SOLID MECHANICS

PROF. AJEET KUMAR
Department of Mechanical Engineering
IIT Delhi

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks [illegible]
EXAM DATE : [illegible]

PRE-REQUISITES : 1st year engineering mechanics

INTENDED AUDIENCE : Undergraduate students

COURSE OUTLINE :
Course, in this deformation of solid bodies and the underlying concepts are introduced to under graduate students.The course begins by building solid foundation of the concept of Stress and Strain in Three-dimensional Deformable Bodies. It further uses these concepts to study extension, torsion and bending of beams. The one-dimensional theory of beams are also introduced. We also discuss various theories of failure which are critical for design of machine elements in industry.

ABOUT INSTRUCTOR :
Prof. Ajeet Kumar is currently working as an Associate Professor in the Department of Applied Mechanics at IIT Delhi. He received his PhD from the Department of Theoretical & Applied Mechanics at Cornell University. He primarily works in the field of solid mechanics. His key topics of research are: Theory of continuum and nano rods, Finite deformation elastoplasticity, Computational Mechanics, Molecular modeling, Fluid-structure interaction, etc.

COURSE PLAN :

Week 1: Mathematical preliminaries and notation; Kinematics of deformation: rigid vs deforming solids; Lagrangian and Eulerian descriptions; Concept of Traction vector

Week 2: Stress tensor and its representation in Cartesian coordinate system; Transformation of stress matrix; Equations of equilibrium; Symmetry of stress tensor;

Week 3: State of stress in simple cases ; Principal stress components and principal planes; Maximizing shear component of traction at a point; Mohr's circle

Week 4: Stress invariants; Octahedral Plane; Decomposition of stress tensor; Concept of strain and strain tensor; Longitudinal, shear and volumetric strains;

Week 5: State of strain in simple cases; Strain compatibility condition; Local infinitesimal rotation; Linear stress-strain relation: isotropic and orthotropic cases; Relation between material constants;

Week 6: Stress and strain matrices in cylindrical coordinate system; Equations of equilibrium in cylindrical coordinate system, Axisymmetric deformations: Combined extension-torsion of a cylinder

Week 7: Spinning of circular shafts; shrunk-fit ptoblems; Pure bending of symmetric beams; Bending under transverse load: shear stress distribution

Week 8: Bending of beams having non-symmetrical cross-section; Shear center, Shear flow in thin and open cross-section beams

Week 9: Deflection of a beam: Euler Bernouli and Timoshenko beam models; Buckling of beams

Week 10: Reciprocal relations, Castigliano's theorem, Deflection of straight and curved beams using energy method

Week 11: Various theories of failure and their application

Week 12: Brief introduction to plasticity, Yield surface