EEE118 Homework sheet
2016-1

Answers should be handwritten and show full working.

Constants and formulae for use in solving these can be found in the lecture notes and on the problems sheets given out so far.

Return answers to EEE Student office by 3 p.m. Monday 12th December 2016

Remember to include your name and registration number on your answer sheet.

1. A metal rod has length 2m and a cross sectional area of $1mm^2$. The resistivity (ρ_0) of the rod at room temperature (T_0) is $2.82x10^{-8}\Omega m$. What is its resistance? The resistivity is temperature dependent and varies according to the formula $\rho = \rho_0[1+\alpha(T-T_0)]$, where $\alpha = 0.0039k^{-1}$. At what temperature will the resistance of the rod be 0.1Ω ?

2. The intrinsic electron density in Silicon at room temperature is $1x10^{16}m^{-3}$. What is the electron density at 350K? Does the conductivity of the semiconductor increase or decrease with temperature and why?

3. A p^+n diode has a forward bias current of 20 mA at 0.2 V at room temperature and a reverse bias saturation current density of 9 Am^{-2}. What is the cross sectional area of the device?

4. Considering the depletion region of a pn junction as a parallel plate capacitor, if a pn junction with equal donor acceptor concentrations is redesigned such that the donor concentration is now 10 times larger, what will be the new capacitance?

5. An n-channel JFET has the following characteristics: channel thickness, a = 2 μm; gate length, L_g = 3 μm; channel resistivity, $\rho = 3x10^{-3}$ Ωm; pinch-off voltage, V_p = 3 V. If the FET has a maximum drain current capability of 1 A operating in the saturation region, what is the gate width required?

6. An npn bipolar transistor has an emitter current dominated by electron flow where the electron emitter current exceeds the hole emitter current by a ratio of 500. Calculate the current gain, β (I_C/I_B), for this device if the base transport factor, B, is 0.98. What is the ratio of collector current to emitter current?