Bipolar Transistors:
Current components, basic parameters, static characteristics, currents and transconductance

Problem - 1

Sketch the minority carrier distribution in the base of a BJT biased in the (a) forward active and (b) saturation regions.

Problem - 2

In normal active mode an n-p-n bipolar transistor is assumed to have emitter injection efficiency $\gamma = 1$ and negligible holes entering from collector into base. If the transit time and life time of electrons in the base region are found to be 10 ns and 0.99 μs, respectively, find out on an average how many electrons will recombine inside the base for every 1000 electrons injected from emitter.

Problem - 3

Pick the correct statement :

To increase the β of a bipolar transistor

(A) the base width or doping concentration in the base should be increased

(B) the base width or doping concentration in the base should be reduced

(C) the base width should be reduced and doping concentration in the base should be increased

(D) the base width should be increased and doping concentration in the base should be reduced

Problem - 4

The emitter efficiency and base transport factor in an n-p-n bipolar transistor are 0.99 and 0.98 respectively. What is the β of this transistor?

Problem - 5

The β of an npn transistor is estimated to be 150 considering only the effect of emitter efficiency (γ) and assuming base transport factor (α_T) =1. On the other hand, considering only the effect of α_T and assuming γ =1, the β of the same transistor is found to be 120. What is the actual β of the transistor if both α_T and γ are taken into account?

Problem - 6

The β of an npn BJT is 78. If it is biased in the normal active mode in the common emitter configuration, what is its transconductance (g_m) at room temperature (300K) when base current (I_B) = 10μA?

Problem - 7

Assume that collector current of an npn bipolar transistor is approximated as

$$i_C = I_C(d.c.) + i_c(a.c.) = I_S \exp\left(\frac{V_{BE} + V_{be}}{V_T}\right)$$

where I_S is the saturation current, V_{BE} is the base-emitter bias voltage, and v_{be} is the small-signal a.c. voltage at the base. In a common emitter configuration, plot the small-signal trans-conductance (g_m) versus operating d.c. current I_C(d.c.).

Problem - 8

Draw the output characteristics of a BJT in (a) common emitter and (b) common base configurations and show the saturation, active and cut-off regions.