

**ECE 352 - DEVICE ELECTRONICS**  
**Fall Semester 2005**

**Examination No. 3 – Study Guide**

The examination (Nov. 15, Tuesday) will be written and will last 1 hr 15 min. Students will be allowed to use 3 sheets of notes. This is in addition to the sheet of “Useful Data for Examinations” that was used in the past and that will be provided. Please show your work, partial credit may be given. At each problem state **explicitly all assumptions** that you make in the solution process. Please write on the paper provided. Use additional sheets only if necessary. Your writing should be legible and well organized. You may lose points for negligent writing and obscure explanations.

**Topics to be covered**

1. Intrinsic silicon, doping, majority and minority carriers, thermal equilibrium, law of mass action, Fermi level.
2. Diffusion and drift of carriers, current density equations, relation between electrostatic potential and energy levels, electrostatic field, Poisson equation (Gauss law).
3. Continuity equations, excess carriers, injection levels definition and meaning of low level injection, behavior of minority carriers, diffusion length.
4. Generation-recombination (*S-R-H* model), carrier life-time.
5. The Haynes-Shockley experiment – modeling diffusion and drift, measurement of minority carrier mobility.
6. *P-N* Junction, junction potential, depletion width, dependence on doping levels.
7. Electrostatic potential and its relation with the carrier densities.
8. Quasi-Fermi levels and relation to carrier and current densities.
9. Minority carrier densities in neutral regions.
10. *P-N* junction modeling under the assumption of abrupt junction.
11. Biasing of *P-N* junction, junction law.
12. I-V characteristic of *P-N* junction.
13. Computation of characteristic quantities such as junction width, built-in voltage, saturation current, etc.
14. Metal semi-conductor contacts, energy-band diagrams, idealized modeling.
15. Imperfections neglected in building model of *P-N* junctions and their effects.

Please review homework assignments, study problems, and practice problems.

Solutions to the problems are available on the class Web Page:

**ECE.ARIZONA.EDU/~ECE352**