Course Title: Theory of Elasticity	**Number of Units:** 1
SSD : ICAR08	**CFU:** 9

Course aims: The basic concepts and the operative use of the finite element method in solving problems of linear elasticity by employing professional software is the main objective of the course. Practical applications are illustrated with reference to framed structures and more complex structural models such as membranes, plates and tridimensional solids. Modeling approaches and validation techniques of numerical results are discussed. .

Course Description: Thermodynamics: Course Description Basic vector and tensor calculus: the index notation. Specialization of Continuum Mechanics equations to linear elastic solids: compatibility, equilibrium, linear elastic constitutive behavior.Weak and strong forms for structural problems: the principle of virtual displacements - theoretical formulation and mechanical interpretation.Equations of elastic equilibrium of mono-, bi- and tri-dimensional elements.Modeling of structural problems by finite element analysis: modeling of geometry (meshing), material, loads and restraints. Solving procedures and rendering of results by professional software.Domain discretization. Displacement field discretization. Procedures for assigning shape function and relevant properties. Formulation of finite element formulation in local reference frames. Iso- and Ipo-parametric transformations. Element distorsion and shape ratios. Numeric integrations: Gauss quadrature. Load and mass vectors. Assemblage of equations and assignment of restraints. Evaluation of support reactions. The finite element method applied to stratic analisys of: Trusses: modeling of a metal space truss roof.
Framed structures: modeling of a bycicle frame.Membranes. 2D tringular and quadrilateral elements, axial-symmetric, plane stress and plane stress state: modeling of a rotor of a micro-engine.Tridimensional (3D) structures: tetrahedral and esahedral elements.Modeling techniques: mesh density and element distorsion. Compatibility between meshes with several element formulations: transition elements.
Assignment of symmetry conditions (plane, spherical, axial, cyclic).
Modeling of ofsets, restraints (global and local), nodes shareb by elements with different formulation.Advanced problems of finite element analysis: the pach test, locking problems, subintegration and hourglassing.

Assumed Background: Tensor calculus and Continuum Mechanics

Assessment methods: illustration of the developed finite element models, oral exam