


MECHANICAL BEHAVIOUR OF MATERIALS (PART – I)

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PRE-REQUISITES : A course related to nature and properties of materials

INTENDED AUDIENCE : Undergraduate Students and first year graduate students of following discipline:

Materials Engineering, Mechanical Engineering, Metallurgical Engineering, Aerospace Engineering

INDUSTRIES APPLICABLE TO : Manufacturing Companies, Automobile companies

COURSE OUTLINE :
This course has a vast syllabus and hence it has been partitioned into two sections. At the end of both the sections of the course, students should be well conversant with theory of plasticity, theory of dislocations and its relation to various mechanical properties exhibited by various materials, viz. strength, fracture, fatigue and creep

ABOUT INSTRUCTOR :
Prof. Shashank Shekhar is an Associate Professor at IIT Kanpur. He joined IITK in 2010 and has since taught manufacturing related courses to 2nd year, 3rd year as well as 4th year UG students. His research interest lies in thermomechanical processing, particularly severe plastic deformation using techniques like machining and constrained groove pressing.

Prof. Sudhanshu Shekhar Singh is an assistant professor at IIT Kanpur. He joined IITK in December, 2015. He has taught courses related to manufacturing and mechanical behavior of materials to UG/PG students. His research interests are deformation behavior of materials at both large and small length scales, Laser processing of materials and Corrosion.

COURSE PLAN :

Week 1: Introduction, Origin of elasticity, Stress as a tensor, Transformation of stress, Principal stresses,
Week 2: Mohr's circle, Stress-strain relationships in isotropic and anisotropic materials
Week 3: Viscoelasticity, Tensile testing, Universal testing machines
Week 4: Flow stress, Yield criterion: Tresca, von-Mises, Effective stress, Effective strain
Week 5: Plastic instability, Effect of strain Rate and temperature, Dislocations: discovery and fundamentals
Week 6: Dislocations: characteristics, stress and strain fields of dislocations, Energy of dislocations, Dislocation motion: glide
Week 7: Dislocation motion: Cross-slip and climb, steps in dislocations, slip systems, More on slip systems
Week 8: Critical resolved shear stress, Dislocation interactions, Image forces, Partial dislocations
Week 9: Strengthening mechanisms: Precipitation strengthening: basic Criteria, precipitate characteristics, mechanisms, effect of temperature; Dispersion Strengthening
Week 10: Solid solution strengthening: Interaction with dislocations, Yield point phenomenon; Grain boundary strengthening
Week 11: Strain hardening: Single crystal and poly crystal deformation, Taylor hardening, Dislocation multiplication, Intersection and locks, Summary of strengthening mechanisms
Week 12: Hardness testing, Impact testing, Mechanical behavior of composites