Course Type	Course Code	Name of the Course	L	T	P	Credit
DE	NMED546	Mechanics of Continuous Media	3	0	0	3

Course Objective

This course will provide the students with a rigorous foundation in the mathematical and physical principles of continuous media, so that they can use tensor calculus and fundamental conservation laws to formulate and solve complex boundary value problems in linear elastic, hyperelastic, viscoelastic, and plastic behaviours.

Learning Outcomes

After completing the course, students will be able to:

- Evaluate finite and infinitesimal strain measures, and perform polar decompositions.
- Derive governing field equations of motion using conservation laws and appropriate stress tensors.
- Develop constitutive laws for linear elastic, hyperelastic, and plastic solid materials.
- Evaluate time-dependent material responses using viscoelastic constitutive model.

Unit No.	Topics	Lecture Hours	Learning Outcome
1.	**Tensor algebra:** Scalar, Vector, second and higher order Tensors, Eigen values & vectors, Transformation of Tensors, Tensor valued functions, Gradient operators and Integral theorems.	7	The students will be familiarized with the index notation and tensor algebra which will be extensively used in continuum mechanics.
2.	**Kinematics:** References and deformations configurations, Mapping and deformation gradients, material and spatial representations, Nanson's formula, Strain measures, Rotation & stretch tensors, Rate of deformation.	8	The students will learn how to describe the motion of particles in the deformed and undeformed coordinate system, understand the deformation of the material and strain developed within it without looking at the forces causing them.
3.	**Kinetics:** Concept of stress, Cauchy's stress theorem, first and second Piola-Kirchoff's & Cauchy's stress tensors, Normal and shear stress, Stress states.	7	The students will grasp the concepts of quantifying internal forces within a continuous medium (both in deformed and undeformed configurations).
4.	**Balance Principles:** Mass conservation, Reynold's transport theorem, Momentum and energy balances in references and current configuration, Weak and strong forms of balance equation, Continuum thermodynamics, Clausius-Duhem inequality, Frame	10	The students will learn to apply fundamental laws of physics to a continuous medium.

	dependent and independent quantities, Objective rates.		
5.	**Constitutive Modeling:** Constitutive equations for Hyperelastic material, Metal plasticity: Yield criteria, Flow rule, Hardening rule, Kuhn Tucker Criteria, Continuum Damage Mechanics: Void growth, degradation of elasticity tensor, Viscoelasticity: Rheological models multiplicative strain decomposition.	10	The students will be exposed to modeling material behavior by linking stress to strain or strain rate, under plastic and rate-dependent behavior of materials.
Total		**42**	

Textbooks

1. Nonlinear Solid Mechanics: A Continuum Approach for Engineering, G. A. Holzaphel, John Wiley & Sons Publication, 2000.

2. Fundamentals of Continuum Mechanics, S. E. Bechtel and R. L. Lowe, Elsevier Publication, 2015.

Reference Books

1. Introduction to Continuum Mechanics, W. M. Lai, D. Rubin, & E. Krempl, 4th Edition, Butterworth-Heinemann, 2010.

2. Continuum Mechanics, A. J. M. Spencer, Dover Publications, 2004.

3. An Introduction to Continuum Mechanics, M. E. Gurtin, Elsevier Publication, 2005.

4. Applied Mechanics of Solids, A. F. Bower, CRC Press, 2010.