Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Mechanics and Structural Design for Energy Engineering
Course code	45502
Scientific sector	ICAR/08 (Module 1) "Structural Mechanics" ICAR/09 (Module 2) "Structural Engineering"
Degree	Master Energy Engineering
Semester	1
Year	2
Academic year	2021/2022
Credits	6
Modular	Yes

Total lecturing hours	60
Total lab and exercise hours	0
Attendance	Not mandatory
Recommended preliminary knowledge	For a fruitful attending of the course basic knowledge of solid and structural mechanics is needed.
Connections with other courses	This course complements the knowledge offered by the other courses of the Master programme.
Course page	

Specific educational objectives	The course investigates good practice in the design of steel structures, presenting requirements, standards and methodologies that have to be followed in order to design efficient yet reliable structures. The students attending this course are expected to learn how to design key components in steel structures to be implemented in systems for energy applications, including wind energy, hydraulic energy, solar energy and bioenergy and relevant industrial plants.

Module 1	**Fundamental of Structural Mechanics**
Lecturers	Dr. Maria Pantano and Prof. Oreste S. Bursi
Scientific sector of the lecturer	ICAR/08
Teaching language	English
Office hours	Appointment by email
Teaching assistant *(if any)*	-
Office hours	-
List of topics covered	**Part I: Overview** – 2 hours, Oreste S. Bursi Overview on the applications and benefits of steel and steel structures in energy engineering systems.

	Examples related to wind energy, hydraulic energy, solar energy and bioenergy and relevant industrial plants. Applications and benefits of steel and steel structures in Energy Engineering. **Part II: Material and Analysis** – 28 hours, Maria Pantano Mechanical properties of materials with particular emphasis on steel and concrete. Standards for the design of steel structures according to European rules. Plasticity. Elements of structural dynamics and fatigue. Exercises with theory applications.
Professional applications of the covered topics	The topics presented in this course can be applied in all those professional activities involving the design and the re-design of building systems, as well as specific elements of energy structural systems, that are typically performed in engineering offices and building companies.
Teaching format	Class lectures (blackboard and/or slides). Some of the lecture material (slides) will be available for download by the students.

Module 2	**Fundamental of Structural Design**
Lecturers	Prof. Oreste S. Bursi and Prof. Nicola Tondini
Scientific sector of the lecturer	ICAR/09
Teaching language	English
Office hours	Appointment by email
Teaching assistant *(if any)*	-
Office hours	Appointment by email
List of topics covered	**Part I: Modern standards and analysis methods** – 8 hours, Oreste S. Bursi Design based on modern national and European standards. Global analysis of structures. Stiffness and strength of elements. **Part II: Design of steel structures** – 16 hours, Nicola Tondini Effect of geometrical and mechanical imperfections on the load-bearing capacity of steel elements. Resistance of steel members to tension, compression, bending, shear and combined actions. Buckling resistance of steel members. Stability of steel shell elements. Bolted and welded connections and joints. Design of bolted connections. Worked examples. **Part III: Exercises** – 6 hours, Oreste S. Bursi Verification of a Wind Turbine Mast.
Professional applications of the covered topics	The topics presented in this course can be applied in all those professional activities involving the design and the re-design of building systems, as well as specific elements of energy structural systems, that are typically performed in engineering offices and building companies.

Teaching format	Class lectures (blackboard and/or slides) and design exercises using spreadsheets. Some of the lecture material (slides) will be available for download by the students

Learning outcomes	Knowledge and understanding 1. Knowledge of the main static and dynamic mechanical properties of materials and structures, with particular reference to steel, as well as the main technical standards used in steel structural applications. Applying knowledge and understanding 2. Capability of recognizing where steel and steel structures could be profitably used in energy systems, such as those related to wind, hydraulic or solar energy, and capability of defining requirements in the design of the steel structures for energy applications. Making judgements 3. The student will be able to assess the validity of the design of an existing steel structure, identify critical aspects and suggest redesign solutions and improvements in both static and dynamic performance. Communication skills 4. The student will be able to discuss the learned knowledge with vocabulary and technical terms of the discipline, describing efficiently the outcome of the design activity and the features of different solutions. Learning skills 5. Lifelong learning capability through the acquisition of critical tools and critical evaluation of product and systems specifications.
Assessment	Oral examination with questions aimed at verifying the knowledge and the capability to understand the topics of the course and the mastery of the technical language. The capability to transfer these competences to applicative cases and the developed autonomy of judgment will be evaluated through the discussion of the design work assigned during the course. **Formative assessment** Form: Development of the assigned design work — Length/duration: During the course — ILOs assessed: (2), (3), (5) **Summative assessment**

	<table><tr><th>Form</th><th>%</th><th>Length/duration</th><th>ILOs assessed</th></tr><tr><td>Oral examination, including discussion of the design work</td><td>100</td><td>About 1 hour</td><td>All, except (5)</td></tr></table>
Assessment language	English
Evaluation criteria and criteria for awarding marks	A single final vote will take into account knowledge of the topics presented during the course, ability to synthesize information, correctness of the technical terms and clarity (50 %). With reference to the developed design work, the capability to analyze the proposed problem and to design reliable steel components in structures for energy applications will be taken into account (50 %).

Required readings	• European technical standard: UNI EN 1993-1-1 • D. Roylance, Modules in Mechanics of Materials, A web-based collection of educational modules developed under the auspices of the National Science Foundation. MIT course. • Davoli et al. "Comportamento meccanico dei materiali", Mc Graw-Hill. • Bursi, O.S., Pucinotti, R., Zanon, G., Progettazione di Giunzioni e Strutture Tubolari in Acciaio, Flaccovio, September 2012 | ISBN: 978-88-579-0158-9
Supplementary readings	• Cocco, D., Palomba, C., Puddu, P., "Tecnologie delle • Energie Rinnovabili", SGEditoriali , Padova, 2010. • Battisti, L., Gli Impianti Motori Eolici, Editore L. Battisti , Agosto 2012.