

**11.4 task (20 min)**

Fuzzy Controller: IF input  $T$  is *cold* THEN output  $u$  is *large*  
 IF input  $T$  is *hot* THEN output  $u$  is *small*

Sketch the input-output characteristic curve  $u = f(T)$  for the following fuzzy sets. Mark the points  $u_i$  and  $T_i$

a)

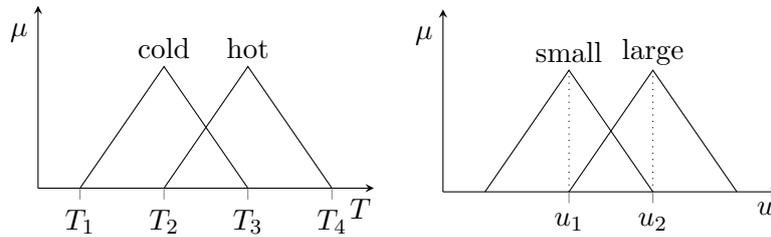


Figure 48: Fuzzy sets

b)

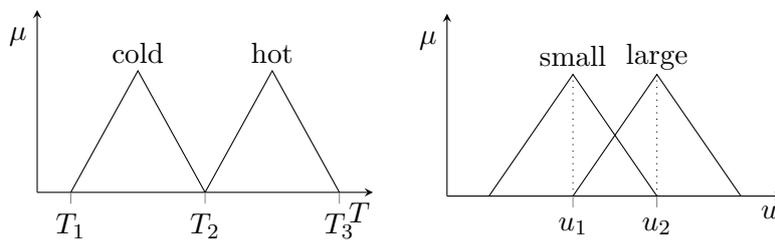


Figure 49: Fuzzy sets

c)

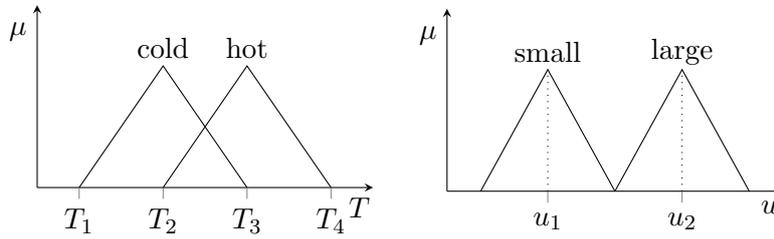


Figure 50: Fuzzy sets

d)

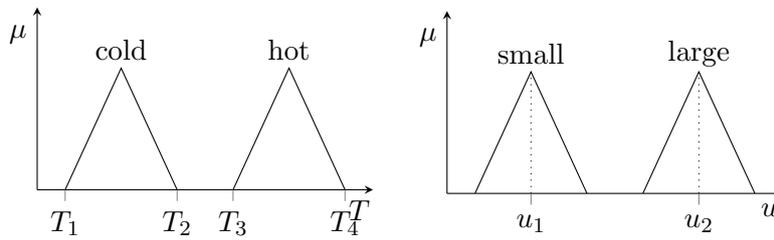


Figure 51: Fuzzy sets

e)

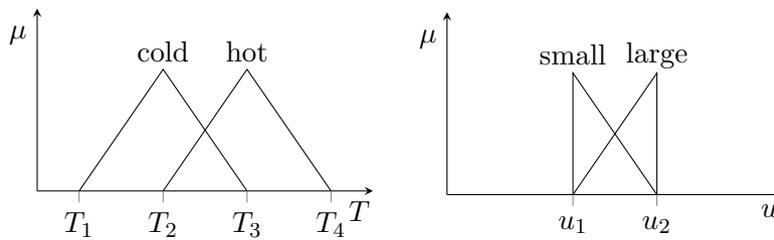


Figure 52: Fuzzy sets

f)

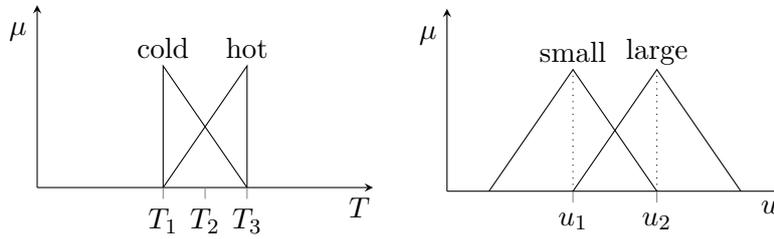


Figure 53: Fuzzy sets

**Solution: a)**

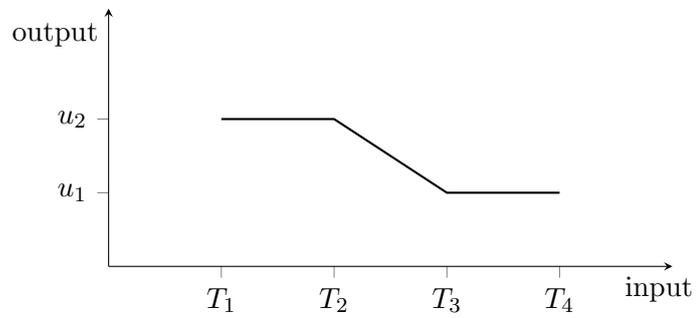


Figure 54: input-output characteristic part a)

**Solution: b)**

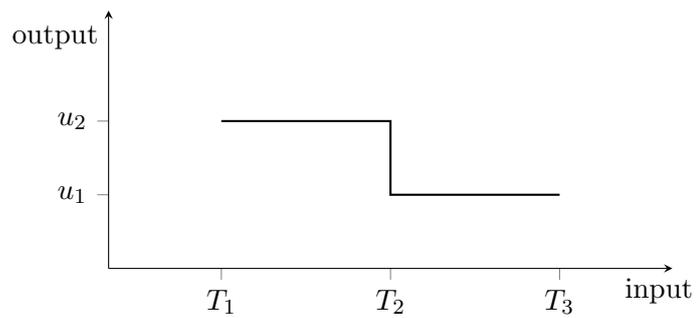


Figure 55: input-output characteristic part b)

**Solution: c)**

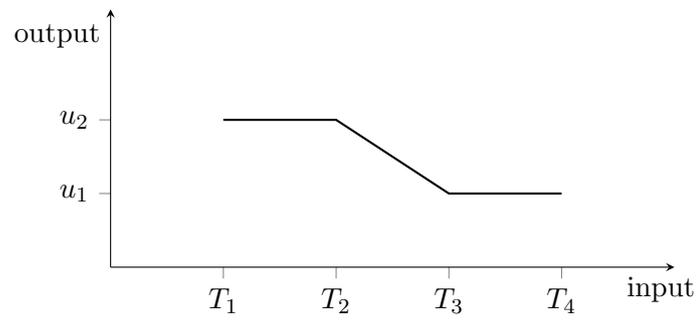


Figure 56: input-output characteristic part c)

**Solution: d)**

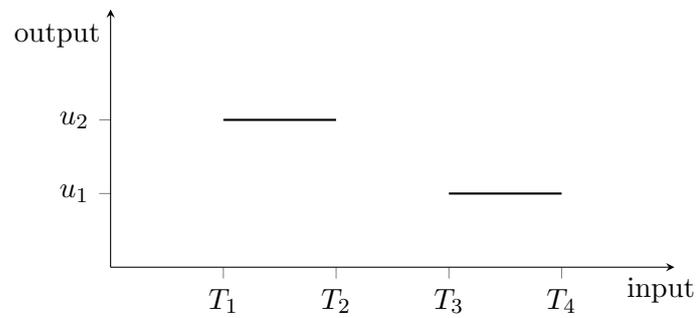


Figure 57: input-output characteristic part d)

**Solution: e)**

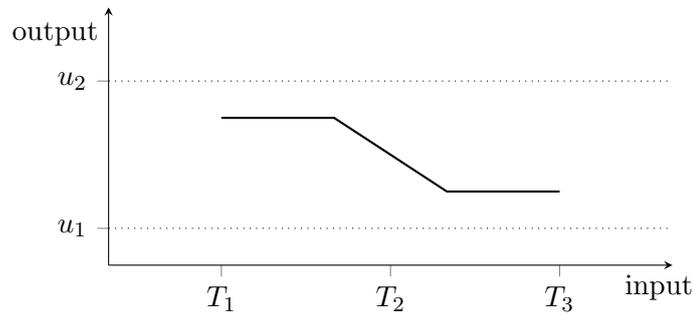


Figure 58: input-output characteristic part e)

**Solution: f)**

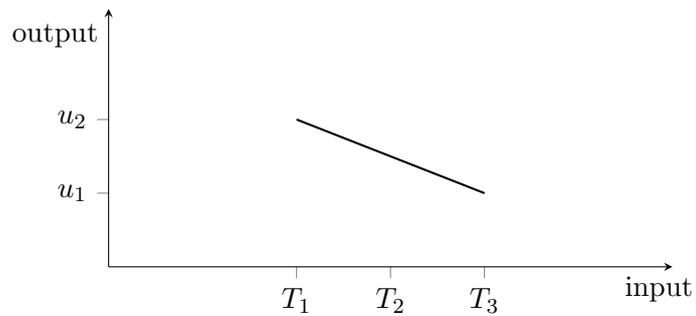
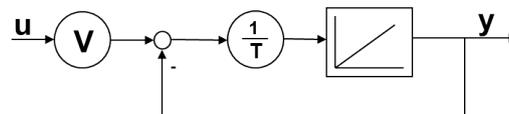


Figure 59: input-output characteristic part f)

**11.5 task (20 min)**

*Discrete Transfer Element*



A continuous first-order lag is given by the block diagram shown above.

- a) The integrator can be approximated by a discrete sum. Write the discrete difference equation of this system.