Tutorial Sheet – Lecture 19

Conduction Processes

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1) A parallel plate capacitor has a spacing 100 μm with air between them. If a dielectric plate of relative permitivity ε_r =10 is placed between the plates what should the new spacing be to leave the capacitance unchanged? For the same capacitor the new dielctric between the plates has a breakdown field of 50 MVm^{-1}. What is the maximum voltage which can be applied across the capacitor?

2) A 2cm long Si rod with cross sectional area of 5mm^2 has a voltage of 10V applied across its length, giving a current of 3 mA. The rod is known to have a uniform density of free electrons and temperature throughout its length. Given that μ=0.12 m^{2}V^{-1}s^{-1} m*=0.98m$_e$
   a. What is the average time between collisions in the material?
   b. What are possible sources of these collisions?
   c. What is the average drift velocity of the electrons in the rod?
   d. What is the concentration of the electrons in the material?

3) Write down the equations for electron (and hole) drift and diffusion currents. Describe in your own words, the role of minority and majority carriers in generating drift and diffusion currents.

4) A semiconductor material with low intrinsic carrier concentration is required for applications in harsh environments (e.g. high temperature). Comment on parameters which will guide you to a suitable material.