MSE-224 Deformation & Fracture

Credit Hours: 3-0

Pre-requisites: MSE-101Fundamentals of Engineering Materials

Course Objectives

- Deformation and Fracture is designed to acquaint the students with the principles of deformation in engineering materials incorporating the mechanisms of elastic deformation, yielding, onset of plastic deformation, strain hardening, necking, crack nucleation mechanisms, crack propagation dynamics and eventually fracture.
- The students are expected to orient themselves with the variability in different engineering materials concerning the deformation mechanisms in each category and fracture mechanics based upon variations in crystal structures in each.

Course Contents

- Deformation by Slip, Dislocation Movement
- Deformation of Single Crystals
- Stress fields and energy of dislocation
- Grain boundaries and dislocation, strain aging, cold working
- Theories of fracture, Fracture toughness, critical stress, measurement of critical stress, stress intensity factor
- Overview of mechanical properties of ceramics, metals, and polymers with emphasis on the role of processing and microstructure in controlling these properties
- Basic topics include: continuum stress and strain, truss forces, torsion of a circular shaft and beam bending, Design of engineering structures

Course Outcome

At the end of the course the students are expected to have learned the following:

- How can a mode of deformation be determined based upon crystal structure and processing history

- What are the different methods of finding the yield point
- How is polymer deformation and fracture different from ceramics and metals
- How do dislocations interact with particles and other dislocations
- How can the yield point be determined based upon strain field around dislocations in single crystals
- How can we theoretically determine the yield point in polycrystalline materials
- How long a material with a crack can perform during service before catastrophic failure

Suggested Books

- R. W. Hertzberg, *Deformation and Fracture Mechanics of Engineering Materials*, 5th Edition Wiley Global Education, 2012
- J. P. Hirth, J. Lothe, *Theory of Dislocation, McGraw Hill Publications*