

Exam II prep



IMPORTANT

- You ARE allowed two more single sided pages, or one more double sided page, of notes
- SO, with your midterm page, that means 4 total sides of notes.
 - *(in your own handwriting only).*
- BRING A CALCULATOR!!!



14: conductivity

1. What are the forms of Ohm's law?
2. What are conductance and resistance and some standard values for materials?
3. Know the equation which accounts for scattering.
4. Describe the contribution of thermal vibrations, atomic defects, and more macroscopic defects on resistivity/conductivity?
5. How do available electron energy states vary for atoms, molecules, large molecules, and solids?
6. Sketch a simple metallic band diagram.
7. Draw a band diagrams for a metal, including E_f .
8. How is conductivity described based on a metal band diagram?
9. How does conductivity change as a function of temperature for metals?



15: Band diagrams

1. How do available electron energy states vary for atoms, molecules, large molecules, and solids?
2. Sketch a simple metallic, semiconducting, and insulating band diagram.
3. Draw band diagrams for metals, insulators, intrinsic semiconductor, and n and p type doped semiconductors, including E_c , E_f , and E_v .
4. How is conductivity described based on metal, semiconductor, and insulating band diagrams?
5. How does conductivity change as a function of temperature for metals and intrinsic semiconductors. What about for extrinsic (doped) semiconductors?

Reading for today

Semiconductors and Integrated Circuits

Chapter sections: 18.1-9



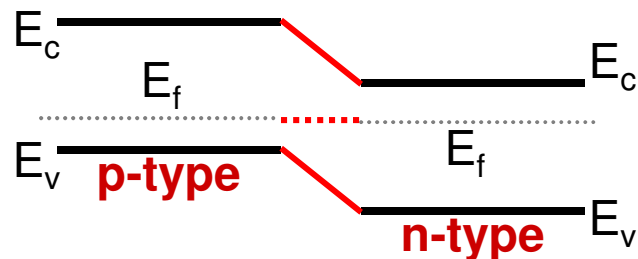
16: Semiconductors

- Draw band diagrams for metals, insulators, intrinsic semiconductor, and n and p type doped semiconductors, including E_c , E_f , and E_v .
- How does conductivity change as a function of temperature for metals and intrinsic semiconductors. What about for extrinsic (doped) semiconductors?
- What are common n and p type dopants?
- What is the appropriate conductivity equation for intrinsic, n, and p type semiconductors.
- How does the concentration of free charges change with temperature and doping (for intrinsic and extrinsic semiconductors)?
- How does mobility change with temperature and doping?



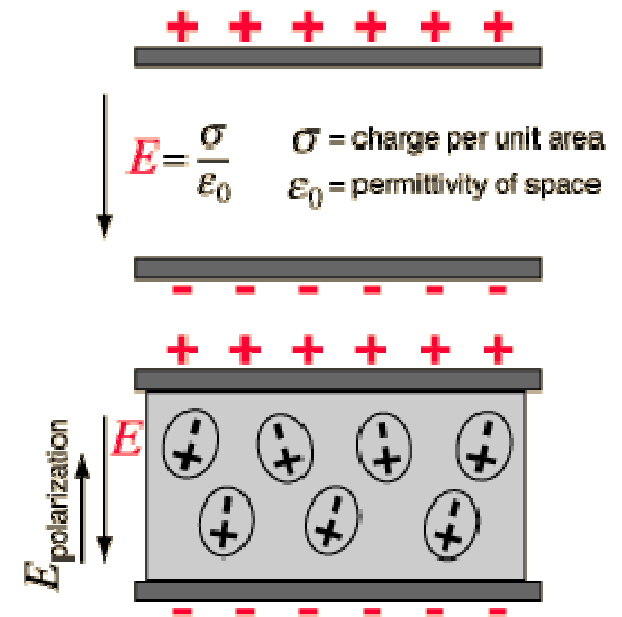
17: DIODES

- Band diagrams for equilibrium, forward, and reverse biased pn junctions
- I/V response for a pn junction and how this leads to rectification
- Mechanisms for breakdown in a pn junction
- Ionic conductivity vs electronic conductivity
- BJT transistor description and application



18: Dielectrics

- What happens to a material when an electric field is applied across it (ie. in a capacitor)
 - How does the electric field change, and how does the charge/area change?
- Equations for capacitance and polarization
- Why is a dielectric better if it is a polar crystal?
- What are the 4 primary contributions to the dielectric constant.
 - Be able to order the frequency at which they occur.
- Describe the 4 primary dielectric breakdown mechanisms.
- How can breakdown strength be improved?



19: Magnetic Properties I

1. Equations describing magnetic field strength, induction (several versions), relative magnetic permeability, magnetic susceptibility, magnetization of a solid, and saturation magnetization.
2. Origins of magnetic moments.
3. Magnetic types of materials, their relative magnetic permeabilities, and why they behave as they do (diamagnetic, paramagnetic, ferromagnetic, antiferromagnetic, ferrimagnetic).
4. Temperature dependence of magnetization and why it occurs.



20: Magnetic Properties II

1. Temperature dependence of saturation magnetization
2. Be able to sketch B vs. H for a ferromagnet and describe why it is hysteretic and nonlinear.
3. Be able to sketch and describe hysteresis loops for soft and hard magnets. How are each applied? How are each optimized?
4. Sketch resistance vs. Temp for a superconductor. Why is there a transition, and what are the magnetic properties above and below T_C ?



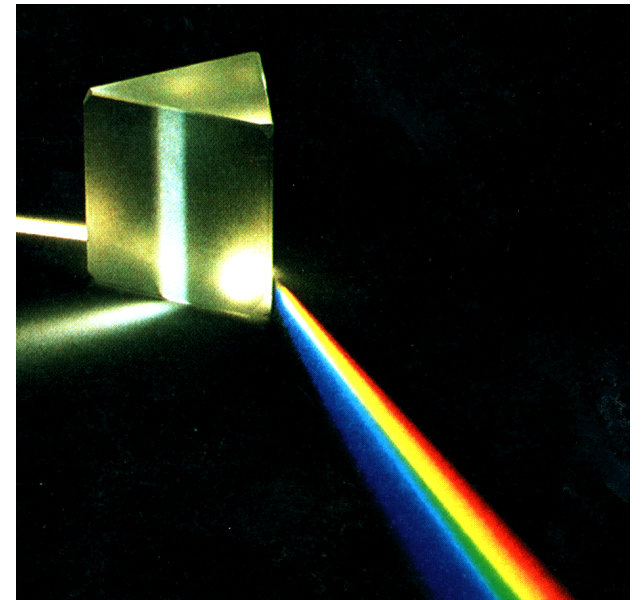
21: Thermal Properties

- How do atoms in crystals respond to temperature?
 - What is the atomic mechanism that leads to the coefficient of thermal expansion?
- How do we define and use:
 - Heat capacity
 - coefficient of thermal expansion?
 - thermal conductivity?
 - thermal shock resistance?
- Be able to calculate the thermal expansion for materials if provided the details.



22: Optical Properties I

1. Frequency, wavelength, and energy, trends in spectrum
2. Optical classifications
3. How does absorption (or emission) relate to band structure (band gaps, donor/acceptor states, etc)?
4. Photoexcitation
5. Atmospheric absorption
6. CCD color detection
7. Thermal imaging



23: Optics II



1. Index of refraction
2. Refraction (especially equations)
3. Reflection, Absorption, and the balance (Transmission)
4. Equations for R, A, T
5. Total internal reflection

24: Fiber optics, optical applications

1. How is total internal reflection optimized for optical fibers?
2. What is a GRIN optical fiber and how and why is it better than a step index optical fiber?
3. How is a fiber optic made?
4. Define Phosphorescence and Fluorescence.
5. Know the principles behind a laser.

