

**WOOD INNOVATION FOR SUSTAINABILITY,
UNDERGRADUATE STUDY PROGRAMME, FIRST BOLOGNA CYCLE
COURSE DESCRIPTIONS**

COMPULSORY COURSES

COMPULSORY COURSES FOR THE 1ST YEAR OF STUDY

Course name: **ENGLISH IN WOOD SCIENCE**

Number of ECTS credits: **6**

Content:

The most important research topics in the field of wood science and technology, among others the following areas:

- wood anatomy
- wood technology
- engineered wood products
- wood structures

Course name: **DIGITAL PROTOTYPING IN WOOD PRODUCTS DESIGN**

Number of ECTS credits: **6**

Introduction to digital design and prototyping

- Overview of sustainable design principles
- The role of digital prototyping in modern wood product design
- Environmental impacts and sustainability considerations in wood product prototyping.
- Digital-to-Physical wood product development workflow.

Digital tools and techniques for designing and prototyping.

- Introduction to 3D modelling software
- Advanced digital design techniques for wood product design (Including BIM)
- Integration of emerging technologies in digital design for sustainability.

Sustainability and digital prototyping

- Principles of circular economy in wood product design.
- Digital modelling for waste reduction and recycling in wood Industry.
- Iterative designing
- Generative designing
- Collaborative design

Advanced Techniques in digital prototyping

- Introduction to Augmented Reality (AR) and Virtual Reality (VR) for wood product design

Rapid prototyping, 3D printing and small series manufacturing

Course name: **ENGINEERED WOOD PRODUCTS**

Number of ECTS credits: **6**

Content:

- Adhesive bonding of wood. Wood adhesives. Surface preparation and its characteristics. Adhesive penetration. Bonding quality.

- Particle and fiber based wood composites. Particle board. Medium Density Fiber Board. OSB panels. Manufacturing processes, properties and uses.
- Solid wood composites. Cross laminated timber, glulam, LVL, plywood. Manufacturing processes, properties and uses.
- Standards for characterisation of engineered wood products.

Course name: **MATHEMATICAL METHODS**

Number of ECTS credits: **6**

Content:

- Sets. Number sets (natural, rational, real, complex numbers). Equations and inequalities. Absolute value. Interest account. Natural growth. Applications in agriculture.
- Sequences. Limits of sequences. Functions of one variable. Graph of a function. Analysis of functions. Derivative. Integral. Extrema of functions. Applications in agriculture.
- Functions of two variables. Partial derivatives. Extrema of functions of two variables. Applications in agriculture.
- Matrix calculus. Definition of a matrix and basic operations. Determinant. Systems of linear equations. Vectors. Applications to agriculture.
- Combinatorics and probability calculus. The notion of probability. Probability of compound events. Conditional probability. Bayes' formula. Discrete random variables. Normal distribution. Applications to agriculture.

Course name: **FUNDAMENTALS OF ENGINEERING MECHANICS**

Number of ECTS credits: **6**

Content:

- Introduction to engineering mechanics
- Fundamental concepts of statics
- Free-body diagrams and static equilibrium
- Structural analysis of determinate structures
- Internal forces in structural members (beams and trusses)

Course name: **CHEMISTRY BASICS**

Number of ECTS credits: **6**

Content:

The short summary of basic chemical concepts: atom, molecule, ion, element, compound, pure substance, mixture, formulas, etc. will be given in the beginning of the subject.

In chapters dealing with the amount of substance, relative atomic and molecular weight, and molecular weight the basics tutorial will be given.

Field structure of atoms and chemical bonds will focus on the importance of chemical bonds within the molecules and atoms of the building and the periodic table of elements. A basic overview of dispersion systems and balancing chemical reactions inside will be introduced. The overview of inorganic compounds will be taken according to the periodic table of elements, and organic functional groups.

The subject will be based primarily on the acquisition of fundamental knowledge of chemistry necessary to understand the content of other agriculture subjects of the study Mediterranean agriculture.

1. Basics concepts

- Atom, molecule, ion
- Element, compound, pure substance, mixture
- Formulas and names of substances

2. The amount of chemical substances
 - The amount of substance
 - Atomic and molecular mass
 - Molar mass
3. Atomic bonds:
 - Ionic bond
 - Covalent bond
 - Metal bond
4. Molecular bond and physical states
5. Disperse Systems
 - The right solution
 - Colloid solutions
 - Concentration of solutions
 - Solubility
 - Colligative properties
6. Chemical equilibrium
 - Electrolytes and Protolitic reaction
 - Acids and bases
 - Hydrolysis
 - Titration
 - Buffers and pH
7. Oxidation and reduction reactions
8. A brief overview of inorganic compounds.
9. Importance and role of organic chemistry
10. Structural characteristics of organic compounds (hydrocarbons, hydrocarbon derivatives: alcohols, aldehydes, ketones, carboxylic acids, ethers, esters, amino acids, carbohydrates, lipids)
11. Nucleophilic substitutions, radical reactions, oxidations and reductions

Course name: **PHYSICAL AND MECHANICAL PROPERTIES OF WOOD PRACTICUM**

Number of ECTS credits: **6**

Content:

- Wood anatomy. Microscopic and macroscopic structure of wood. Microscopic and macroscopic identification of wood. Softwoods and hardwoods. Cambium and wood formation.
- Wood technology. Sorption curves and wood moisture content. Wood density and porosity.
- Dimensional instability of wood. Viscoelastic properties of wood. Mechanical properties of wood and influence of fibre orientation, moisture content, density, utrujanje materiala.

Course name: **COMPUTER PRACTICUM**

Number of ECTS credits: **6**

Content:

- Fundamentals of computer use, file management, and professional document preparation,
- Basic skills of computer use
- Office Software
- Basic and advance functionalities usage of text editor (styles, sections, heading and footer)
- graphics, tables, tables of contents, cross-references, bibliography
- Basics functionalities of spreadsheets (cell references, formulas, graphics, functions)
- Effective presentation preparations
- Computer engineering for wood science
 - Wireless technologies
 - Global Positioning System

- Geographic information systems
- Computer-controlled devices (automated systems)
- Smartphone mobile apps in forestry and woodscience
- RFID
- Computer tools for wood science

Course name: **STATISTICAL METHODS**

Number of ECTS credits: **6**

Content:

- Introduction. What is statistics? Examples of applications of statistical methods in natural sciences. Population. Sample.
- Random variables. Continuous and discrete random variables. Examples of random variables. Probability function, probability density function, cumulative distribution function.
- Descriptive statistics. Frequency distribution. Measures of central tendency. Quantiles. Measures of variability.
- Sampling. Introductory examples. Random sampling. Sampling distribution. Standard error. Confidence intervals.
- Graphical methods of data representation. Histogram. Scatter plots. Box and whisker plot. QQ-diagram.
- Hypothesis testing. Null hypothesis, alternative hypothesis. Errors in hypothesis testing.
- Correlation and dependence. Correlation analysis and linear regression. Non-linear dependencies.
- Simple analysis of variance (ANOVA) and HSD test

Course name: **INTRODUCTION TO EXPERIMENTAL METHODS AND DATA ANALYSIS**

Number of ECTS credits: **6**

Content:

- Introduction to Experimentation
- Characterization of Experimental Data. Data acquisition and data processing. Units of Measurement. Measurement Uncertainties
- Graphical Presentation of Data
- Data Acquisition and Signal Processing. Analog-to-digital conversion. Sampling frequency.
- Statistical Properties of Data and Data Fitting

COMPULSORY COURSES FOR THE 2ND YEAR OF STUDY

Course name: **DATA ANALYTICS**

Number of ECTS credits: **6**

Content:

- Data sources
- Data management
- Data preparation
- Data analysis
- Data visualisation
- Data interpretation

Course name: **ERGONOMICS IN WOOD FURNITURE DESIGN**

Number of ECTS credits: **3**

Content:

Introduction to ergonomics

- Definition of basic concepts
- Position of the field among other branches
- Principles in ergonomics
- Anthropometrics
- Human factors
- Body posture, movement behaviours and health
- Ergonomics in physical activity
- Sitting ergonomics
- Sleeping ergonomics
- Environmental factors
- Health and safety in a woodworking workshop

Wood and well-being

- People and nature
- Forest bathing
- Biophilic design
- Attention restoration theory
- Stress reduction theory
- Restorative Environmental and Ergonomic Design (REED) paradigm
- The impact of materials on well-being
- People's perception and preferences
- Wood choices

History of furniture

- Culture, aesthetics and function
- Furniture Styles and Periods
- Materials and ergonomics
- Iconic furniture
- Case studies

Contemporary furniture design

- Furniture design standards, certificates
- Individuality, customisation, adaptability
- Sustainability
- Digitalisation in furniture design (smart furniture solutions, sensors integration etc.)
- Active furniture design
- Wooden flooring, handles and safety
- Wooden panels
- Upholstery
- Co-creation design
- Comfort and discomfort assessment
- Innovation patents
- Case studies

Ergonomic furniture in settings

- Home
- Kindergarten
- Workplace
- Retirement home
- Hospitals
- Public spaces
- Outdoor furniture
- Case studies

Course name: **TIMBER BUILDING SYSTEMS**

Number of ECTS credits: **6**

Content:

- Specifics of different types of building systems: Log house. Timber frame construction. Post and beam systems. Light timber frame construction. Moment-resisting frame construction. Modular timber systems. Cross-laminated timber (CLT) systems. Hybrid building systems.
- Composite timber-based structural elements/components (including timber-concrete and timber-steel hybrid systems).
- Examples of tall buildings in hybrid timber-based structural systems.

Course name: **PERFORMANCE MODELLING OF WOOD PRODUCTS**

Number of ECTS credits: **6**

Content:

Introduction to Digital Performance Modelling

- Overview of digital modelling in the wood industry and timber construction
- Overview of physical and mechanical properties of different wood-derived materials.
- Introduction to »design for performance« and »design to disassembly«.

Techniques for simulating service life performance of wood products

- Introduction to performance simulation techniques including FEM and CFD.
- aesthetical and functional modelling of wood products' performance in varying use conditions.
- BIM for digital design, performance simulation and lifecycle analysis of timber structures.
- Integration of emerging technologies for performance analysis and monitoring.
- Product optimization techniques.

Digital performance modelling tools

- Introduction to digital performance modelling tools for the wood industry.
- Digital twin concept

Course name: **ADVANCED MANUFACTURING**

Number of ECTS credits: **6**

Content:

- Basic of industry 4.0 and industry 5.0. Concepts.
- Data driven technology advancements.
- Automatization in wood industry, including robotics, CNC and 3D printing applications.
- Digital twin concepts. Integration of virtual tools along the value/transformation chain.
- Non destructive testing. Acoustic methods. Movement detection. Internal structure analysis. Optical methods.
- Traceability of wood.

Course name: **PRACTICAL TRAINING IN WORKING ENVIRONMENTS I**

Number of ECTS credits: **12**

Content:

Students will perform practical training under expert mentoring in various organizations, engaged with wood processing. Students will be able to practice in the work environment of companies and research institutions. Practice is also possible in the scientific and research institutions of the University of Primorska.

Practical training will be organized in agreement with the coordinator of study practice at the faculty department, and appropriately trained mentors in organizations, in order to familiarize students with the

production and organization of the company, taking into account the specific field of activity of each company.

Course name: **WOOD MODIFICATION TECHNOLOGIES**

Number of ECTS credits: **6**

Content:

- Chemical modification processes. Acetylation, furfurylation, resin impregnations, Compreg™ processes, DMDHEU
- Thermally-based modification processes. Thermo (T) treatment, Thermo-Hydro (TH) treatment, Thermo-Mechanical (TM) treatment, and Thermo-Hydro-Mechanical (THM) treatment.
- The use of microwaves, plasma and laser for wood modification
- Other modification processes. biological treatments - metabolites from the fungal and bacterial bioprocessing of wood, biological incising, enzyme modification and impregnation with naturally occurring compounds
- Environmental impacts of modified wood
- Assessment of the service life performance of modified wood products

Course name: **ARTIFICIAL INTELEGENCE AND MACHINE LEARNING**

Number of ECTS credits: **3**

Content:

- Introduction and overview of Artificial Intelligence and Machine Learning. Deep learning. Computer vision. OpenAI. Generative AI. ChatGPT. Ethical Standards in AI.
- Python Basics. Python environment. Basics of the python language, operators, data structures, control structures, functions and modules, libraries.
- Exploratory Data Analysis. Visualization. AI examples.

COMPULSORY COURSES FOR THE 3RD YEAR OF STUDY

Course name: **BUILDINGS DESIGN DRIVEN BY NEW EUROPEAN BAUHAUS**

Number of ECTS credits: **6**

Content:

- New European Bauhaus (NEB). Values and working principles. Green Deal. NEB Compass. NEB Toolbox. NEB investment guidelines. NEB Checklist
- Sustainable construction techniques. Working with bio-based materials: opportunities and overcoming challenges. Circularity in construction: recovery, reuse, recycling, and resource management. Renovation and cultural heritage.
- Engineered living materials for architecture. Materials inspired by nature. Bioinspired solutions in architecture.
- Restorative environmental and ergonomic design. Nature-inspired design solutions. Restorative and wellbeing benefits of built environment.
- Comfort of the users through acoustics. Acoustic comfort. Sound insulation. Reverberation time. Perception of sound.

Course name: **PRACTICAL TRAINING IN WORKING ENVIRONMENTS II**

Number of ECTS credits: **12**

Content:

Students will perform practical training under expert mentoring in various organizations, engaged with wood processing. Students will be able to practice in the work environment of companies and research institutions. Practice is also possible in the scientific and research institutions of the University of Primorska.

Practical training will be organized in agreement with the coordinator of study practice at the faculty department, and appropriately trained mentors in organizations, in order to familiarize students with the production and organization of the company, taking into account the specific field of activity of each company.

The focus of the second internship will be on managements and organization of production processes.

Course name: **SUSTAINABILITY ASSESSMENTS**

Number of ECTS credits: **6**

Content:

- Systemic framework for sustainability assessment. Sustainable Development and its interaction with policies.
- Use of various tools & method sustainability assessment. Qualitative/Quantitative tools. Sustainability indicators and indices, modelling tools.
- Examples of policy relevant key indicators for sustainability performance assessment of companies, technological systems, states/sector, projects etc.
- Knowledge on research and policy interface, linking research outcomes with SDGs.
- Regenerative sustainability.

Course name: **FINAL SEMINAR**

Number of ECTS credits: **6**

Content:

The aim of the final seminar is that student studies intensively the literature from the field of selected topic. They must understand the content and professionally present it.

The course lecturer, together with other teachers who are involved in the implementation of the study programme, presents potential seminar topics, with relevant literature. Student is motivated to suggest topics that it is interested in, and looks for additional literature.

Presentation of the instructions for preparation of the final seminar and to give student guidelines during the preparation of the seminar.

ELECTIVE COURSES

Course name: **BASICS OF ENTREPRENEURSHIP AND MARKETING**

Number of ECTS credits: **6**

Content:

Course content will consist of sections: entrepreneurship and marketing.

a. **ENTREPRENEURSHIP**

- The definition and importance of entrepreneurship
- The definition and importance of entrepreneurship
- Business Plan
- Examples of entrepreneurship (entrepreneur)- an analysis of good practices

b. **MARKETING**

- Development and definition of marketing.
- Basic marketing concepts.
- Market environment: analysis of internal and external environment.
- Consumer behavior in the purchase
- decision-making process: definition, the factors that influence the consumer behavior in the purchase decision-making process.
- Market research: market research process.
- Segmentation and positioning.
- Marketing mix: product, price, distribution, promotion.
- Brand: basic concepts.

Course name: **BUSINESS COMMUNICATIONS**

Number of ECTS credits: **6**

Content:

- Basic understanding of the key concepts, theories, and practices within the field of communication. theoretical frameworks and definitions, models of communication, and types of communication.
- Business communication strategies, including practical communication strategies.
- Interpersonal communication.
- Written and oral communication skills.
- Use of various communication technologies.

Course name: **PROJECT MANAGEMENT**

Number of ECTS credits: **6**

Content:

- Types of projects.
- Defining projects. Objectives. Key performance indicators. Implementation plan. Impacts. Risks.
- Management of project. Content management. Administrative management. Evaluation of projects' results.
- Project documentation.