ENGR/MSE 170 final review

☐ Exam date: Section A: 6/5/2007 Tues, 8:30-10:20am; B: 6/7/2007 Thurs 8:30am-10:20pm
☐ Place: Mueller 153
☐ The final exam will be comprehensive
☐ Closed book, notes and neighbors
☐ 2 sheets of double-side letter-sized paper are allowed
☐ Material on the exam will be taken from text book, lecture, homework and lab
☐ Bring a calculator and straight edge/triangle
Bonding and atomic forces

- The Periodic table

- What types of bonding are there?

- How does bonding affect materials properties?
Bonding and atomic forces (continue)

- Atomic forces & potential vs interatomic distance
Crystal structure

- Determine #atoms/unit cell, CN#, APF and density
- Draw and index crystallographic direction and planes
- Close-packed plane stacking sequence
Crystal structure (continue)

- Know the types of ceramic structures and identify their unit cells
- Determine coordination number for ceramic structures based on ionic radii and charge
Defects

- Distinguish point, linear (dislocation 1D), interfacial (2D), volume (3D)
- Draw and describe edge and screw dislocations
- Understand equilibrium of vacancies and effect of $T$
Diffusion

- Mechanisms, concentration gradients, diffusion coefficient
- Fick's first law
- Effects of T on diffusion coefficients
- Diffusion paths (interstitial vs. vacancy, grain boundary and surface)
Mechanical properties

- Definition of stress, strain, elastic modulus
- Analysis of stress-strain curves
- Yield strength, tensile strength, Poisson's ratio, ductility, resilience and toughness
- Hardness
Plastic deformation

- Slip plane, direction and system, resolved shear stress
- Mechanism of plastic deformation
- Strengthening mechanisms
- Recovery, recrystallization and grain growth
Failure

- Ductile vs brittle fracture
- Stress concentrations and fracture toughness
- Creep and fatigue failure
Phase diagram

- Solubility limits, solidus, liquidus
- Binary isomorphous and eutectic phase diagrams
- Eutectic, peritectic, eutectoid reactions
- Lever law, weight fraction of phases
- Composition and microstructure of equilibrium phases
Phase diagram
Phase diagram
Phase diagram
Phase transformation

- Nucleation/growth controlled phase transformation
- Diffusional vs diffusionless
- Rate of transformation
- Isothermal transformation diagrams
Phase transformation
Phase transformation

3000X  3000X  1000X
Electrical properties

- Intrinsic semiconductors
- Extrinsic semiconductors
- Energy band structure
- Electric conductivity, resistivity and mobility
- Carrier concentration
- P-N junctions and diodes
Polymer properties

- Hydrocarbon molecules
  - Saturated and unsaturated
  - Bonding
  - Melting point
  - Isomerism
  - mer, monomer, polymer

- copolymer, homopolymer, blockpolymer

- Molecular structures of polymers

- Mechanical properties of polymers

- Crystallization, melting, and glass transition phenomena

- Thermoplastic and thermosetting polymers
Structures and properties of ceramics

- Imperfection in ceramics
- Electric properties of ceramics
- Ceramic phase diagrams
- Mechanical properties of ceramics
Composites

- Composites, matrix, dispersed phase
- Types of composites and characteristics of each
- Mechanical properties of composites including upper bound and lower bound of elastic modulus