Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Advanced Topics on Machine Design *Materials behavior and machine elements*
Course code	47555
Scientific sector	ING-IND/14
Degree	**Master in Industrial Mechanical Engineering**
Semester	2
Year	I
Academic year	2025/26
Credits	5
Modular	No

Total lecturing hours	32
Total lab hours	
Total exercise hours	12
Attendance	
Prerequisites	Machine Design
Course page	https://www.unibz.it/en/faculties/engineering/master-industrial-mechanical-engineering/course-offering/?academicYear=2025

Specific educational objectives	The course aims to introduce the design mind-set 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. Students will learn, in the first module, fundamental concepts and methodologies for understanding and modelling mechanical systems. In the second module, the theory of numerical finite element methods is introduced. Emphasis is given to practical applications, especially considering the advantages achievable with the latest technologies.

Module 1	Materials behavior and machine elements
Lecturer	Prof. Franco Concli E-mail: franco.concli@unibz.it Ph.: 0471017748
Scientific sector of the lecturer	ING-IND/14
Teaching language	English
Office hours	By appointment
Teaching assistant *(if any)*	no
Office hours	15
List of topics covered	The module will cover:

	PART 1: Material behavior and basic concepts 1. Principle of virtual work 2. Force Method for the solution of Hyperstatic Structures 3. Multi-axial fatigue criteria a. Critical plane concepts 4. Low cycle fatigue of materials a. Masing Hp. b. Ramberg-Osgood eq. c. Neuber Hp. d. Basquin-Coffin-Manson eq. e. Loading spectra **PART 2: Machine Elements** 5. Shafts and shaft components a. Interference fits (shaft-hub connection) b. Deflections 6. 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. Synthetic factors (sizing) e. Strength calculation (ISO 6336) f. Gear stiffness (Deformation under load) g. Examples of gearboxes (motorcycle and car transmissions) 7. Bolted connections (screwed joints) a. Pretension b. Tearing c. Sheet yielding 8. Welded connections a. Pressure vessel
Teaching format	The topics are presented by the professor by means of Power Point presentations or the blackboard. A selection of the material presented in class as well as online resources and useful material will be available in the OLE database/. Further deepening material will be supplied or recommended by the teacher.

Learning outcomes	Knowledge and understanding *1)* Handle the analysis methods used in structural

	design of mechanical systems. Applying knowledge and understanding 2) Know how to face a new project of a mechanical system starting from its functional design. Making judgements 3) Identify the critical zones and the corresponding stress states of all components of a mechanical system, under service loading conditions. 4) Choose the geometry and materials able to satisfy the requirements of each component in terms of strength, deformation, fatigue life, and so on and realize the technical drawing of the system. Communication skills: 5) Oral communication skills (technical language) Learning skills 6) Ability to autonomously extend the knowledge acquired
Assessment	**Formative assessment** *In class and exercises and activities (2,3,4)* **Summative assessment** *The assessment of the course is:* • *Written exam* 3/4 exercises • *Oral Exam* Open-ended questions - Theoretical knowledge (40%) - Ability to provide examples/applications of the theoretical concepts (30%) - Ability to establish relationships between topics (20%) - Mastery of language (also with respect to teaching language) (10%)
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

	There is no single textbook that covers the entire course. The course material is collected from various sources that will be announced during the course. A selection of the material presented in class and useful material will be available in the course reserve collection database
Supplementary readings	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. HAEFELE, L. ISSLER, H. RUOSS, fertigkeitslehre – Grundlagen, Springer (GER) P. DAVOLI, M. FILIPPINI, C. GORLA, A. LO CONTE, Lezioni sugli organi di macchine, Politecnica (ITA) P. DAVOLI, A. BERNCASCONI, M. FILIPPINI, S. FOLETTI, Comportamento meccanico dei materiali, McGraw-Hill (ITA)