Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	**Material and Construction Sciences**
Course code	42147
Scientific sector	ICAR/08 – ING-IND/22
Degree	Bachelor in Industrial and Mechanical Engineering
Semester	I
Year	II
Academic year	2017/2018
Credits	12 (6+6)
Modular	*yes*

Total lecturing hours	72 (36+36)
Total lab hours	-
Total exercise hours	48 (24+24)
Attendance	Recommended
Prerequisites	None
Course page	https://next.unibz.it/en/faculties/sciencetechnology/bachelor-industrial-mechanical-engineering/course-offering/

Specific educational objectives	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 the materials and structural elements and how they are to be analyzed. This includes the mathematical modeling of a structural-mechanical problems, solving and understanding of the results.

Module 1	**Structural Mechanics**
Lecturer	Dr.-Ing. Erich Wehrle
Scientific sector of the lecturer	IND-ING/13
Teaching language	German
Office hours	18 h
Teaching assistant *(if any)*	N. N.
Office hours	See timetable online: www.unibz.it/en/timetable/ and by appointment
List of topics covered	**Part I: Stereostatics – the mechanics of rigid structures** • Statics of rigid bodes: ↘ Force, force systems • Centroids of volumes, surfaces and lines • Structure as a load-bearing assembly ↘ Structural elements ↘ Supports and links

- ↘ Statically determinant
- ↘ Superposition principle

- Statics of rigid bars
  - ↘ Analysis of single rigid bars
  - ↘ Analysis of rigid cables
  - ↘ Analysis of rigid trusses
- Statics of rigid beams
  - ↘ Analysis of single rigid beams
  - ↘ Analysis of rigid arches
  - ↘ Analysis of rigid frames
- Work and potential energy of rigid structures
  - ↘ Work and potential energy
  - ↘ Virtual displacement and virtual work
  - ↘ Principle of virtual work
- Friction
  - ↘ Static friction
  - ↘ Kinetic friction
  - ↘ Belt friction

Part II: Elastostatics – the mechanics of deformable structures

- Statics of elastic bodies
  - ↘ Stress
  - ↘ Strain
  - ↘ Mohr‘s circle
  - ↘ Principal axes and values
  - ↘ Material law
  - ↘ Strength hypotheses
- Statics of elastic bars
  - ↘ Stress, strain, material law
  - ↘ Thermal loading
  - ↘ Static determinance
  - ↘ Analysis of single elastic bars
  - ↘ Analysis of elastic trusses
- Statics of elastic beams
  - ↘ Stress, strain, material law
  - ↘ Assumptions of beam theory
  - ↘ Moment of inertia
  - ↘ Deflection of ordinary bending
  - ↘ Static determinance
  - ↘ Analysis of single elastic beams
  - ↘ Analysis of elastic frames
  - ↘ Torsion
  - ↘ Superposition of loads

Statics of surface structural elements

- Energy methods in elastostatics
  - ↘ Deformation energy
  - ↘ Methods of Maxwell, Castigliano und Menabrea
- Stability in elastostatics
  - ↘ Buckling of elastic beams

	↘ Euler's buckling cases
Teaching format	Frontal lectures, exercises

Module 2	**Material Science and Technology**
Lecturer	Stefano Rossi, room C4.02, stefano.rossi@unibz.it, and stefano.rossi@unitn.it, 0471-017092, https://www.unibz.it/it/faculties/sciencetechnology/academic-staff/person/1075-stefano-rossi
Scientific sector of the lecturer	ING-IND/22
Teaching language	Italian
Office hours	18 h - before classes and exercise
Teaching assistant (if any)	n.d.
Office hours	13:00 – 14:00
List of topics covered	In the course the followings topics about materials will be considered. **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), copper and aluminum alloys; alloys with high performances. The mechanical workability; thermal treatments. **Ceramics and glasses**: ceramics for building; the production and utilization of ceramic materials; materials for high temperatures; 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**: the use of standard in the classification and in the properties testing of materials.
Teaching format	Class lectures in which topics are presented by the teacher. The lecture topics will be arguments of exercises and practical activities explained by the teacher and the teaching assistants. Generally power point presentations will be used during the lectures, which could be supply to the students as track for the preparation of the final examination. The lessons will then be integrated with classroom exercises and exercises in laboratories by the teacher and by the teaching assistant. They will try to encourage students to independently perform some exercises as a self-learning test. The PowerPoint presentations will be given to students as material for the study track.

Learning outcomes	**Module I Structural Mechanics:** Knowledge and understanding: 1. Knowledge and understanding of the fundamentals of structural mechanics Applying knowledge and understanding: 2. Applying knowledge and understanding to analyze structures and structural systems. Making judgments: 3. The design of structures requires understanding and ability to make judgments on what design or concept should be used. Communication skills: 4. Communication skills to convey and transfer structural-mechanical understanding. 5. Communication skills to explain results of structural-mechanical analysis and their consequences to design Ability to learn: 6. Learning skills to study independently the large field of structural mechanics for specific applications beyond this lecture. **Module II 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. … to present the acquired skills with their own lexicon of the discipline and to be able to prepare a technical report about material tests. Ability to learn 5. … through the ownership of tools and instruments of knowledge acquisition and comprehension of technical information and update.

Assessment

Module I Structural Mechanics:
Formative assessment :

Form	Details	Learning outcomes assessed
In-class exercises	Continuously in exercise courses	1, 2, 3, 4, 5

Summative assessment:

Form	Length /duration	Learning outcomes assessed
Written exam	2 h	1, 2, 3, 4, 5

Module 2 Material Science and Technology:
Formative assessment:

Form	Length /duration	ILOs assessed
examination		

Summative assessment:

Form	Length /duration	ILOs assessed
Oral	20 min.	1,2,3,4,5

Assessment language

Module I Structural Mechanics: German
Module II Material Science and Technology: Italian

Evaluation criteria and criteria for awarding marks

Module I Structural Mechanics:
Written examination (in German) will include numerical examples to show ability to solve structural-mechanical problems as well as knowledge-based questions to show understanding of material.

Form	Evaluation criteria and weight

	Written exam — Theoretical knowledge (30%) Correctness of methods (30%) Correctness in solution (30%) Appropriate use of units (10%) Module II Material Science and Technology: 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%). Final mark: 50% Module I Structural Mechanics 50% Module II Material Science and Technology Note: Students must pass both modules in order to pass this course

Required readings	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 preparation of exam.
Supplementary readings	Module I Structural Mechanics: 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. Module II Material Science and Technology: • William F. Smith “Scienza e Tecnologia dei Materiali” Mc Graw-Hill 1995 • William F. Smith “Esercizi di Scienza e Tecnologia

	dei Materiali" Mc Graw-Hill 1995 • 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

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Attendance	Recommended
Prerequisites	None
Course page	https://next.unibz.it/en/faculties/sciencetechnology/bachelor-industrial-mechanical-engineering/course-offering/

Specific educational objectives	Understanding and knowledge of the fundamentals of structural mechanics. This includes the mathematical modeling of a structural-mechanical problem, solving and understanding of the results. This course is part of the CdS specifically in the disciplinary context related to technology. After the course the students could be the basic knowledge about the several materials typologies, which are used in industrial processes. The mechanical properties of the materials and the their workability could allow to the students to individuate the better material and the better technology applying an industrial production during the design process and production steps.

Modul 1	**Structural Mechanics**
Dozent	Dr.-Ing. Erich Wehrle
Wissenschaftlich-disziplinärer Bereich des Dozenten	IND-ING/13
Unterrichtssprache	Deutsch
Sprechzeiten	18 h
Wissenschaftlicher Mitarbeiter	
Sprechzeiten	

Auflistung der behandelten Themen	**Teil I: Stereostatik – die Mechanik starrer Strukturen** • Statik starrer Körper: ↘ Kraft, Kraftgruppen • Schwerpunkte von Volumen, Flächen und Linien • Struktur als Tragwerk ↘ Strukturelemente ↘ Lager und Gelenke ↘ Statische Bestimmtheit ↘ Überlagerungsprinzip • Statik starrer Stäbe ↘ Analyse einzelner starrer Stäbe ↘ Analyse starrer Seilen ↘ Analyse starrer Fachwerke • Statik starrer Balken ↘ Analyse einzelner starrer Balken ↘ Analyse starrer Bögen ↘ Analyse starrer Rahmen • Arbeit und potentielle Energie starrer Strukturen ↘ Arbeit und potentielle Energie ↘ Virtuelle Verrückung und virtuelle Arbeit ↘ Prinzip virtueller Arbeit • Reibung ↘ Haftreibung ↘ Gleitreibung ↘ Seilreibung **Teil II: Elastostatik – die Mechanik verformbarer Strukturen** • Statik elastischer Körper ↘ Spannung ↘ Verzerrung ↘ Mohr'scher Kreis ↘ Hauptachsen und -werte ↘ Stoffgesetz ↘ Fetigkeitshypothesen • Statik elastischer Stäbe ↘ Spannung, Dehnung, Stoffgesetz ↘ Wärmeausdehnung ↘ Statische Bestimmtheit ↘ Analyse einzelner elastischer Stäbe ↘ Analyse elastischer Fachwerke • Statik elastischer Balken ↘ Spannung, Dehnung, Stoffgesetz ↘ Annahmen der Balkentheorie ↘ Flächenträgheit ↘ Biegelinie einachsiger Biegung ↘ Statische Bestimmtheit ↘ Analyse einzelner elastischer Balken ↘ Analyse elastischer Rahmen

	↘ Torsion ↘ Überlagerte Belastungen • Statik flächeartiger Strukturelemente • Arbeitssatz in der Elastostatik ↘ Formänderungsenergie ↘ Sätze von Maxwell, Castigliano und Menabrea • Stabilität in der Elastostatik ↘ Knickung elastischer Balken ↘ Euler'sche Knickfälle
Unterrichtsform	Vorlesungen, Übungen

Modulo 2	**Scienza e Tecnologia dei materiali**
Docente	Stefano Rossi, room C4.02, stefano.rossi@unibz.it, e stefano.rossi@unitn.it, 0471-017092, https://www.unibz.it/it/faculties/sciencetechnology/academic-staff/person/1075-stefano-rossi
Settore scientifico disciplinare del docente	ING-IND/22
Lingua ufficiale del corso	Italiano
Orario di ricevimento	18 h - prima delle lezioni ed esercitazioni
Collaboratore didattico (se previsto)	n.d.
Orario di ricevimento	13:00 – 14:00
Lista degli argomenti trattati	Durante il corso verranno considerati i seguenti aspetti: **Introduzione**: i materiali e il loro utilizzo nei prodotti industriali **Le basi delle proprietà di interesse tecnologico dei materiali**: classi di materiali e loro proprietà caratterizzanti; relazioni generali fra microstruttura e proprietà; accenni di termodinamica delle trasformazioni di stato. Il comportamento meccanico dei diversi tipi di materiali. **I materiali metallici**: generalità sulle leghe ferrose; le leghe di rame ed alluminio; leghe speciali. Lavorazioni e trattamenti termici dei materiali metallici. **I materiali ceramici e vetro**: ceramici per l'edilizia, loro produzione ed utilizzo; ceramici refrattari. La produzione di componenti in vetro. **I materiali polimerici**: produzione e proprietà dei polimeri; lavorazione ed utilizzi dei materiali polimerici. **I materiali compositi**: produzione, proprietà ed utilizzi dei materiali compositi. **Le normative nel campo dei materiali**: come si leggono e come si utilizzano
Attività didattiche previste	Il corso si basa su lezioni frontali in aula tenute dal docente. Le lezioni verranno quindi integrate con esercizi in aula e esercitazioni in laboratorio tenute dal docente e dall'assistente didattico. Si cercherà di stimolare gli studenti a svolgere autonomamente alcuni esercizi e prove in modo da avere una valutazione dell'autoapprendimento.

	Generalmente si utilizzeranno presentazioni PowerPoint che verranno fornite agli studenti come materiale traccia per lo studio.

Learning outcomes	Knowledge and understanding 1. Knowledge and understanding of the fundamentals of structural mechanics Applying knowledge and understanding 2. Applying knowledge and understanding to analyze structures and structural systems. Making judgments 3. The design of structures requires understanding and ability to make judgments on what design or concept should be used. Communication skills 4. Communication skills to convey and transfer structural-mechanical understanding. 5. Communication skills to explain results of structural-mechanical analysis and their consequences to design Ability to learn 6. Learning skills to study independently the large field of structural mechanics for specific applications beyond this lecture. The learning outcomes need to refer to the Dublin Descriptors: 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 judgements 3. Connect the properties of different materials with their

	microstructure; capacity to evaluate the experimental data obtained in laboratory tests. Communication skills 4. ... to present the acquired skills with their own lexicon of the discipline and to be able to prepare a technical report about material tests. Ability to learn ... Ability to learn through the ownership of tools and instruments of knowledge acquisition and comprehension of technical information and update.

Assessment

For the module "Structural Mechanics":

Formative assessment

Form	Details	Learning outcomes assessed
In-class exercises	Continuously in exercise courses	1, 2, 3, 4, 5

Summative assessment

Form	Details	Learning outcomes assessed
Written exam	2 h	1, 2, 3, 4, 5

For the module "Material Science and Technology":

Formative assessment

Form	Length /duration	ILOs assessed

Summative assessment

Form	Length /duration	ILOs assessed
Oral examination	20 min.	1,2,3,4,5,

Assessment language

For the module "Structural Mechanics": German
For the module "Material Science and Technology": Italian

Evaluation criteria and criteria for awarding marks

For the module "Structural Mechanics":

Written examination will include numerical examples to

show ability to solve structural-mechanical problems as well as knowledge-based questions to show understanding of material.

Form	Evaluation criteria and weight
Written exams	Theoretical knowledge (30%) Correctness of methods (30%) Correctness in solution (30%) Appropriate use of units (10%)

For the module "Material Science and Technology":

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%).

Final mark:
50% Module I Structural Mechanics
50% Module II Material Science and Technology
Note: Students must pass both modules in order to pass this course

Required readings	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 preparation of exam.
Supplementary readings	For the module "Structural Mechanics": 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. <u>For the module "Material Science and Technology":</u> - William F. Smith "Scienza e Tecnologia dei Materiali" Mc Graw-Hill 1995 - William F. Smith "Esercizi di Scienza e Tecnologia dei Materiali" Mc Graw-Hill 1995 - 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