MSE 170 final review

- Exam date: Dec 11th, Thur 8:30-10:20am
- Place: Johnson 075
- 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 isomorphic and eutectic phase diagrams
- Eutectic, peritectic, eutectoid reactions
- Lever law, weight fraction of phases
- Composition and microstructure of equilibrium phases
Phase diagram
Phase transformation

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

3000X 3000X 1000X

Structures and properties of ceramics

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

### 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
## Electrical properties

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