Materials Science and Engineering
Study Guide for Ph.D. Qualifying Exam and M.S. Comprehensive Exam

Content Level: Equivalent to MEGR 3161 (Introduction to Engineering Materials) and MEGR 3152 (Materials and Mechanics Lab) taught at UNC Charlotte

Reference: Materials Science and Engineering: An Introduction, by W. D. Callister, Jr., John Wiley, 8th edition and above.

Outcomes: In MEGR 3161, contents from Chapter 1 to Chapter 11 in the Callister and Wiley's book are convered. It is expected that the students are able to:

- Identify different classes of engineering materials and explain the basis for property control interns of the underlying structure.
- Specify crystal structures of common metals, semiconductors and simple compounds and apply x-ray diffraction method to the deter mination of crystal parameters.
- Describe the origin, structure and elementary properties of point, line and planar defects in crystals and their roles in determining material behavior.
- Apply mass transport equations to calculate concentration pro files in diffusion couples and processed components following such treatments as carburization and doping.
- Define basic mechanical properties of materials and methods of their measurement and interpret mechanical test data.
- Understand the influence of dislocations on plastic deformation; understand and apply different strengthening mechanisms to strengthen metals.
- Apply basic fracture mechanics to solve fracture problems
- Apply phase diagrams to predict microstructural features in alloy systems and calculate mass fractions of phases and microconstituents developed under equilibrium cooling conditions.
- Apply TTT diagrams to predict microstructural features in steel developed under non-equilibrium cooling conditions.