

ME 541 Continuum Mechanics (3-0-0-6)

Introduction to Tensors: Vectors and second order tensors; Tensor operation; Properties of tensors; Invariants, eigenvalues and eigenvectors of second order tensors; Tensor fields; Differentiation of tensors; Divergence, Stokes and Localization theorems.; Kinematics of Deformation: Continuum hypothesis; Deformation mapping; Material (Lagrangian) and Spatial (Eulerian) field descriptions; Length, area and volume elements in deformed configuration; Material and spatial time derivatives - velocity and acceleration; Linearized kinematics; Balance Laws: Conservation of mass; Balance of linear and angular momentum - Cauchy stress tensor, state of stress; Spatial and material forms of balance laws - concept of first and second Piola-Kirchoff stress tensors; Conservation of energy; Continuum Thermodynamics: Basic laws of thermodynamics; Energy equation; Entropy; Clausius-Duhem inequality. Constitutive Equations: Material frame-indifference; Objective stress and stress-rates; Material symmetry; Constitutive relations for Hyperelastic Solids, Generalized Hooke's law; Simple fluids; Navier-Stokes equation.

Texts/References

1. Jog, C. S., Continuum Mechanics: Foundations and Applications of Mechanics, Volume-I, Third edition, Cambridge-IISc Series, Cambridge university press, 2015.
2. Tadmor, E. B., Miller, R. E., and Elliot, R. S., Continuum Mechanics and Thermodynamics: From Fundamental Concepts to Governing Equations, Cambridge University Press, 2012.
3. Lai, W. M., Rubin, D., and Krempf, E., Introduction to Continuum Mechanics, Butterworth-Heinemann, 4th edition, 2015.
4. Bower, A. F., Applied Mechanics of Solids, CRC Press, 2010. Website: <http://solidmechanics.org/>
5. Rudnicki, J. W., Fundamentals of Continuum Mechanics, John Wiley & Sons, 2015.
6. Heinbockel, J. H., Introduction to Tensor Calculus and Continuum Mechanics, Trafford Publishing, 2001.
7. Gurtin, M., Fried, E. and Anand, L., The Mechanics and Thermodynamics of Continua, Cambridge University Press, 2013.
8. Mase, G. T., and Mase, G. E., Continuum Mechanics for Engineers, CRC Press, 2nd Edition, 1999.
9. Malvern, L. E., Introduction to the Mechanics of A Continuous Medium, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1969.
10. Jaunzemis, W., Continuum Mechanics, The Macmillan Company, New York, 1967.
11. Chadwick, P., Continuum Mechanics: Concise Theory and Problems, Dover Publications Inc., New York, 1999.
12. Chandrasekharaiah D. S., Debnath L., Continuum Mechanics, Academic press, 1994..