```
t = 0:0.01:8;
num = [2 10];
den = [1 12 10];
sys = tf(num,den);
step(sys, t)
grid
```