

Solid State Electronics (ECE 103) – ECE MS Comp Exam, Fall 2013

- (a) Draw the energy band diagram of a piece of Si at room temperature (label the diagram) and use the band diagram to illustrate the doping practices of n-type (phosphorus as dopant) and p-type (Boron as dopant) doping practices at room temperature (r.t.).
- (b) Use band diagrams to illustrate the formation of p/n junction.
- (c) For a p/n+ diode, p-Si region is moderately doped and n-Si region is degenerately doped (n^+). Draw the energy band diagrams under applied biases of $V_{\text{bias}} = -10\text{V}$, 0V , and $+2\text{V}$ at 0K , r.t., and 500°C (total 9 drawings). Based on the band diagram, sketch the possible I-V characteristic curve from -10 to $+2\text{V}$ and give explanation to your estimate (total 3 curves, one at each temperature)? Assuming there is no traps or interface states, etc.
- (d) Draw the structures (cross section view) of an n-channel MOSFET and use the energy band diagrams (by cutting a line from metal gate to body at the middle of the MOSFET) to illustrate the MOSFET operation (accumulation, depletion, and inversion)? Label the schematics.