

# task\_unkkahm3u0v9azny\_with\_calculation

## Student Group

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self induction, induction, exam ee2 SS2022

### Exercise E11 Self Induction (written test, approx. 8 % of a 120-minute written test, SS2022)

2. A motor with a maximum current of  $I = 63 \text{ A}$  is connected to a DC voltage source  $U = 3150 \text{ V}$ , which is fused with a circuit breaker.

Sketch the circuit with a circuit breaker and a DC voltage source. The induced current  $i_{\text{ind}}(t)$  is to be calculated for  $t = 0$  to  $t = 1 \text{ } \mu\text{s}$ . The induced voltage  $u_{\text{ind}}(t)$  is to be calculated for  $t = 0$  to  $t = 1 \text{ } \mu\text{s}$ .

(The inner resistance of the motor shall be neglected.)

$$u_{\text{ind}}(t) = 3150 \text{ V}$$

Path

1. Draw the circuit (the circuit breaker can be drawn as a switch), with all voltage and current arrows.

For the maximum voltage on the circuit breaker one has to consider the following:

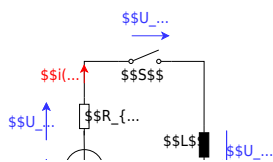
Result

- external voltage of the voltage source  $U_{\text{ext}}$
- voltage  $u_{\text{ind}}(t)$  induced by the change of the current

The first one is not given in the exercise, and therefore not considered here.

The induced voltage can be calculated by linearizing the following: 
$$u_{\text{ind}}(t) = -L \frac{di}{dt} \rightarrow u_{\text{ind}}(t) = -L \frac{\Delta i}{\Delta t}$$

With the given details: 
$$u_{\text{ind}}(t) = -L \frac{0 - I}{t_1 - t_0} = 50 \cdot 10^{-6} \text{ H} \cdot \frac{63 \text{ A}}{1 \cdot 10^{-6} \text{ s}} = 3150 \frac{\text{Vs}}{\text{A}} \cdot \frac{\text{A}}{\text{s}}$$



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Last update: **2024/07/05 03:25**

