

Introduction of deformation processes from the point of view of underlying physics. Stresses and Strain: stress and strain behavior of materials, plastic and tangent modulus, work hardening, plastic instability in tensile test, empirical stress-strain equations, effect of pressure, strain-rate and temperature, analysis of stress tensor, eigenvalues, decomposition into deviatoric and hydrostatic components, octahedral stresses, analysis of strain and strain rates, stress equilibrium and virtual work, objective stress rates. Plasticity: the criteria of yielding, isotropic and anisotropic hardening, rules of plastic flow, Levy-Mises and Prandtl Reuss equations, anisotropic flow rule, Hill's 1948 and 1979 yield criteria for anisotropic yielding. Upper bound theorem and its application in deformation processes like rolling, wire drawing, extrusion, forging. Lower bound theorem with a few applications. Slab method and its application in deformation process like symmetric/asymmetric rolling, forging, wire drawing and extrusion. Elastoplastic sheet bending. Analysis of autofrettage. Theory of slip line field and its application in metal forming. Heat transfer analysis in deformation processes with examples from rolling and friction stir welding/processing. Workability and dynamic materials model.

Texts/ References

1. U. S. Dixit and R. Ganesh Narayanan, Metal Forming: Technology and Process Modelling, McGraw Hill Education, New Delhi, 2013.
2. P. M. Dixit and U. S. Dixit, Modelling of Metal Forming and Machining Processes: By Finite Element and Soft Computing Methods, Springer, London, 2008.
3. W. F. Hosford and R. M. Caddell, Metal forming: mechanics and metallurgy, Cambridge University Press, London, 2011.
4. J. Chakrabarty, Theory of plasticity, Elsevier Butterworth-Heinemann Company, Singapore, 2006.
5. Y. V. R. K. Prasad and S. Sasidhara, Hot working guide: a compendium of processing maps, ASM International, Materials Park, OH, 1997.
6. B. L. Juneja, Fundamentals of metal forming processes, New Age International, New Delhi, 2007.