Syllabus

Course Description

Course Title	Finite Element Analysis (FEA)
Course Code	47556
Course Title Additional	
Scientific-Disciplinary Sector	ING-IND/14
Language	English
Degree Course	Master in Industrial Mechanical Engineering
Other Degree Courses (Loaned)	
Lecturers	Prof. Franco Concli, Franco.Concli@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/34279
Teaching Assistant	
Semester	Second semester
Course Year/s	1
CP	5
Teaching Hours	28
Lab Hours	18
Individual Study Hours	79
Planned Office Hours	
Contents Summary	The course introduces the theoretical background of the Finite Element Method in order to promote a critical and aware approach to its application in in machine design. It also provides exposure practical design cases to encourage understanding of the broader implications of design. The course introduces the finite element method (FEM) for the analysis of solid structural problems. The background of the finite element method and its solution procedures for linear analysis will be provided and the different type of elements will be introduced.
Course Topics	• Introduction to FEM: the method of displacements applied to

	FEM • Formal Procedure For FEM: discretization, Shape functions, displacement, strain, stress, stiffness matrix, solution, recovery of results. • Bar, Simple Beam, 2D and 3D Beam Element. Property and limitations of beam elements • Plane Elements, Plane stress and plane strain, linear and quadratic triangular and quadrilateral elements. Properties and limitations of plane elements • Isoparametric elements. Properties, limitations • Solid Elements, linear and quadratic tet and hex elements. Solid of Revolution. Properties, limitations. • Theory of Plates and Shells. Finite elements for plates and shells • Theory of composite laminate materials. Orthotropy. Finite elements for orthotropic laminated composite materials Nonlinear analyses, contact analysis, large deformation analysis, modal analysis and structural instability analysis will also be addressed. Beside the theoretical part, students will apply the above-mentioned approaches to some simple benchmark at the beginning and to the design of real mechanical components and systems then In particular a practical case study will be developed by the students in the application part and a report will be issued. The report will be object of discussion in the oral exam.
Keywords	FEA
Recommended Prerequisites	None.
Propaedeutic Courses	
Teaching Format	Frontal lectures, exercises, labs, projects, etc.
Mandatory Attendance	Recommended
Specific Educational Objectives and Learning Outcomes	Intended Learning Outcomes (ILO) By the end of the course, students should be able to: Knowledge and understanding: 1. Know the theoretical bases of the Finite Element Method for the solution of structural problems

	Applying knowledge and understanding: Know how to apply FEA to practical design cases in the field of stress analysis for machine design. Making judgements: 3. Critically analyze the results of FEA simulation, discuss their accuracy, on the basis of the mesh and elements properties 4. Define a FEM model with a tradeoff between the accuracy and the computational effort Communication skills: 5. Prepare a technical report describing the design application, expose and discuss it at the oral exam Ability to learn: 6. Ability to autonomously extend the knowledge acquired.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	- Formative assessment: In class exercises: 9x120 minutes; ILOs assessed: 2, 3, 4; - Summative assessment: 50% written exam questions; ILOs assessed: 1, 2. 50% report and oral discussion; Quality of the technical report (30%), correctness of the results (20%) Orla discussion (50%); ILOs assessed: 3,4, 5, 6.
Evaluation Criteria	The final mark will be obtained combining the evaluations of the l written test and of the oral examination.
Required Readings	Lecture notes and documents for exercise will be available on OLE.
Supplementary Readings	Olek C Zienkiewicz, Robert L Taylor, J.Z. Zhu, The Finite Element Method: Its Basis and Fundamentals, Seventh Edition (ENG) Robert D. Cook, Finite Element modeling for stress analysis, L Wiley & Sons, 1995 (ENG)
Further Information	

Sustainable Development Goals (SDGs)	Industry, innovation and infrastructure, Quality education