Syllabus

Course Description

Course Title	Mechanics and Design of Sustainable Structures
Course Code	45551
Course Title Additional	
Scientific-Disciplinary Sector	
Language	English
Degree Course	Master in Energy Engineering
Other Degree Courses (Loaned)	
Lecturers	Prof. Maria Pantano, Maria.Pantano@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/35831 Dr. Nicola Tondini, Nicola.Tondini@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/37176
Teaching Assistant	
Semester	First semester
Course Year/s	2
CP	6
Teaching Hours	60
Lab Hours	0
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	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 and sustainable applications, including wind energy, hydraulic energy, solar energy and

	bioenergy and relevant industrial plants.
Course Topics	Design based on modern national and European standards. - Global analysis of structures. - Stiffness and strength of elements. - 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. - Fatigue of steel structures - Bolted and welded connections and joints. - Design of bolted connections. - Worked examples. - Verification of a sustainable structural system: Wind turbine mast.
Keywords	Structures; Stiffness and strength of elements; Steel elements; Fatigue; Connections and joints.
Recommended Prerequisites	Recommended preliminary knowledge: For a fruitful attendance of the course basic knowledge of solid and structural mechanics is needed.
Propaedeutic Courses	
Teaching Format	Class lectures (blackboard and/or slides). Some of the lecture material (slides) will be available for download by the students.
Mandatory Attendance	Not mandatory.
Specific Educational Objectives and Learning Outcomes	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 and sustainable applications, including wind energy, hydraulic energy, solar energy and bioenergy and relevant industrial plants.
Specific Educational Objectives and Learning Outcomes (additional info.)	Learning outcomes Knowledge and understanding 1. Knowledge of the main mechanical properties of materials and conception of 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 and sustainable 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 structural performance. Communication skills 4. The student will be able to discuss the learned knowledge with vocabulary and technical terms of the discipline, describing the outcome of the design activity and the features of different solutions efficiently. 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: Development of the assigned design work: during the course; ILOs assessed: (2), (3), (5) - Summative assessment: Oral examination, including discussion of the design work: about 1 hour; ILOs assessed: all, except (5)
Evaluation Criteria	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 • Simoes da Silva L., Simoes R. e Gervasio H., Design of Steel Structures, 2nd Edition, ECCS, 2016. • Nussbaumer A., Davaine L., Borges L., Fatigue Design of Steel and Composite Structures: Eurocode 3: Design of Steel Structures, Part 1-9 Fatigue; Eurocode 4: Design of Composite Steel and Concrete Structures, 2011
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
Further Information	Connections with other courses: This course complements the knowledge offered by the other courses of the Master programme. 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.
Sustainable Development Goals (SDGs)	Industry, innovation and infrastructure, Responsible consumption and production, Sustainable cities and communities

Course Module

Course Constituent Title	Mechanics
Course Code	45551A
Scientific-Disciplinary Sector	CEAR-06/A

Language	English
Lecturers	Prof. Maria Pantano, Maria.Pantano@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/35831
Teaching Assistant	
Semester	First semester
CP	3
Responsible Lecturer	
Teaching Hours	60
Lab Hours	0
Individual Study Hours	15
Planned Office Hours	9
Contents Summary	Overview of the applications and benefits of steel and steel structures in energy engineering systems, with emphasis on sustainability aspects. Mechanical properties of structural materials, with specific attention to steel and concrete. Standards for the design of steel structures according to European rules. Plasticity. Elements of structural dynamics and fatigue. Exercises with theoretical applications.
Course 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	Teaching format Class lectures (blackboard and/or slides). Some of the lecture material (slides) will be available for download by the students.
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

	• Simoes da Silva L., Simoes R. e Gervasio H., Design of Steel Structures, 2nd Edition, ECCS, 2016.
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.

Course Module

Course Constituent Title	Design
Course Code	45551B
Scientific-Disciplinary Sector	CEAR-07/A
Language	English
Lecturers	Dr. Nicola Tondini, Nicola.Tondini@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/37176
Teaching Assistant	
Semester	First semester
CP	3
Responsible Lecturer	
Teaching Hours	60
Lab Hours	0
Individual Study Hours	15
Planned Office Hours	9
Contents Summary	Design based on modern national and European standards. Global analysis of structures. Stiffness and strength of elements. 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. Verification of a sustainable structural system: Wind turbine mast.

Course 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.
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 • Simoes da Silva L., Simoes R. e Gervasio H., Design of Steel Structures, 2nd Edition, ECCS, 2016.
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.