Associate professor Petr KUKLÍK, CTU

Course unit title	***ADVANCED DESIGN OF TIMBER STRUCTURES***
Course unit code	1E6
Type of course unit	Optional
Semester	1
Number of ECTS credits allocated	5
Name of lecturer(s)	Pert KUKLIK (CTU); Lecturer (UC); Lecturer (UNINA); Lecturer (UPT); Lecturer (ULg); Lecturer (LTU); Lecturer(Associate 1); Lecturer (Associate2).
Learning outcomes of the course unit	**Aim** The aim of this course is to give students the latest knowledge about the timber structures.To describe the historical development of the use of timber in building and engineering structures and to develop an awareness of significance of timber as a traditional structural material. To focus attention on the essential properties of timber which have to be considered in the design, detailing and construction of timber structures. To develop an understanding of importance of strength grading in process of converting wood, a natural raw material, into timber for structural use. To introduce new high strength wood-based materials. To describe their use and how they can be designed by following the Eurocode 5 principles. To describe the Eurocode principles for safety and serviceability and the bases of design common to all materials, together with the special rules for timber structures necessitated by, for example, the effects of load duration and moisture content. To describe the strength and stiffness of timber members and components at different loading. To give an overview of the different types connections used in timber structures. To give introduction to the design and use of planar and spatial timber structures. To describe the structural behaviour of timber frame house construction. To describe the use of timber in modern bridges. To present calculation methods for structural fire design. To present information about timber under influence of climatic conditions and durability of timber structures. **Skills** The course is conceived in order to give students the following skills: - Understanding of wood as a cellular and anisotropic material. - Understanding the behaviour of different timber structures. - Understanding how to calculate the design resistance of timber structures according to Eurocode 5. - Understanding how to do the best detailing.

	- Understanding basics of manufacturing and maintenance of different timber structures. - Knowledge how to do FE analysis and interpret obtained results.
Mode of delivery	Frontal lessons, seminar work and home work
Prerequisites and co-requisites	No requirements
Course contents	The purpose of this course is to introduce students step by step with the design of timber structures. Eight topics, listed below are covered in the course.
Recommended or required reading	Kuklík, P.: Design of timber structures with worked examples, CTU in Prague, 2012. Thelandersson, S. – Larsen, H.J.: Timber engineering, John Wiley& Sons Ltd., 2003. Eurocodes and European standards.
Planned learning activities and teaching methods	**1 Introduction to advanced timber structures** 1.1 - History of building construction Timber framed houses, roof and wall structures, bridges. 1.2 - Wood as a structural material Technical and non-technical characteristics, potential of timber in building sector. **2 Wood properties and wood engineering products** 2.1 - Wood properties Structure of wood (macro-, micro-, submicro-), natural features in sawn timber, shrinkage, creep, loss of strength, evaluation of structural properties. 2.2 - Structural timber and glulam Grading, mechanical properties, poles and round timber, solid timber, structural timber with special properties (KVH, DUO/TRIO). Glulam production and properties, structural use of glulam. 2.3 - Wood based panels Panels based on wood pieces (fibres, strands and veneers) and also wood boards. Detailed description of cross laminated timber - production, load- carrying behaviour, modelling and verification (plates, walls and joints). **3 Limit states design** 3.1- Structural members Reliability assessment (deterministic, semi or fully probabilistic). Design of members according to Eurocode 5 (stress in one direction, combined stresses, with varying cross-section or curved shape). Stability of members. 3.2 - Connections

Connections with metal fasteners (nails, dowels, bolts, screws, connectors, punched metal plate fasteners). Design according to Eurocode 5.

3.3 - Components, assemblies and composite structures

Glued thin-webbed or thin-flanged beams, roof and floor diaphragms, timber-concrete composite floors, strengthening of timber members.

Possible assignment

- Design of column and beam of a heavy timber frame structure.

4 Planar and spatial timber structures

4.1 - Planar structures

Beams, portal frames, arches, trusses, bracing, serviceability limit state criteria, 2nd order theory.

4.2 - Spatial structures

Space grid and shell structures.

Possible assignment

- Design of moment resisting connection.

5 Timber frame houses

5.1 - Methods of construction

Light and heavy frames. Massive structures.

5.2 - Design models

5.3 - Connections between elements

Possible assignment

- Design of timber-concrete composite floor of a multi-storey building.

6 Timber bridges

6.1- Types, sizes and structural systems

6.2 - Bridge decks

6.3 - Connections and details

6.4 - Design according to Eurocode 5

6.5 - Maintenance

7 Fire resistance of timber structures

7.1 - Behaviour of timber and wood-based materials in fire

7.2 - Fire resistance of timber members and joints

7.3 - Design according to Eurocode 5

8 Durability of timber structures

7.1 - Natural durability of timber

7.2 - Deterioration mechanisms, hazard and durability classes

7.3 - Timber structures in aggressive environments

Assessment methods and criteria	Approved assignments will be necessary to prepare at the end of the course on the work performed during the course. Grading system. Passed or not passed. A certificate awarding ECCS credits may be provided upon the request.
Language of instruction	English