

Written exam at courses – UNOFFICIAL TRANSLATION
ELEMENTI POLPREVODNIŠKE ELEKTRONIKE and
ELEMENTS OF SEMICONDUCTOR ELECTRONICS

I. grade – 2. year – Electronics – AE

6. 2. 2014

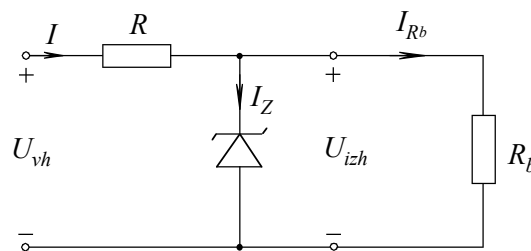
1. Draw energy band diagram of a silicon sample doped with phosphorus impurities (phosphorus has five valence electrons). The concentration of phosphorus impurities in the sample is $1,5 \cdot 10^{17}$. Calculate the energy difference between the actual and intrinsic Fermi level (in units of eV) and highlight it on the energy band diagram.

(Data: $E_G = 1,12$ eV, $T = 297,8$ K, $\mu_n = 1300$ cm²/Vs, $\mu_p = 450$ cm²/Vs)

(Solution: $E_F - E_{Fi} = 424$ meV)

2. For the given voltage stabiliser with load resistor R_b calculate the change in output voltage ΔU_{izh} if the input voltage U_{vh} varies between 8 V and 12 V.

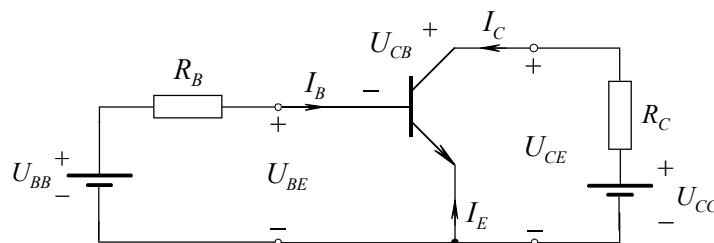
(Data: $U_{Z0} = 5,6$ V, $r_z = 20$ Ω , $R = 100$ Ω , $R_b = 500$ Ω)



(Solution: $\Delta U_{izh} = 0,161 \cdot \Delta U_{vh}$, $\Delta U_{izh} = 644$ mV)

3. In the given circuit with *npn* transistor determine the base resistance R_B so that the voltage at the collector resistor R_C equals to $U_{CC}/2$. The transistor in the active area.

(Data: $\alpha_F = 0,99$, $U_{BB} = U_{CC} = 12$ V, $R_C = 10$ k Ω , $U_{BE} \approx 0,7$ V)



(Solution: $I_C = 600$ μ A, $\beta = 99$, $I_B = 6,06$ μ A, $R_B = 1,86$ M Ω)

4. Calculate the admittance quadripole parameters y_{21} in y_{22} of a junction FET-a, which operates in the operating point of $U_{GS} = -2,0$ V in the saturation area and can at small high-frequency signals with a frequency $f = 10$ MHz replaced with the given replacement circuit.

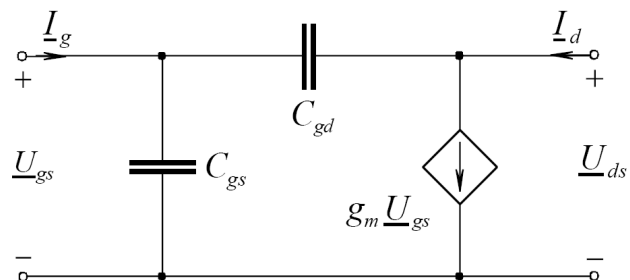
Data:

$U_p = -4$ V

$I_{DSS} = 16$ mA

$C_{gs} = 10$ pF

$C_{gd} = 2$ pF



(Solution: $y_{21} = 4$ mS – j126 μ S, $y_{22} = -j126$ μ S)

You have 60 minutes, you are allowed to use a sheet with basic formulas and constants.
The results are expected to be published on Monday 10. 2. till 12 hours in the inf. system.