ECE 3213 – Solid State Electronics

Textbook: Ben G. Streetman, Sanjay K. Banerjee, *Solid State Electronic Devices, 6th Ed.*, Prentice-Hall, Upper Saddle River, New Jersey, 2006, ISBN 0-13-149726-X.

I. Crystal properties

II. Introduction to quantum mechanics
- A. Photoelectric effect
- B. Bohr's model
- C. Matter as waves; wave function
- D. Uncertainty principle
- E. Schrodinger wave equation
- F. Potential wells, tunneling
- G. Hydrogen atom
- H. Many-electron atoms

III. Energy bands and charge carriers in semiconductors (4 contact hours)
- A. Energy-band structure of solids; metals, dielectrics, semiconductors
- B. Electrons and holes; effective mass
- C. Bonds in solids; intrinsic semiconductor
- D. Doping; extrinsic semiconductors

IV. Statistical mechanics
- A. Distribution function; the Fermi level
- B. Electrons and holes at equilibrium
- C. Temperature dependence of carrier concentrations
- D. Compensation and space charge neutrality

V. Physics of charge transport
- A. Carrier drift
- B. Carrier diffusion

VI. Excess carriers in semiconductors
- A. Generation and recombination
- B. Minority carrier lifetime
- C. Diffusion length
- D. Continuity equation
- E. Steady state carrier injection

VII. VII. P-N junctions
- A. P-N junction contact potential
- B. P-N junction under applied bias
- C. Space-charge region; junction capacitance
- D. Reverse-bias
- E. Electric breakdown

VIII. Metal-semiconductor junctions
- A. Schottky barriers
- B. Ohmic contacts

IX. Metal-oxide-semiconductor contact
    A. The ideal MOS capacitor
    B. Real MOS capacitor
    C. MOS capacitance-voltage analysis

X. Introduction to transistors
    A. Bipolar junction transistor
    B. Metal-oxide-semiconductor field-effect transistor