Syllabus
Course description

Course title	Advanced Topics on Machine Design I – Materials behavior and machine elements II – Finite Element Method (FEM)
Course code	47503
Scientific sector	ING-IND/14
Degree	Master in Mechanical Engineering and Industrial Management
Semester	2 and 3
Year	*I and II*
Academic year	2017/18
Credits	10 (5+5)
Modular	*Yes*

Total lecturing hours	60 (32 + 28)
Total lab hours	
Total exercise hours	30 (12 + 18)
Attendance	
Prerequisites	
Course page	https://next.unibz.it/en/faculties/sciencetechnology/master-industrial-mechanical-engineering/course-offering/

Specific educational objectives	The course aims to introduce the design mindset and the main methods for the design of mechanical systems, to provide exposure to the practice of design through application and to encourage understanding of the broader implications of design.

Module 1	**Materials behavior and machine elements**
Lecturer	Franco Concli, franco.concli@unibz.it
Scientific sector of the lecturer	ING-IND/14
Teaching language	English
Office hours	15 - By appointment
Teaching assistant *(if any)*	-
Office hours	-

List of topics covered	The course covers the following main topics:
	
	1. Principle of virtual work
	2. Shafts and shaft components
	    a. Interference fits (hub and key)
	    b. Deflections
	    c. Natural frequencies
	    d. Hyperstatic structures

	3. Gears

	a. Failure modes (bending - pitting - micro pitting - scuffing)
	    b. Gear types (spur - helical - bevel - worm)
	    c. Gear configurations (parallel axis, orthogonal axis, planetary)
	    d. Sintetic factors (sizing)
	    e. Strenght calculation (ISO 6336)
	    f. Gear efficiency (Power losses)
	    g. Gear stiffness (Deformation under load)
	    h. Examples of gearboxes (motorcycle and car transmissions)
	4. Bearings (journal beraing)
	5. Bolted connections (screwed joints)
	6. Belts (flat - V - ropes)
	7. Welded connections
	8. Pressure vessels
	9. Internal combustion engine parts (cylinder - piston - piston ring - connecting rod - crankshaft)

Teaching format	Frontal lectures, exercises (Exercises, case studies and computer lab), excursions

Module 2	**Finite Element Method (FEM)**
Lecturer	Prof. Carlo Gorla; carlo.gorla@unibz.it
Scientific sector of the lecturer	ING-IND/14
Teaching language	English
Office hours	15 - by appointment
Teaching assistant *(if any)*	no
Office hours	-
List of topics covered	The second module of 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 and nonlinear analyses, contact analysis, large deformation analysis, modal analysis and structural instability analysis will be presented. Beside the theoretical part, students will apply the above-mentioned approaches to the design of real mechanical component such as those presented in the first module (shafts, slider and rolling-elements bearings, springs, threaded fasteners, power transmission and gears, pressure vessels, welded connections, internal combustion engine parts) and more complex systems for which an analytical approach is not available.
Teaching format	Frontal lectures, exercises (Exercises, case studies and

	computer lab), excursions

Learning outcomes	By the end of the course, students should: - be able to apply the analysis methods to mechanical components and to design the main mechanical systems. - be able to choose the geometry and materials so to satisfy the requirements of each component in terms of strength - be able to make reasonable assumptions when data are missing - be able to make a critical evaluation between different designs solutions - be able to develop entire projects

Assessment	Coursework will be weighted as follows: final written test dealing with a simple design of a structural problem (50%) and, if successful, an oral examination (50%).
Assessment language	English
Evaluation criteria and criteria for awarding marks	The final mark will be obtained combining the evaluations of the final written test and of the oral examination.

Required readings	Lecture notes and documents for exercise will be available on the reserve collections
Supplementary readings	**Module 1** R.S.KHURMI AND J.K. GUPTA, A Textbook of Machine Design, S Chand **(ENG)** Shigley's Mechanical Engineering Design, McGraw-Hill **(ENG)** G. NIEMANN, H. WINTER, Maschinenelemente, Springer **(GER)** P. DAVOLI, M. FILIPPINI, C. GORLA, A. LO CONTE, Lezioni sugli organi di macchine, Politecnica **(ITA)** **Module 2** Olek C Zienkiewicz, Robert L Taylor, J.Z. Zhu, The Finite Element Method: Its Basis and Fundamentals, Seventh Edition **(ENG)** Bernd Klein, Grundlagen und Anwendungen der Finite-Element-Methode im Maschinen- und Fahrzeugbau,

	Springer Verlag **(GER)**
	Giovanni Belingardi , Il metodo degli elementi finiti nella progettazione meccanica, Levrotto&Bella **(ITA)**