

Written exam at the course  
**SEMICONDUCTOR DEVICES**  
 (ELEMENTI POLPREVODNIŠKE ELEKTRONIKE)  
 1<sup>st</sup> Bologna grade – 2<sup>nd</sup> year – Electronics – AE  
 26. 1. 2018

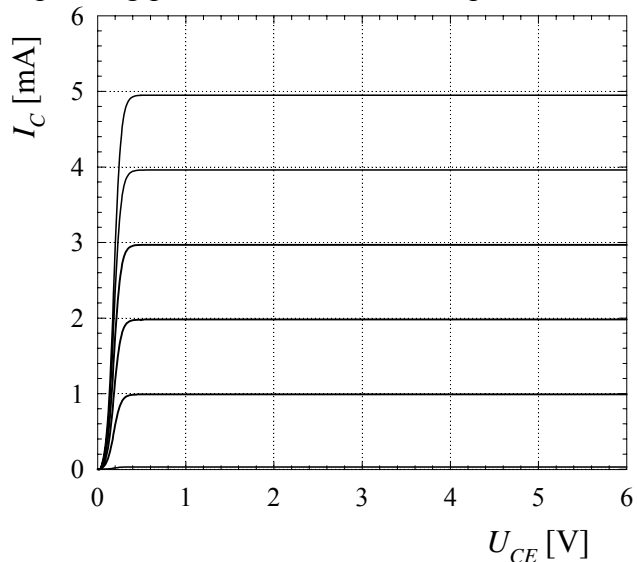
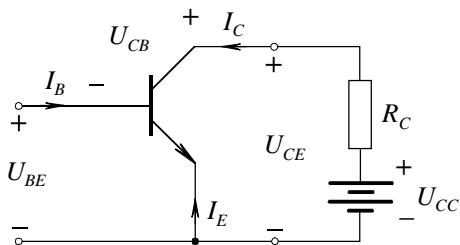
1. To what extent does the specific conductivity of the silicon n-type sample with a donor concentration of  $N_D = 4 \cdot 10^{15} \text{ cm}^{-3}$  change, if the concentration of majority and minor free carriers increases because of light by  $\Delta n = \Delta p = 1 \cdot 10^{15} \text{ cm}^{-3}$ ?  
 (Data:  $\mu_p = 460 \text{ cm}^2/\text{Vs}$ ,  $\mu_n = 3 \cdot \mu_p$ )

2. For a given diode, at a temperature of  $50 \text{ }^\circ\text{C}$ , we have measured the following two points of the conducting direction current-voltage characteristic:  
 -  $I_1 = 40,0 \text{ }\mu\text{A}$  at  $U_1 = 0,4 \text{ V}$  and  
 -  $I_2 = 2,0 \text{ mA}$  at  $U_2 = 0,6 \text{ V}$ .

Calculate the diode's saturation current,  $I_S$ , and the diode quality factor,  $n$ . You can assume that the voltage at both points is much higher than the thermal voltage and that the series resistance is negligible.

3. For the plotted circuit, determine the base current  $I_B$  so that the operating output voltage is  $U_{CE} = 3 \text{ V}$ . Draw the operating line and the operating point to the enclosed output characteristic of the bipolar transistor and enter the values of the base currents for the individual curves.

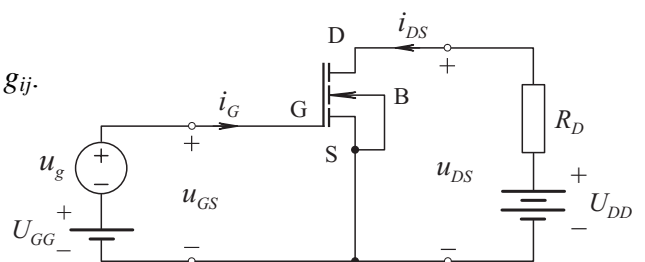
(Data:  $\alpha_F = 0,99$ ,  $U_{CC} = 5 \text{ V}$ ,  
 $R_C = 1 \text{ k}\Omega$ )



4. The MOS transistor in the drawn circuit works at the operating point  $U_{DS} = 6 \text{ V}$   
 $U_{GS} = 3 \text{ V}$ . Determine:

- type of the transistor,
- the operating range and
- incremental conduction quadripole parameters  $g_{ij}$ .

Data:  
 $\mu_n C_0 = 1 \text{ mAV}^{-2}$   
 $W/L = 2,0$   
 $U_T = 2 \text{ V}$



You have 60 minutes, you are allowed to use the sheet with basic formulas and constants.  
 The results are expected to be communicated by Monday morning via STUDIS.