

元智大學 102 學年度研究所 碩士班 招生試題卷

系(所)別：光電工程學系碩士班 組別：不分組 科目：電子學 用紙第 1 頁共 2 頁

●不可使用電子計算機

元智大學一百零二學年度 研究所考試 招生試題卷

系列：光電工程研究所 科目：電子學

1. The electron and hole diffusion coefficients in silicon are $D_n = 35 \text{ cm}^2/\text{s}$ and $D_p = 12.5 \text{ cm}^2/\text{s}$, respectively. Calculate the electron and hole diffusion current densities (a) (10%) if an electron concentration varies linearly from $n = 10^{15} \text{ cm}^{-3}$ to $n = 10^{16} \text{ cm}^{-3}$ over the distance from $x = 0$ to $x = 2.5 \text{ } \mu\text{m}$ and (b) (5%) if a hole concentration varies linearly from $p = 10^{14} \text{ cm}^{-3}$ to $p = 5 \times 10^{15} \text{ cm}^{-3}$ over the distance from $x = 0$ to $x = 4.0 \text{ } \mu\text{m}$.
2. An n-type silicon material has a resistivity of $\rho = 0.65 \text{ } \Omega\text{-cm}$. (a) (10%) If the electron mobility is $\mu_n = 1250 \text{ cm}^2/\text{V-s}$, what is the concentration of donor atoms? (b) (5%) Determine the required electric field to establish a drift current density of $J = 250 \text{ A/cm}^2$.
3. (15%) A pn junction diode and a Schottky diode have equal cross-sectional areas and have forward-bias currents of 0.5 mA . The reverse-saturation current of the Schottky diode is $I_S = 5 \times 10^{-7} \text{ A}$. The difference in forward-bias voltages between the two diodes is 0.50 V . Determine the reverse-saturation current of the pn junction diode.
4. Consider the circuit shown in Fig.1. Determine I_{BQ} , I_{CQ} , and V_{CEQ} for: (a) (5%) $\beta = 75$, and (b) (5%) $\beta = 150$.
5. (15%) Determine the small-signal voltage gain and input resistance of a common-emitter with an emitter resistor. For the circuit in figure 2, the transistor parameters are: $\beta = 100$, $V_{BE(\text{on})} = 0.7 \text{ V}$, and $V_A = \infty$.
6. (15%) For the transistor in the circuit in fig.3. The parameters are $V_{TN} = 1 \text{ V}$, $k_n' = 75 \text{ } \mu\text{A}/\text{V}^2$, and $W/L = 25$. Determine V_{GS} , I_D , and V_{DS} .
7. (15%) For the transistor in the circuit in fig.4. The parameters are: $I_{DSS} = 10 \text{ mA}$ and $V_P = -5 \text{ V}$. Determine I_{DQ} , V_{GSQ} , V_{DSQ} .

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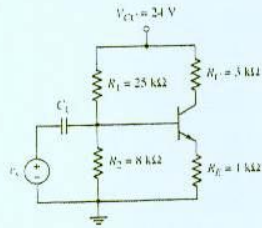


Figure 1

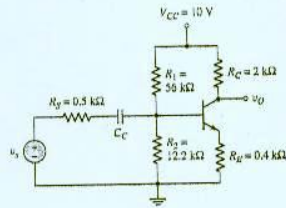


Figure 2

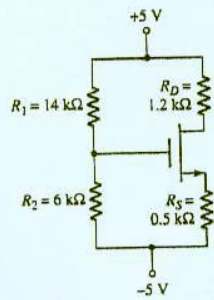


Figure 3

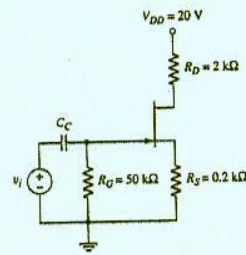


Figure 4