AAST
Faculty of Engineering
CE-Department
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Fifth Term
EC233: Devices II
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Sheet : 2

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1. A silicon n^+-p-n transistor has a base width of $1*10^{-4}$ cm, a base resistivity of 0.1 Ω.cm, and an electron diffusion length in the base region of 10 μm. The emitter region thickness is $1.0*10^{-4}$ cm and has a resistivity of 0.005 Ω.cm. the emittere and collector areas are both $2.5*10^{-5}$ cm^2. Take μ_n = 650 cm^2/V.sec and assume the transistor is operating in the active mode.
   a) Calculate the total charge of electrons stored in the active base region when the transistor base current is 100 μA at room temperature.
   b) Determine the collector current under the condition of (a).
   c) Calculate the electron density just at the edge of the emitter space-charge region, in the p-type base region.
   d) Calculate the emitter-base voltage V_{BE} in this case.
   e) Calculate the emitter-base current gain α_F.
   f) Calculate the common-emitter current gain β_F.

2. Draw the approximate Ebers-Moll equivalent circuit for a transistor operating in the active region, where $\alpha_F >> \alpha_R$ and $I_{CBO} << \alpha_F I_E$.

3. For a transistor with strongly reverse-biased collector junction and emitter-base open-circuited, show that the floating emitter-base voltage is $(KT/q)\ln(1- \alpha_F)$.