Tensor Analysis

Department: MATH
Course Number: 7586
Hours - Lecture: 3
Hours - Lab: 0
Hours - Recitation: 0
Hours - Total Credit: 3
Typical Scheduling: no regular schedule
Description:
Review of linear algebra, multilinear algebra, algebra of tensors, co- and cotravariant tensors, tensors in Riemann spaces, geometrical interp of skew tensors
Prerequisites:

Math 2403 and either Math 2406 or Math 4305

Course Text:

No text

Topic Outline:

- Algebraic Theory of Tensors with Application to the Understanding of Crystals: - Review of linear algebra, multilinear algebra, algebra of tensors, co- and contravariant tensors, tensors in Riemann spaces, geometrical interpretation of skew tensors
  - Applications:
    - Geometry of crystals, invariant tensors,
    - Dual basis, reciprocal lattice, x-ray crystallography
    - Applications to lattice geometry
- General Coordinates and Tensor Fields: - Vector-fields, tensor-fields, transformation of tensors, transformation of differential equations, gradient and Laplace operator in general coordinates
  - Applications:
    - Mechanics: D'Alembert principle and Lagrangian mechanics
    - Emphasis on co-variance of the Euler-Lagrange equations
    - Motion of a particle on surfaces and in the Schwarzschild metric
- Elasticity: Strain Tensor, Tensor of Elasticity, Motions in an Elastic Body, Elastic Moduli of Crystals
- Electromagnetism: Solution of Boundary Value Problems in Suitable Coordinates
- Differentiation and Integration of Tensors: - Transformation properties of the gradient, differentiation of skew tensors, covariant differentiation, divergence, curl and Stokes' theorem - Torsion tensor and curvature tensor as examples from geometry
  - Applications:
    - Electromagnetism: Field tensor, field energy tensor
- Fluid Dynamics: Conservation of Mass, Euler Equations, Conservation of Vorticity