ASSIGNMENT 1 CONTINUED

1. An *npn* transistor has an emitter area of 10µm × 10µm. The doping concentrations are as follows: in the emitter *ND* = 1019cm-3, in the base *NA* = 1017cm-3, and in the collector *ND* = 1015cm-3. The transistor operates at *T* = 300K, where *ni* = 1.5 × 1010cm-3. For electrons diffusing in the base, *Ln* = 19µm and *Dn* = 21.3cm2/s. For holes diffusing in the emitter, *Lp* = 0.6µm and *Dp* = 1.7cm2/s. Calculate the saturation current *Is* and *β* assuming that the base width *W* is (a) 1µm; (b) 2µm; (c) 5µm.

**8. (a)** Calculate the built-in potential, depletion layer depths, and maximum field in a plane-abrupt *pn* junction in silicon with doping densities *NA* = 8 × 1015atoms/cm3 (p-type) and *ND* = 1017atoms/cm3(n-type). Do this for (i) 5V reverse bias, (ii) zero external bias and(iii) 0.3V forward bias.

* 1. Calculate the junction capacitance at (i) 5V reverse bias, (ii) zero bias and (iii) 0.3V forward bias, respectively. Assume a junction area of 2 × 10-5cm2.