


MECHANICAL BEHAVIOUR OF MATERIALS (PART – I)

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TYPE OF COURSE : New | Core | UG
COURSE DURATION : 12 Weeks (24 Jan' 22 - 15 Apr' 22)
EXAM DATE : April 23, 2022

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**:** Elastic constants (atomistic origin), State of stress in 2D/3D, Transformation of stress, Principal stresses

Week 2**:** Mohr Circle, Stress-strain relationships in isotropic and anisotropic materials

Week 3**:** Viscoelasticity, Tensile test

Week 4**:** Other tests for Plasticity (Compression, Torsion, Bend testing, Hardness and measurement)

Week 5**:** Yield criteria, Effective Stress and Effective Strain

Week 6**:** Theoretical Strength, Concept of Dislocations, Concept of Slip, Burger Vector and its properties, Stress and Strain fields of Dislocations

Week 7**:** Energy of Dislocations, Forces on dislocation, Line tension, Motion of Dislocations, Peierls Model, Concept of slip systems

Week 8**:** Single crystal slip (critical resolved shear stress - CRSS), Dislocations in FCC and partial dislocations, Stacking faults and energy

Week 9**:** Dislocation in other crystal systems, Source of dislocations and multiplication

Week 10**:** Strengthening mechanisms (Strain hardening, Solid Solution Strengthening)

Week 11**:** Strengthening mechanisms (Precipitation and Dispersion Strengthening)

Week 12**:** Strengthening Mechanism (Grain Boundary and Hall-Petch relation, Martensitic Strengthening)