ME 213 Engineering Materials (3-0-0-6)

Introduction to engineering materials. Introduction to atomic structure and bonding in solids. Crystallography: crystal systems and lattices, various types of crystal structure, simple cubic, FCC, BCC, HCP, Tetragonal, CsCl, NaCl, Zinc Blend, diamond cubic. Miller indices for directions and planes. Atomic packing density in crystals: planar density and volume density, voids in crystals. Crystal imperfections: point defects, line defects, dislocations, surface and volume defects, grain boundary, twin boundary, twist boundary, partial dislocations, stacking faults. Deformation mechanisms: critical resolved shear stress, strain hardening, Frank Read source of dislocation generation, Bauschinger effect, strain ageing. Strengthening mechanisms in metals. Basic principles of solidification and concept of critical radius. Phase diagrams: principles and types of phase diagrams, iron carbon equilibrium phase diagram, TTT and CCT diagrams: pearlitic, martensitic, and bainitic transformations. Various heat treatment processes and hardenability of steels. Hot working and cold working of metals. Recovery, recrystallization and grain growth phenomenon. Mechanical testing of metals: tensile test, compression test, hardness test, fatigue test, creep test, impact test; failure analysis. General classifications, properties and applications of different alloy systems steels: tool steels, stainless steels, cast irons, copper base alloys, aluminum base alloys, nickel base alloys. Introduction to composites, ceramics and polymers.

Texts:

[1] G. E. Dieter, Mechanical Metallurgy, McGraw Hill, 3rd Ed., 2013.
[2] W. D. Callister, Material Science and Engineering and Introduction, Wiley, 9th Ed.,2013.
[3] V. Raghavan, Materials Science and Engineering, Prentice Hall India, 6th Ed., 2015.

References:

[1] S. R. Askland and P.P. Phule, The Science and Engineering of Materials, 7th Ed., 2016.
[2] V. Singh, Physical Metallurgy, Standard Publishers, 2010.
[3] T.V. Rajan, C.P. Sharma and A. Sharma, Heat Treatments: Principles and Techniques, PHI, 2nd Ed., 2011.
[4] J. F. Shackelford and M.K. Muralidhara, Introduction of Materials Science for Engineers, Pearson, 6th Ed., 2006.
[5] W. F. Smith, Principles of Materials Science, McGraw Hill, 3rd Ed., 1996.
[6] Michael F. Ashby, Engineering Materials 1: An Introduction to Properties, Applications and Design, Elsevier, 4th Ed., 2011.