

Continuum Mechanics - Web course

COURSE OUTLINE

The continuum mechanics clearly brings out the general principles that are common to both solid and fluid mechanics. This subject also discusses necessity for assumption of solid and fluid i.e., in the form of constitutive equations. Further, the frame work of continuum mechanics is useful for understanding elasticity, plasticity, viscoelasticity and viscoplasticity. The necessary Cartesian tensors to understand this subject are also discussed in this course. The topics covered in this course are:

1. Tensor algebra and calculus (only Cartesian tensors)
2. Application of basic principles of mechanics to continuous media
3. Constitutive equations

Linear elasticity and fluid mechanics

COURSE DETAIL

Sl. No.	Module/ Lecture Topics	No. of (Total) Hours`
1	Introduction	1
2	Vector space, Cauchy-Schwartz inequality, and Triangle inequality	1
3	Dot product, Cross product, Outer product, Kronecker delta, Permutation symbol	1
4	Definition of tensor, Summation convention, Free index, Dummy index	1
5	Examples to understand notations, Operations on second-order tensors (SOT)	1
6	Cofactor tensor, Invariants of SOT, Inverse of SOT	1
7	Eigenvalues and Eigenvectors, Geometric interpretation of eigenvectors, Cayley-Hamilton theorem	1
8	Skew-symmetric, Orthogonal, and Symmetric tensors	5
9	Additive decomposition, Polar decomposition, Square root tensor	1



NP-TEL

NPTEL

<http://nptel.iitm.ac.in>

Mechanical Engineering

Pre-requisites:

Basic linear algebra is advantageous, but not necessary

Additional Reading:

1. Truesdell, C.A., A first course in rational continuum mechanics, Volume I, 1991, Academic Press, Inc.
2. Truesdell, C.A., and Noll, W., The non-linear field theories of mechanics, 1977, Springer-verlag.
3. Liu, I-Shih., Continuum Mechanics, 2002, Springer.

Coordinators:

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10	Calculus of tensors		5
11	Kinematics	Mapping function, Deformation gradient, Length, Area, and Volume	7
		Material and spatial description	
		Rate of deformation, Spin tensors, Strain tensors, Rigid transformation	
12	Leibniz rule of integration, Transport theorems		1
13	Cauchy hypothesis and Cauchy theorem, Equation of motion		1
14	Angular momentum balance		1
15	Equation of motion in material coordinates, Piola-Kirchhoff stress tensor		1
16	Energy balance		1
17	Second law of thermodynamics		1
18	Principle of material frame-indifference		1
19	Constitutive equations		2
20	Linear elasticity		3
21	Fluid mechanics		3
	Total Hours		40

References:

1. Jog, C.S., Foundations and applications of mechanics: Volume I: Continuum mechanics, 2007, Narosa Publishing House.
2. Malvern, L.E., Introduction to the mechanics of continuous medium, 1969, Printice-Hall, Inc.
3. Gurtin, M.E., An introduction to continuum mechanics, 1981, Academic press, Inc.