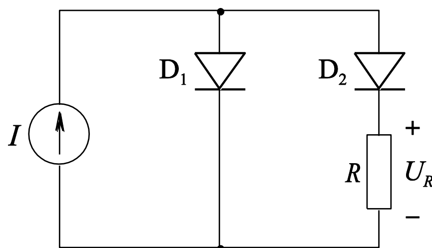
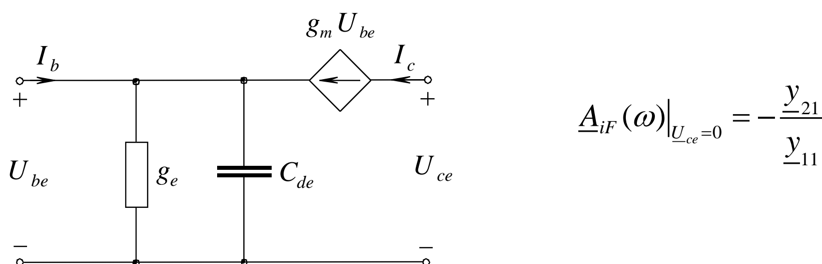
Written exam »Semiconductor Devices«
(30. 8. 2012)

1. Silicon p^+n-junction ($N_A >> N_D$) has breakdown voltage U_{BR} = 250 V, at forward bias voltage U = 0,6 V conducts I = 1 mA. Calculate concentration of doping in lower-doped layer and area of pn-junction. Other data: τ_p = 0,1 μs in n-layer, μ_p = 400 cm^2/(Vs). Breakdown voltage occurs, when the electric field at the junction reaches 400 kV/cm. In calculation you can neglect the difussion voltage U_D.

2. Calculate R in given circuit, so that U_R = 50 mV. Diodes are identical, DC source current is I = 10 mA.

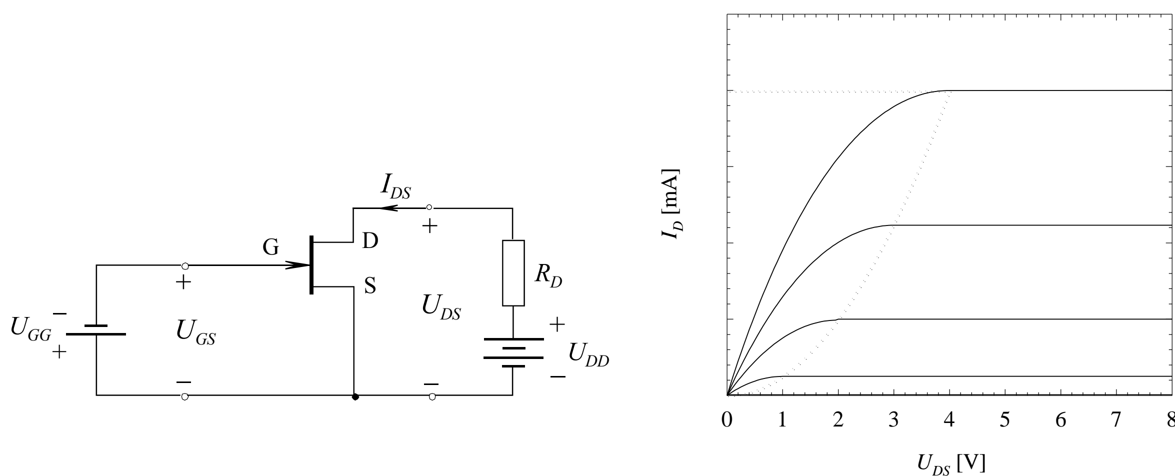


3. Calculate short-circuit current amplification $\underline{A}_{iF}(\omega, \underline{U}_{ce} = 0)$ of bipolar transistorja in orientation CE for small signals with frequency $\omega = 10^6$ rads^{-1}. Data: α_0 = 0,99, g_e = 25 mS, C_{de} = 200 pF. Calculate also ω_T. ($g_m = \alpha_0\, g_e$)



$$\underline{A}_{iF}(\omega)\Big|_{\underline{U}_{ce}=0} = -\frac{\underline{y}_{21}}{\underline{y}_{11}}$$

4. Channel of junction FET-a is doped with $N_D = 4\times10^{15}$ cm^{-3}, channel thickness is D = 2,425 μm, difussion voltage U_D at pn-junctions is 0,7 V, largest saturation current is I_{DSS} = 4 mA. Calcultae and draw in graph missing current I_D, voltages U_{GS} and U_{DSsat}. Draw also resistive load line determine the quiscent point. Other data: U_{DD} = 8 V, U_{GG} = 1 V and R_D = 2 kΩ.



Time limit: 60 minutes. One page with basic equations allowed.