Syllabus

Course Description

Course Title	Materials science and structural mechanics
Course Code	42175
Course Title Additional	
Scientific-Disciplinary Sector	
Language	German; Italian
Degree Course	Bachelor in Industrial and Mechanical Engineering
Other Degree Courses (Loaned)	
Lecturers	Prof. Stefano Rossi, Stefano.Rossi@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/1075 Dott. Thomas Franz Xaver Moosbrugger, ThomasFranzXaver.Moosbrugger@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/42499
Teaching Assistant	
Semester	First semester
Course Year/s	2
CP	12
Teaching Hours	76
Lab Hours	39
Individual Study Hours	185
Planned Office Hours	36
Contents Summary	Module I: The course will cover the fundamental aspects of different types of materials. Emphasis will be placed on engineering properties, particularly mechanical properties, highlighting the influence of microstructure. The production processes of materials and subsequent manufacturing techniques used to obtain finished components will also be illustrated.

	Module II: Structural Mechanics: The basic concepts of mechanics are covered. In particular, the following topics are addressed: equilibrium in a plane, fundamentals of modeling various structural elements, basic formulations for structural elements subjected to compression, tension, and bending.
Course Topics	Module I: - Introduction: the materials and their use in the industrial production. - Technological properties of materials: different type of materials and their typical properties; - correlation between microstructure and mechanical properties; - basis of thermodynamics and equilibrium diagrams. - Metals: - characteristics and properties of iron alloys (steel and cast iron), - non ferreous metals. - Ceramics and glasses: - the production and utilization of ceramic materials; - the characteristics of glass; the production of glass components. - Polymers: production and properties of polymeric materials; - production of components in polymeric matter; utilization of polymers. - The composite materials: production, properties, utilization of composite materials. Testing standard about of materials. Module II: 1. Core topics of the course (fundamental for the learning objectives and cultural project) • Equilibrium of forces with a common point of application, and of rigid bodies • Determination of support reactions and internal forces • Centre of forces, mass, and gravity • Elementary theory of tension/compression, bending, and torsion • Stresses, stress resultants, strains, and Hooke's law 2. Complementary topics of the course • Buckling • Basic energy methods in statics and elastostatics

	• Kinematical and statical determinacy • Coulomb theory of friction, and belt friction • Thin-walled pressure vessels.
Keywords	Materials, Microstructure, Properties, structural mechanics, statics, structural elements
Recommended Prerequisites	None
Propaedeutic Courses	
Teaching Format	Frontal lectures, exercises.
Mandatory Attendance	Recommended.
Specific Educational Objectives and Learning Outcomes	The specific educational objectives include the understanding and knowledge of the fundamentals of material science and structural mechanics. The students will learn mechanical properties of engineering materials and structural elements and how they may be analyzed. This includes modelling abstractions, solution methods and the interpretation of results of relevant engineering mechanics problems. Module I Material Science and Technology: Knowledge and understanding: 1. Knowledge and understanding of the different properties of materials and different technologies and production processes. Applying knowledge and understanding: 2. Applying knowledge and understanding through the development of skills and the ability to choose the suitable materials and the technology for a particular industrial product. In addition, the students should develop the ability to apply the knowledge on the behavior of materials in the performance of laboratory technological tests. Making judgments 3. Connect the properties of different materials with their microstructure; capacity to evaluate the experimental data obtained in laboratory tests. Communication skills 4. Communication skills to present the acquired knowledge with their own lexicon of the discipline and to be able to prepare a technical report about materials tests. Ability to learn 5. Acquire skills to deepen the topics covered during the course in order to apply them to simple practical cases.

	6. Acquire the ability to interpret experimental test data obtained in material characterization tests. Module II Mechanics of structures: Knowledge and understanding: 7. Knowledge and understanding of the fundamentals of structural mechanics. Applying knowledge and understanding: 8. Applying theoretical methods to analyze engineering structures and structural systems. Making judgments: 9. Analyzing structural engineering devices/systems requires a deep understanding and the ability to show judgment regarding methods, results and designs. Communication skills: 10. Communication skills to convey and transfer structural mechanics knowledge. 11. Communication skills to interpret results of structural mechanics analyses and their consequences with respect to design. Ability to learn: 12. Learning skills to study independently the large and complex field of structural mechanics for specific applications beyond this lecture.
Specific Educational Objectives and Learning Outcomes (additional info.)	By the end of the course, students are expected to have acquired a fundamental understanding of materials science and technology, particularly of mechanical properties and their correlation with microstructure. They should also have a basic knowledge of the mechanical behavior of structures. As a result, students should be able to identify the most suitable materials and processing technologies for a given design problem and to perform basic component sizing and selection.
Assessment	Module I: Material Science and Technology: Written exam with open questions and exercises (5/6 in number) aimed at verifying the acquisition of the concepts and topics illustrated during the course and the ability to put them into practice. Exam duration: 2 hoursm, ILO: 1-6. Module II: Mechanics of structures:

	The examination of the course will be an oral examination consisting of two parts. i) a short preparation of two different problems with presentation; ii) discussions of a theoretical problem in a small group to evaluate the students' understanding. Formative assessment: Oral exam in groups*): duration 2 - 4 students, 1 hour; ILO: 7-12. *)Oral exam in groups (2-4 Students, 1 hour): clarity of answers, mastery of language (also with respect to teaching language), ability to summarize, evaluate, and establish relationships between topics.
Evaluation Criteria	Module I, ILO: 1-6: Material Science and Technology: Written exam Theoretical knowledge of the subject (40%). Ability to link different topics highlighting the similar peculiarities and characteristics (30%). Ability to apply the concepts relating to materials and production technologies, for examples of objects and products (20%). Mastery of technical language (10%). Module II, ILO: 7-12: Structural Mechanics: Oral examination (in German) will include derivations and numerical examples to evaluate the ability to solve structural-mechanics problems as well as comprehension questions. Theoretical knowledge (30%) Appropriate use of methods (30%) Ability to solve problems (30%) Appropriate use of units (10%) Final mark: 50% Module I Material Science and Technology 50% Module II Structural Mechanics Note: Students must pass both Modules in order to pass this course
Required Readings	Module I Material Science and Technology: Lectures notes. The slides, supplied during class, are a useful to follow the lectures and for the individual study. However, they are NOT sufficient for the successful exam preparation.

	Module II: Structural Mechanics: Personal transcript of the blackboard notes
Supplementary Readings	Module I Material Science and Technology: • William F. Smith “Scienza e Tecnologia dei Materiali” Mc Graw-Hill 2021 • A. Bugini, C. Giardini, R. Pacagnella, G. Restelli “Tecnologia Meccanica vol I, Lavorazioni per fusione e deformazione plastica” Città Studi Edizioni 1995 • A. Bugini, C. Giardini, R. Pacagnella, G. Restelli “Tecnologia Meccanica vol II, Lavorazioni per asportazione di truciolo” Città Studi Edizioni 1995 Module II: Structural Mechanics: • Gross, D., W. Hauger, J. Schröder, W. A. Wall, and J. Bonet (2011). Engineering mechanics 2: Mechanics of materials (1 ed.). Springer. • Gross, D., W. Hauger, J. Schröder, W. A. Wall, and N. Rajapakse (2013). Engineering mechanics 1: Statics (2 ed.). Springer.
Further Information	Software used: Module I Material Science and Technology: none Module II: Structural Mechanics: none
Sustainable Development Goals (SDGs)	Industry, innovation and infrastructure, Quality education

Course Module

Course Constituent Title	Materials Science and Technology
Course Code	42175A
Scientific-Disciplinary Sector	IMAT-01/A
Language	Italian
Lecturers	Prof. Stefano Rossi,

	Stefano.Rossi@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/1075
Teaching Assistant	
Semester	First semester
CP	6
Responsible Lecturer	
Teaching Hours	40
Lab Hours	15
Individual Study Hours	95
Planned Office Hours	18
Contents Summary	• Introduction: the materials and their use in the industrial production. • Technological properties of materials: different type of materials and their typical properties; • correlation between microstructure and mechanical properties; • basis of thermodynamics and equilibrium diagrams. • Metals: • characteristics and properties of iron alloys (steel and cast iron), • non ferreous metals. • Ceramics and glasses: • the production and utilization of ceramic materials; • the characteristics of glass; the production of glass components. • Polymers: production and properties of polymeric materials; • production of components in polymeric matter; utilization of polymers. • The composite materials: production, properties, utilization of composite materials. Testing standard about of materials.
Course Topics	The course will cover the fundamental aspects of different types of materials. Emphasis will be placed on engineering properties, particularly mechanical properties, highlighting the influence of

	microstructure. The production processes of materials and subsequent manufacturing techniques used to obtain finished components will also be illustrated.
Teaching Format	Frontal lectures, exercises.
Required Readings	Module I Material Science and Technology: Lectures notes. The slides, supplied during class, are a useful to follow the lectures and for the individual study. However, they are NOT sufficient for the successful exam preparation.
Supplementary Readings	Module I Material Science and Technology: • William F. Smith “Scienza e Tecnologia dei Materiali” Mc Graw-Hill 2021 • A. Bugini, C. Giardini, R. Pacagnella, G. Restelli “Tecnologia Meccanica vol I, Lavorazioni per fusione e deformazione plastica” Città Studi Edizioni 1995 A. Bugini, C. Giardini, R. Pacagnella, G. Restelli “Tecnologia Meccanica vol II, Lavorazioni per asportazione di truciolo” Città Studi Edizioni 1995

Course Module

Course Constituent Title	Mechanics of structures
Course Code	42175B
Scientific-Disciplinary Sector	CEAR-06/A
Language	German
Lecturers	Dott. Thomas Franz Xaver Moosbrugger, ThomasFranzXaver.Moosbrugger@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/42499
Teaching Assistant	
Semester	First semester
CP	6
Responsible Lecturer	
Teaching Hours	36

Lab Hours	24
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	1. Core topics of the course (fundamental for the learning objectives and cultural project) • Equilibrium of forces with a common point of application, and of rigid bodies • Determination of support reactions and internal forces • Centre of forces, mass, and gravity • Elementary theory of tension/compression, bending, and torsion • Stresses, stress resultants, strains, and Hooke's law 2. Complementary topics of the course • Buckling • Basic energy methods in statics and elastostatics • Kinematical and statical determinacy • Coulomb theory of friction, and belt friction^ • Thin-walled pressure vessels.
Course Topics	Module II: Structural Mechanics: The basic concepts of mechanics are covered. In particular, the following topics are addressed: equilibrium in a plane, fundamentals of modeling various structural elements, basic formulations for structural elements subjected to compression, tension, and bending.
Teaching Format	Frontal lectures, exercises.
Required Readings	Module II Mechanics of structures: Teaching materials in the form of the students' own notes on the lecturer's notes on the blackboard German: · Gross, D., W. Hauger, J. Schröder, and W. A. Wall (2013). Technische Mechanik 1: Statik (12 ed.). Springer · Gross, D., W. Hauger, J. Schröder, and W. A. Wall (2014). Technische Mechanik 2: Elastostatik (12 ed.). Springer. English: · Gross, D., W. Hauger, J. Schröder, W. A. Wall, and J. Bonet (2011). Engineering mechanics 2: Mechanics of materials (1 ed.).

	Springer. · Gross, D., W. Hauger, J. Schröder, W. A. Wall, and N. Rajapakse (2013). Engineering mechanics 1: Statics (2 ed.). Springer. Italian: • Curti, G. and F. Curà (2006). Fondamenti di meccanica strutturale. Clut. Further literature will be discussed during the lectures and exercises.
Supplementary Readings	Module II Mechanics of structures: Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it and Ilaria Miceli, Ilaria.Miceli@unibz.it