



# University of Zagreb Faculty of Forestry

## Course Catalogue for Incoming Students

Zagreb, February 15, 2019

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# Study at Faculty of Forestry

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The Faculty of Forestry is an internationally recognized institution which offers a high level of education for careers in forestry, wood processing and furniture manufacture. The Faculty is a place for permanent education and for the development of an intellectual with a broad spectrum of knowledge, whose work is recognized not only in the professional field but also in the social life of Croatia. The Faculty draws on the celebrated past and activities of its forerunners. We are a renowned profession which has its written rules and values, but also unwritten rules which you will learn in practice. We are well known for our close collaboration and solidarity.

## Incoming Students

Exchange students are students participating in a formal exchange programme between their home university and the University of Zagreb (i.e. Erasmus+, CEEPUS, Bilateral agreements etc.)

**Incoming students can choose courses from the list „Courses in English Available to Incoming Students in Academic Year 2019./2020.“ in this catalogue, published on Faculty’s website.** Courses in catalogue are divided according to study level (undergraduate or graduate) and according to Faculty departments (Forestry, Wood Technology). All courses are awarded with credits using the ECTS system.

At the moment, Faculty of Forestry does not offer full degree study programs (undergraduate or graduate) in English language.

# Study Programmes

Faculty of Forestry offers 3 Undergraduate Study Programmes, 5 Graduate Study Programmes, 8 Specialist Postgraduate Study Programmes and one Postgraduate Doctoral Study Programme.

<b>Undergraduate Study Programmes (BSc)</b>
Forestry
Urban Forestry, Nature Conservation and Environmental Protection
Wood Technology
<b>Graduate Study Programmes (MSc)</b>
Forestry - Silviculture and Management Planning with Wildlife Management
Forestry - Techniques, Technologies and Forestry Management
Urban Forestry, Nature Conservation and Environmental Protection
Design of Wood Products
Wood Technology Processes
<b>Specialist Postgraduate Study Programmes (8)</b>
<b>Postgraduate Doctoral Study Programme (1)</b>

The undergraduate study programmes have duration of 3 years (6 semesters; 180 ECTS credits).

The graduate study programmes have duration of 2 years (4 semesters; 120 ECTS credits).

Upon graduation there is a possibility to continue the studies at the doctoral level in duration of 3 years (180 ECTS) or at specialist level in duration of 2 years (120 ECTS).

At all programme levels, students participate in classes in newly equipped classrooms and laboratories, and at the training and research forest centres.

Field classes enable students to acquire practical knowledge, and are held at the Faculty's 5 forest centres.

These are distributed among all the important climatic zone forest communities in Croatia, of which the Faculty is particularly proud.

## Learning outcomes at program level

### **Undergraduate Study Programmes (BSc)**

#### **Forestry**

Upon completion of the undergraduate studies, the student receives a certificate stating the completion of studies and the acquisition of a title according to the course of studies: University degree of Bachelor (baccalaureus/baccalaurea) in Forest Engineering

Forestry is a profession, science and art of managing and preserving forest ecosystems for the permanent welfare of society, environment and economy. Accordingly, the students of undergraduate and graduate studies are instructed to manage forest ecosystems from the biological, ecological, technical and economic point of view.

Programme of Undergraduate Studies in Forestry is designed in a way that it leads the student in a logical sequence from the fundamental biological and technical disciplines, over the introductory disciplines to the components of the forest ecosystems and forest management techniques, to those disciplines that complete the knowledge about forest and forest land management.

The skills acquired by completing these programme studies: full proficiency as forest district manager, expert associates in forestry professions, duties in forest inventory, participating in the implementation of the forest management program, all professional field works on establishing, tending and regeneration of forest stands, knowledge of mechanical means, techniques and standard technologies applicable in forestry - first of all in forest harvesting from natural forests, forest cultures and plantations. Furthermore, a bachelor of forestry is qualified for expert works on melioration and landscaping of forest areas in the Mediterranean area, protection of forests from abiotic and biotic factors, especially from fires, management of professional activities related to the implementation of hunting management plans and programmes, organization of hunting grounds, collaboration in the preparation of the environmental studies and zoning plans, technique and technology of forest road construction, sales of wood assortments, organization of production in forestry, safety in forestry work. He/she has been trained for individual works in sectors of private enterprise and forest district management system, as well as for the teamwork in all other activities related to the professions in forestry, nature and environment protection.

With a Bachelor's degree of Forestry students are prepared for their professional development by participating in various seminars and workshops during their practical experience, and during their regular studies they get completely qualified to continue their studies at the Faculty of Forestry in graduate studies with the programmes in Silviculture and Management Planning with Wildlife Management, and in Technique, Technologies and Management in Forestry.

#### **Urban Forestry, Nature Conservation and Environmental Protection**

Upon completion of the undergraduate studies, the student receives a certificate stating the completion of studies and the acquisition of a title according to the course of studies: Bachelor/(baccalaureus/baccalaurea) Engineer of Urban Forestry, Nature Conservation and Environmental Protection

The Undergraduate Studies of Urban Forestry, Nature Conservation and Environmental Protection are studies based on a reform of similar studies in Europe and it partially derives from the Studies existing at the Department of Forestry so far.

A Bachelor of Urban Forestry, Nature Conservation and Environmental Protection is qualified for professional forestry jobs of an expert associate carried out in urban areas (biological and technical works on landscaping of parks and greening, protection of plants in urban areas, arboriculture, nursery, seed growing, etc), as well as for the jobs related to nature and environment protection (professional jobs in natural protected areas, collaboration in the development of environmental studies and space planning, integrated environmental management and legislation, environmental monitoring, etc.)

With a Bachelor's degree in Urban Forestry, Nature Conservation and Environmental Protection students are prepared for their professional development by participating in various seminars and workshops during their practical experience, and during their regular studies they get completely qualified to continue their studies at the Faculty of Forestry in the graduate studies with the programmes in Urban Forestry, Nature Conservation and Environmental Protection. He/She is also qualified for an individual or team-work, he/she has been introduced to the trends in urban forestry, nature conservation and environmental protection in the country and in the world.

### **Wood Technology**

Upon completion of the undergraduate studies, the student receives a certificate stating the completion of studies and the acquisition of a title according to the course of studies: Bachelor's degree (baccalaureus/baccalaurea) in Wood Technology

The Undergraduate Studies of Wood Technology provide basic knowledge from a wide range of technical and natural sciences, as well as the professional knowledge and skills required by the modern development of the wood industry companies: knowledge of wood structure and wood technical properties, basic knowledge of wood protection, basic technical knowledge for monitoring and control of machine operations and transport equipment, competences for monitoring wood technology processes and implementing certain technological operations. Participating in the supply of materials and other equipment, monitoring the product and work performance quality, expert, operational knowledge of the management of wood technology processes.

With a Bachelor's degree in Wood Technology students are prepared for their professional development by participating in various seminars and workshops during their practical experience, and during their regular studies they get completely qualified to continue their studies at the Faculty of Forestry in graduate studies with the programmes in Wood Technology Processes and Design of Wood Products.

A Bachelor of Wood Technology is qualified for professional jobs in all forms of enterprises dealing with wood treatment and wood processing, he/she can work as an associate in trade business and distribution of wood products and carry out duties and tasks in wood-processing enterprise. A Bachelor of Wood Technology is also qualified for supervising the processes of wood drying and of wood materials, for monitoring the implementation of technological processes in sawmills, in the field of the production of veneer, plywood panels and chipped wood panels, furniture, builders joinery and of other wood products.

The students at the undergraduate studies of wood technology will be able to participate in horizontal mobility within the areas of the Biotechnical Sciences and European Universities, the University of Zagreb or the Faculty of Forestry has signed the Cooperation Agreement with. A special programme will enable the undergraduate students of related faculties who want and are entitled to follow individual courses or to further continue with graduate studies at the Faculty of Forestry.

# Graduate Study Programmes (MSc)

## Forestry - Silviculture and Management Planning with Wildlife Management

Upon completion of graduate studies and final thesis defence, the student receives a university diploma stating the completion of studies and the acquisition of an academic title according to the programme of studies: Master's degree in Forest Engineering - Silviculture and Forest Management with Wildlife Management

The skills acquired by completing these programme studies: the knowledge of the position and trends of forestry profession in the country and in the world, full proficiency in forest ecosystems management in every sense, implementation of the forest management plans, establishment and growth of forests, melioration and landscaping of forest areas in the Mediterranean area, protection of forests from abiotic and biotic factors, especially from fires, management of professional activities related to the implementation of hunting management plans and programmes, organization of hunting grounds, the preparation of the environmental studies, development of forest zoning plans, the activities of an expert manager and supervisor in nature and environment protection, wood assortment placement, safety in the forestry workplace, organization of production in forestry, coordination of all activities in forestry, he/she is prepared for his/her professional and scientific development and postgraduate studies through various educational forms.

Master of Forest Engineering - Silviculture and Forest Management with Wildlife Management is fully prepared for an individual and teamwork in the fields of forest growing and tending, forest and hunting planning, and has additional applied knowledge in the fields of techniques, technologies and management in forestry.

Job competences and qualifications: most complex jobs in all forms of forestry organizations from forest district to complex trade company, county and state inspectors, forestry and hunting advisory service, a professional associate in research institutions in the field of forestry and hunting, directors, expert manager and supervisor in protected natural facilities, manager and associate in forestry products trade and traffic affairs, jobs and tasks in forestry entrepreneurship, teacher in vocational secondary and related schools, publicist writing and media jobs and tasks related to forestry profession..

## Forestry - Techniques, Technologies and Forestry Management

Upon completion of graduate studies and final thesis defence, the student receives a university diploma stating the completion of studies and the acquisition of an academic title according to the programme of studies: Master's degree in Forest Engineering - Techniques, Technologies and Management in Forestry

The skills acquired by completing these programme studies: the knowledge of mechanical means, techniques and standard high quality technologies applied in forestry, primarily in forest harvesting from natural, even-aged and uneven-aged forest stands, cultures, plantations and energy woods, the knowledge of main and secondary wood products and their movement from their point of production to the market by means of the off-road transportation and through the network of forest and public roads, the knowledge of the preparing and planning methods for technical works in forestry, methods, techniques and technology of forest opening, ie the design and construction of a forest road network, the choice of mechanical means and technologies based on cost analysis and other criteria, the knowledge of the forest, human and technical potential management, marketing knowledge related to forest wood products and secondary forest products. The candidate additionally masters the applied knowledge of ecology, forest protection and forest management.

The Studies develop student's competence and ability to manage and make independent and team-oriented expert (business) decisions, and the ability to involve in doctoral studies and in scientific expert courses.

Job competences and qualifications: forestry jobs of a greater complexity from the Forest Office to Forest District as vertically the lowest structural forest units, forestry jobs under the competency of county and republic institutions, inspections services, duties and tasks related to forestry entrepreneurship, jobs and duties in



development, scientific and educational institutions, the traffic of forest products on domestic and foreign markets, the traffic of equipment, the duties of a professional publicist writing and media related to the profession.

### **Urban Forestry, Nature Conservation and Environmental Protection**

Upon completion of graduate studies and final thesis defence, the student receives a university diploma stating the completion of studies and the acquisition of an academic title according to the programme of studies: Master of Engineering in Urban Forestry, Nature Conservation and Environmental Protection

The Skills acquired by completing these studies: the knowledge about urban forestry, nature conservation and environmental protection in the country and in the world, proficiency in the development of environmental studies, management and planning in forest ecosystems of the natural protected areas, space analysis and evaluation, integrated protection in natural protected areas, ecological monitoring, management and protection of soil and water, restoration of degraded habitats, management of animal species, proficiency in development of environmental studies, management in specific urban forest ecosystems, analysis and evaluation as well as design of park areas, horticultural Dendrology, production of ornamental plants, integrated protection of tree species in urban areas, planning and management of professional forestry jobs in urban areas, development of programmes and management bases in natural protected areas and urban forest ecosystems, preparation for the professional and scientific development through various educational forms and postgraduate studies.

By acquiring knowledge and skills through graduate studies, a Master of Engineering in Urban Forestry, Nature Conservation and Environmental Protection is fully prepared for an individual and team-work in the field of urban forestry, nature conservation and environmental protection.

Job Qualifications: the most complex jobs in all types of organizations of the protected natural areas (strictly protected reserves, national parks, special reserves, nature parks, nature monuments, significant landscapes, forest parks and monuments of park architecture), in public/state administration, county and municipal administration, including advisory services and inspections, proficiency in horticultural jobs and jobs in utility companies, expert associate and coordinator jobs in research and scientific institutions in the field of urban forestry, nature conservation and environmental protection, expert manager and supervisor in nature conservation and environmental protection, teaching and education jobs in vocational high-schools and other related schools, duties and tasks in publicist writing and media related to urban forestry, nature conservation and environmental protection.

### **Wood Technology Processes**

Upon completion of graduate studies and final thesis defence, the student receives a university diploma stating the completion of studies and the acquisition of an academic title according to the programme of studies: Master of Wood Technology - Wood Technology Processes

Skills acquired by completing these studies: the knowledge of position and trends in the wood processing sector in the home country and abroad, scientific knowledge about wood as a renewable material, full proficiency in management of wood technology processes, planning and calculation of production, coordination of all the activities in wood industry, preparation for the professional and scientific development through various educational forms and postgraduate studies. A Master in Engineering is completely prepared for an individual and team work in the fields of sawing and hydrothermal treatment of wood, wood protection, in the field of veneer production technology, of plywood panels and chipped wood panels, in the production technology of the final wood products, in particular the coordination of wood and wood products surface treatment processes. A Master's in engineering is involved in design of technology, developing and improving production, optimizing production and has additional applied knowledge in the fields of engineering and management in the wood industry. He/She writes his/her final thesis of an experimental, professional or scientific character.

Master of Engineering is qualified for the most complex jobs in all forms of enterprises dealing with the treatment, processing of wood and wood trade and in consulting and design companies, he/she can work as expert associate in research institutions in the field of wood and wood technologies, as a manager and associate in trade and traffic of wood products, he/she can carry out duties and tasks in wood technology enterprises, work as a teacher in vocational high schools and other related schools and carry out duties and tasks in publicist writing and media related to professions in wood industry.

## **Wood Product Design**

Upon completion of graduate studies and final thesis defence, the student receives a university diploma stating the completion of studies and the acquisition of an academic title according to the programme of studies:  
Master of Wood Technology - Design of Wood Products

Given the specificity of the Studies in Design of Wood Products, whose program is mainly addressed to the sector of wood industry, it is expected that the cooperation with the economic and public sector will be of a wide and mutual advantage. The objective of the students' education is to establish an interdisciplinary collaboration of this profile of students with economic entities, and finds support in the practical use of their solutions through communication and cooperation with the industry and trade, either from the state or private sector. The project tasks that a student solves in collaboration with production companies, lead him/her systematically through the knowledge, problem analysis, conceptual solutions and proposals for solving the default problem in all directions - of design, structural, technical, technological - in the very process of production, programming and of market research, promotional activities and distribution of wood products, to bring the solution to the creation of a model or a prototype while mastering communication skills with associates of different profiles.

Master of Wood Technology - Design of Wood Products is qualified to carry out professional duties in bigger and smaller companies (from the company's plant to the saloon) dealing with the production or distribution of furniture or other wood products. He/She is also ready to take part in solving the interdisciplinary problems related not only to a part of designing or constructing products and their presentation, but also to a decision about the choice of materials, reproductive materials, treatment technology and the quality assurance of the final product. Thanks to the knowledge of the methodology of design of final wood products, the graduate students are qualified to carry out a series of functions, from the product development, quality improvement, product design and construction, equipment of facilities, all the way to the presentation and sale of products on the fairs.

# Academic Calendar 2020/2021

## WINTER SEMESTER

<b>Teaching period</b>	October 1, 2020 to January 22, 2021
<b>Winter holidays (no classes)</b>	December 24, 2020 to January 6, 2021
<b>Winter examination period (no classes)</b>	January 25, 2021 to February 19, 2021

## SUMMER SEMESTER

<b>Teaching period</b>	February 22 to June 4
<b>Summer examination period (no classes)</b>	June 7 to July 9

## NATIONAL HOLIDAYS

January 1	New Year's Day
January 6	Epiphany
April 4, April 5	Easter Sunday and Monday
May 1	Labor Day
May 30	Statehood Day
June 3	Corpus Christi
June 22	Anti-Fascist Struggle Day
August 5	Victory and Homeland Thanksgiving Day
August 15	Assumption of Mary
November 1	All Saint's Day
November 18	Remembrance Day
December 25	Christmas
December 26	St. Stephen's Day

# Student Support

## Faculty of Forestry

### International Relations Office

- room 146 (yellow building)
- International Relations Coordinator  
Katarina Korov, Ms  
Phone: +385 99 263 3048  
E-mail: [kkorov@sumfak.hr](mailto:kkorov@sumfak.hr) (contact for students)
- ECTS Coordinator  
Assistant Professor Andreja Pirc Barčić, PhD  
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# Courses in English Available to incoming students in Academic Year 2020./2021.

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## Department of Forestry Courses - Undergraduate Study Programmes (BSc)

### **BASES OF HUNTING MANAGEMENT (code: 33863)**

<b>Original course title</b>	Osnove lovnog gospodarenja	<b>Status</b>	compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	prof. dr. sc. Marijan Grubešić, prof. dr. sc. Krešimir Krapinec, doc. dr. sc. Kristijan Tomljanović
<b>ECTS</b>	6	<b>Study level</b>	BSc

#### **Course content**

Historical overview of hunting management. Hunting management as sporting, recreational and economic activity Exploring of game species starts with the classification of game on a scientific, legal and hunting basis. Then each single game species is addressed morphologically and biologically in detail. Manners of game rearing, such as natural breeding, breeding in an enclosed area and ombined breeding. Under game illnesses and protection an overview of infectious, uninfetious, parasitic and diseases of artificial breeding is given. Arrangement of hunting grounds, basic hunting ground factors, preparing of hunting ground cadastre, establishment of hunting-productive areas for economically important game species, evaluation of hunting grounds for large and ground game, establishment of hunting ground capacities in terms of game and establishment of numerical game strength. Technical arrangement of hunting grounds refers to the familiarization with hunting management and hunting-technical structures. Hunting of game, manner of hunting, rules of behavior during the hunt and hunting usage Hunting weapons, rifles and shotguns, their parts, manner of functioning, correct handling and maintenance of weapons. Rifle and shotgun ammunition, hunting ballistics Hunting kinology, historical development of dogs, classification of hunting dogs, working characteristics and methods for upbringing and training of dogs. Domestic and international regulations. The hunting management basis as the document on the basis of which the hunting ground is managed. Exercises take place in lecture-hall, cabinet and laboratory. Teaching in the field: Organization and Implementation of Hunting and Arrangement of Hunting Ground and Game Counting.

## Learning outcomes

- ✓ Describe the role and importance of hunting management through history, legal regulations in hunting (hunting and hunting development, the role of hunting management)
- ✓ Explain hunting zoology (game species, morphological and biological characteristics, protected animal species, bugs and horns, determining age and sex, assessing hunting trophies).
- ✓ Interpret game disease (symptoms, pests, hygiene hunting ground, and treatment of patients game mortality).
- ✓ Describe the hunting ground (division and arrangement of the hunting ground, hunting productive area, bonitating hunting ground for large and small game)
- ✓ Interpret catching wild animals, hunting weapons and ammunition (the proper operation and maintenance of weapons, ammunition, hunting ballistics).
- ✓ Explain hunting kinology (division of hunting dogs, working characteristics and methods of dog education and training).

## Language

All teaching activities will be held in Croatian. However, foreign students will have the opportunity to attend additional office hours with the lecturer in English. Additionally, the lecturer will refer foreign students to the corresponding literature in English, as well as give them the possibility of taking the associated exams in English.

## Literature

1. Pascal Durantel, P. 2007 : Enciklopedija lovstva, Sveučilišna knjižnica Rijeka, 607 str.
2. Pascal Durantel, P. 2007: Praktična enciklopedija lovstva, Sveučilišna knjižnica Rijeka, 285 str.
3. Whitehed, G. K. (1993): The Whitehead Encyclopedia of Deer. Swan Hill Press, Shrewsbury, UK, 597 str.
4. Blüchel, K.G.: Die Jagd, 652 str.

## Forms of teaching

Lectures (30 h), exercises (30 h), field work

## Assessment methods

Written exam. Term papers and student oral presentation

# BASICS OF FOREST ECONOMICS (code: 33866)

<b>Original course title</b>	Osnove ekonomike u šumarstvu	<b>Status</b>	compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	dr. sc. Stjepan Posavec, izv. prof., dr. sc. Karlo Beljan
<b>ECTS</b>	4	<b>Study level</b>	BSc

## Course content

Name, concept, subject and methods of forestry economics.  
Characteristics of forestry economics and its place in science.  
Forest as a socio-economic category. Forest functions. Specificity of production process in forestry.  
Biological-technical characteristics and economic features.  
The ranking and importance of forestry in Croatia. Natural characteristics of Croatia. Forests in Croatia.  
Characteristics of the forests in relation to ownership. The relationship between forestry and wood processing industry. Forest products trade. Share of forestry in gross domestic product.

The basics of natural resources economy of, the basis of environmental pollution economic, the essential features of forestry (economic and market determinants).

Natural resources, importance of forest resources and consumers. The basic market laws and their impact on the forest resources price formation. Supply and demand law.

Manufacturing in forestry. Duration, activity and multifunctional character of production in forestry.

Specificities of forestry planning process. Land as a resource, forest rent and forest tax.

Meaning of forest as capital. Interest account application.

### Learning outcomes

- ✓ To explain economics of natural resources and sustainable development (specificity of production in forestry, biological-technical characteristics and economic characteristics).
- ✓ Interpret forest rent and forest tax.
- ✓ Interpret the determination of forests value (methods of evaluation in forestry, problems of total economic value of natural resources)
- ✓ To explain the meaning of forest as capital (fixed assets and capital in forestry, categories of capital goods in forestry).
- ✓ To analyze marketing in forestry (market laws, formation of forest resource prices, supply and demand laws).
- ✓ Present economic analysis and planning in forestry (business indicators, forestry production, outline investment plan and business plan).

### Language

All teaching activities will be held in Croatian. Foreign students will have the opportunity to attend additional office hours with the lecturers and be provided with teaching materials and literature in English.

### Literature

1. Figurić, M.: Uvod u ekonomiku šumskih resursa, Šumarski fakultet, Zagreb, 1998.
2. Sabadi, R.: Ekonomika šumarstva, Školska knjiga Zagreb, 1992.
3. Klemperer, W.D.: Forest resource economics and finance, McGraw-Hill Book Comp., New York, 1996.

### Forms of teaching

Lectures (30), exercises (15)

### Assesment methods

Written and oral exam

## FOREST MENSURATION (code: 33861)

<b>Original course title</b>	Dendrometrija	<b>Status</b>	compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Mario Božić, PhD; Assistant prof. Ernest Goršić, PhD; Assistant prof. Mislav Vedriš, PhD
<b>ECTS</b>	7	<b>Study level</b>	BSc

### Course content

Introduction. Measures and measurement systems. Measurement errors (precision, accuracy, bias,

significant digits). Presentation of data. Tree measurement. Diameter, breast height diameter, perimeter. Crown measurement. Measuring heights, hypsometers: Blume-Leiss, Haga, Bitterlich Relascope (standard, CP), Vertex, Laser. Estimating cross section area of a stem. Bitterlich basal area. Tree volume. Sectional method. Volume of fuelwood and wood for chemical processing. Determination of standing tree volume. Tree form coefficients. Bitterlich method. Height accumulation method. Grosenbaugh 3P method. Tree volume tables (construction and application). Bark volume. Weight of tree and its parts. Tree growth and increment (height, diameter, basal area, volume, bark, form factor). Increment rate. Total analysis. Dendrochronology. Relationships of tree parameters in a forest stand. Growth and yield tables. Single entry volume tables.

### Learning outcomes

- ✓ List measured variables, precision and accuracy in measurement, and means of data presentation.
- ✓ Interpret measurement of tree diameter, perimeter and height (instruments, errors).
- ✓ Explain data collection on sample plot, stand and management unit (sample and sample size, types and sizes of sample plots, measurement on sample plots).
- ✓ Interpret a diameter distribution in even-aged and selection stands (change of diameter distribution due to harvest, importance of diameter distribution by tree species and diameter classes).
- ✓ Describe construction of height curves (height curve of even-aged and selection stands, shift of height curve in even-aged stands, methods of curve construction).
- ✓ Interpret determination and calculation of volume (volume of felled and standing trees, sectional method, single-entry and double-entry volume tables, applicability of single-, double- and triple-entry volume tables for single trees and forest stands).
- ✓ Describe design of a sample and data collection methods for diameter increment.

### Language

All teaching activities will be held in Croatian. Foreign students will have the opportunity to attend additional office hours with the lecturers and be provided with teaching materials and literature in English.

### Literature

1. Božić, M., Goršić, E., Vedriš, M.: Forest mensuration, Teaching materials from lectures and exercises
2. Bitterlich, W., 1984: The Relascope Idea. CAB, pp.242, London
3. Loetsch, F., Zöhrer, F., Haller, K.E., 1973: Forest Inventory. pp.467, BLV München.
4. West, P.W., 2004: Tree and Forest Measurement. Springer V, pp.167, Berlin.

### Forms of teaching

Lectures (45), exercises (30), field work (2 days)

### Assessment methods

Evaluation of exercise assignments, partial exams, written and oral final exam.



# ARBORICULTURE (code: 33828)

<b>Original course title</b>	Arborikultura	<b>Status</b>	compulsory
<b>Semester</b>	summer	<b>Course teacher</b>	doc. dr. sc. Vinko Paulić, doc. dr. sc. Damir Drvodelić
<b>ECTS</b>	5	<b>Study level</b>	BSc

## Course content

The subject aims to acquaint students with theoretical knowledge and skills in managing plantations and trees. Due to urbanization and wish of city inhabitants for recreation as well as rising awareness of the important role of trees and greenery for the quality of life there is a need to take better care of city greenery. In a broad sense, the subject comprises all types of growing plants whether of artificial or natural origin. Because of the very difficult conditions in which trees are planted in city or suburban areas, much attention is focused on establishing and maintaining favourable conditions for growth and development of city greenery. Special emphasis will be put on pruning of branches and whole tree crowns with the purpose of damage prevention and control of potential danger to people. Another subject matter to be taught is estimation of the value of trees, as well as their cataloguing. The outline of the subject follows the principles of modern forestry science. It is comprised of lectures, practice, field classes, and seminars. Modern teaching aids are used during classes.

## Learning outcomes

- ✓ Interpret basic principles of arboriculture (arboriculture and urban forestry, selection of tree species and influence on tree care operations, analysis of desirable tree characteristics from arboriculture point of view, selection of quality plants for planting, basic types of planting material)
- ✓ Explain planting of trees and shrubs (basic types of planting techniques for trees and shrubs in urban areas, planting of seedlings, trees, shrubs and transplanting large trees in urban surroundings) and mulching of plants (use of mulch, mulch materials selection, advantages and disadvantages of certain mulch materials, mulch application and decontamination)
- ✓ Interpret pruning of trees and shrubs (reasons for pruning, pruning effects and reaction of plants, formative pruning of young trees, pruning of old trees, shrubs, hedges, etc.)
- ✓ Explain fertilization and irrigation of urban trees (types, way and time of tree fertilization, use of antitranspirants, difference in irrigation systems for urban greenery)
- ✓ Interpret root system of urban trees (trees in pavement, soil and other factors that influence growth of trees in urban areas, influence of root growth on infrastructure, remedial treatment for root-pavement conflicts)
- ✓ Explain hazardous trees in urban areas (hazard from tree failure, biomechanics in arboriculture, optimization of tree form, tree defects and symptoms, tree static, tree vitality, arboricultural instruments for hazardous tree assessment)
- ✓ Interpret management and inventory of urban greenery (care and management schedule of urban trees, tree sanitation plan, methods for tree inventory and tree cadastre)

## Language

All teaching activities will be held in Croatian. Foreign students will have the opportunity to attend additional office hours with the lecturers and be provided with teaching materials and literature in English.

## Literature

1. Grey, G.W. The Urban Forestry: Comprehensive Management. New York. 1996.
2. Harris, W.R. Arboriculture, Integrated management of Landscape Trees, Shrubs, and Vines. Prentice Hall. Fourth edition. 2004.

3. Brown, G,E. The Pruning of trees, Shrubs and Conifers. Timber press Oregon. 2004.
4. Shigo, A,L. Moderne Bumpflege: Grundlage der Baumbiologie. Bernard Thalacker Verlag. 1994.
5. Shigo, A,L. Modern Arboriculture. 1991.
6. Gilman, E, F. Illustrated Guide to Pruning. Delmar. Second Edition. 2002.
7. Badler, Hartmut. Die Wurzeln der Stadbbäume. Paul Parey Verlag.Berlin. 1998.
8. Miller, RW. Urban forestry: Planing and Managing Urban Green Spaces, 2nd ed. Upper Saddle River, NJ: Prentice Hill. 1997

### Forms of teaching

Lectures (30), exercises (30), field work (2 days)

### Methods of grading

Written and oral examination-passing of written part conditional for oral exam entry. Preconditions: course attendance, finished exercise and field work.

## BIOMETRICS (code: 33857)

<b>Original course title</b>	Biometrika	<b>Status</b>	compulsory
<b>Semester</b>	summer	<b>Course teacher</b>	Prof. Anamarija Jazbec, PhD; Assistant prof. Mislav Vedriš, PhD
<b>ECTS</b>	5	<b>Study level</b>	BSc

### Course content

Basic biometric terms (observations, data, population). Types of variables. Graphical tools.  
 Descriptive statistics. Frequency table.  
 Measures of central tendency. Measures of position.  
 Measures of variation, asymmetry and skewness.  
 Normal distribution.  
 Binomial distribution. Normal approximation to a binomial distribution.  
 Sampling methods. Central limit theorem. Estimators. Standard error.  
 Confidence interval. Interval estimation of the mean and proportion. T-distribution.  
 Hypothesis testing and inference. Testing expected value. Testing proportion.  
 Testing variances. F distribution. Testing means from two samples.  
 Testing proportions from two samples. Paired t-test.  
 $\chi^2$  distribution. Chi-square test.  
 Correlation.

### Learning outcomes

- ✓ Explain types of variables: numeric (continuous and discrete) and categorical (dichotomous, ordinal i nominal); graphical presentation and frequency tables, classification of graphs according to data types: bar chart, histogram, frequency polygon, line chart, pie chart, scatterplot, stemand- leaf plot, Box-Whisker plot; relative frequencies, cumulative absolute and cumulative relative frequencies, calculation and analysis.
- ✓ Describe measures of central tendency and measures of position (arithmetic mean, geometric mean, harmonic mean, quadratic mean, minimum, maximum, median, lower and upper quartile, mode)

- ✓ Explain measures of variation (data range, interquartile range, standard deviation, variance, coefficient of variation)
- ✓ Interpret theoretical distributions or models of population distributions (normal Gaussian distribution, Student's t-distribution, binomial distribution, chi-square distribution, F-distribution, definition of density function and distribution function, calculating probability (area) under the density function for normal and t-distribution, calculating probability for binomial distribution, normal approximation to the binomial distribution)
- ✓ Explain point estimates of arithmetic mean, variance and proportion (central limit theorem, sampling distribution, standard error) Distinguish population parameters from their sample estimates; estimate population arithmetic mean (expected value), variance and proportion based on the sample
- ✓ Present hypothesis testing of arithmetic mean and proportion (rules and procedure of testing, type I ( $\alpha$ ) and type II ( $\beta$ ) errors, power of the test ( $1 - \beta$ ), testing (assumed constant) arithmetic mean and proportion of population
- ✓ Present interval estimates of expected value and proportion, testing of proportion, variances (F-test) and arithmetic mean (Student t-test) from two independent samples and testing difference of arithmetic means from two dependent samples (paired t-test)
- ✓ Present analysis of observed and expected frequencies for categorical variable using chi-square test
- ✓ Describe correlation analysis and calculate linear correlation coefficient for two continuous variables

### Language

All teaching activities will be held in Croatian. Foreign students will have the opportunity to attend additional office hours with the lecturers and be provided with teaching materials and literature in English.

### Literature

1. Biometrika course on e-learning system Merlin
4. Sokal, RR., Rohlf, FJ., 1995: Biometry. Freeman and Company. New York. 880 pp.
6. Kozak, A., Kozak, R., Staudhammer, C., Watts, S., 2008: Introductory probability and statistics: Applications for forestry and natural sciences. CABI International, 408 pp.

### Forms of teaching

Lectures (30), exercises (30)

### Assessment methods

Evaluation of exercise assignments, partial exams, written and oral final exam

## Department of Forestry Courses - Graduate Study Programmes (MSc)

### **FOREST ROAD DESIGN (code: 33908)**

<b>Original course title</b>	Projektiranje šumskih prometnica	<b>Status</b>	compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Tibor Pentek, PhD.; Assist. Prof. Ivica Papa, PhD.
<b>ECTS</b>	6	<b>Study level</b>	MSc

#### **Course content**

The course Forest Road Design focuses on the second phase of the establishment of an optimal network of forest roads in the field – the design. The design phase is divided in two components: field work and office work. The course covers the complex design procedure, defines the basic types of projects with an emphasis on and the elaboration of a detailed final forest road design. Students gain knowledge of the technical requirements and the required technical characteristics of forest roads in Croatia and the world. The course elaborates on the criteria for the categorization of primary forest roads. Students gain knowledge of the different phases of field work, measurement methods and procedures, and the collection of necessary data by using the classical method, the tachymeter, or GPS. The course explains the data processing in the classical method and on a personal computer. The course elaborates in detail on the rules and professional postulations to be observed in the horizontal and vertical development of the forest road route. It analyzes the positioning plan, the graphical longitudinal section and the graphical cross sections. The course explains methods for staking out horizontal curves, carriageway widening in horizontal curves and transition curves. The course also discusses normal profiles and drainage facilities. Students get acquainted with the topics of incurved and curved grade level, vertical curves and fitting the grade level. They also learn how to calculate the earth volume, make an earth volume diagram, they learn about equalizing and transport of materials. The course also deals with the technique and technology of construction and maintenance of forest roads and with the different methods for improving soil quality during the construction of forest roads. The course looks into the basic bridge types, forest fire protection roads and cable yarding.

#### **Learning outcomes**

- ✓ Explain forest road design and the basic elements of the transport of timber (determine the towing capacity for motor vehicles, resistance to the motion of vehicles, trucks, truck units, primary and secondary legislation, ordinances, guidelines, regulations, etc., direct/indirect pole setting or forest roads, design procedure for forest roads, documentation for forest road design).
- ✓ Analyze the detailed positioning plan of the forest road and use computer programs for the design of forest roads (zero line, operational and axial polygon of the forest road, design software, develop the final design for a forest road).
- ✓ Describe the staking out of main points and the methods for staking out detailed points of horizontal curves, transition curves and serpentines, detailed construction marking of the forest road cross-sections for the beginning of construction in the field.
- ✓ Explain the longitudinal section, the cross section and the lower layer of a forest road (written and graphical longitudinal cross section, design the incurved grade level, curved grade level, select the vertical curve radius, normal/type/orientation crosssections, advantages and disadvantages, possible problems and restrictions in the application of type-cross sections in specific cases).
- ✓ Recommend the structures for the safety/protection of the lower structure of a forest road and drainage facilities (retaining walls, types and forms of retaining walls, stability check and dimensioning of the

retaining walls, combination retaining and revetment walls, the effects of water on forest roads, surface and underground drainage facilities for forest roads).

- ✓ Evaluate the pavement construction and the causes of damage on forest roads (dimensioning of pavement constructions, stone pavements, causes of damage on forest roads, develop the final design of a forest road, positioning of road structures, final adjustments to the detailed positioning/situation plan).

### Language

All teaching activities will be held in Croatian. However, foreign students will have the opportunity to attend additional office hours with the lecturer and teaching assistants in English to help master the course materials. Additionally, the lecturer will refer foreign students to the corresponding literature in English, as well as give them the possibility of taking the associated exams in English.

### Literature

1. Anon., 2002: Forest Road Engineering Guidebook, B.C. Ministry of Forests, p. 1-208, odabrana poglavlja.
2. Anon., 2011: Colorado Forest Road Field Handbook, Colorado State Forest Service, p. 1-142, odabrana poglavlja.
3. Lacrombe, G., 1999: Forest Roading Manual, Liro Forestry Solutions, New Zealand, p. 1-404, odabrana poglavlja.
4. Ryan, T. et al., 2004: Forest Road Manual, Guidelines for the design, construction and management of forest roads, COFORD, Dublin, p. 1-156, odabrana poglavlja.

### Forms of teaching

Lectures (30 h), exercises (30 h), 4 days of field work

### Assessment methods

Oral exams

## MECHANISATION OF WOOD LOGGING (code: 33901)

<b>Original course title</b>	Mehanizacija pridobivanja drva	<b>Status</b>	compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	Assist. Prof. Zdravko Pandur, PhD., Prof. Marijan Šušnjar, PhD.
<b>ECTS</b>	7	<b>Study level</b>	MSc

### Course content

Students learn in details about the development, bases and classification of the most important forest machines for mechanisation of wood logging, principles of their building and their most important energetic, ecological and ergonomic features. After having met the components of forest machines, their driving engines, the lectures include morphological and other analyses of the individual group of machines, like devices for cutting and processing (motor chain saws), equipment of mechanised loading and unloading (forest cranes and forest winches), special forest vehicles (adapted agricultural tractors, skidders, forwarders, forest trucks). Special emphasis is given to the analysis of dynamic burden of a vehicle and the method of transfer of force from a wheel to the soil – Basic mechanics of motor vehicles: resistance of vehicle movement, slipping, pitch resistance, resistance in vehicle acceleration, air resistance, calculation of drawbar pull, basis of the system wheel-soil, forest

soil and realisation of drawbar pull. Students also learn about the machines for logging and using forest biomass as an energy source.

### Learning outcomes

- ✓ Compare machines for tree felling and processing – motor chainsaws (history development, parts and elements, chainsaw use in Croatia, energy and environmental suitability of 2-stroke engines, chain (construction and maintenance), ergonomic features, guidelines of development, morphological analysis of chainsaw).
- ✓ Recommend machines for tree felling and processing – Harvesters (basic technical features, types, morphological, ergonomic, energy and environmental characteristics of harvester).
- ✓ Recommend forest vehicles for timber logging – Skidders, Forwarders (construction, types of skidders and forwarders, technical features, principle of Diesel engine, environmental suitability, morphological features).
- ✓ Present machines for timber transport – tractor assemblies (adapted farming tractor, adaptation for forest work, farming tractor equipped with forest winch, tractor with semi-trailer and crane).
- ✓ Present other machines of mechanised timber logging (forest trucks for timber transport, forest cableways, forest biomass chippers).

### Language

All teaching activities will be held in Croatian. However, foreign students will have the opportunity to attend additional office hours with the lecturer and teaching assistants in English to help master the course materials. Additionally, the lecturer will refer foreign students to the corresponding literature in English, as well as give them the possibility of taking the associated exams in English.

### Literature

1. CD with lectures in „Windows Power Point“ presentations with printed version.
2. Bekker, M., G., 1956: Theory of land locomotion, The University of Michigan Press, 1 – 499.
3. Bekker, M., G., 1960: Off-the-road locomotion, The University of Michigan Press, 1 – 215.
4. Bekker, M., G., 1969: Introduction to Terrain-Vehicle Systems, prijevod Mašinstroenije 1973., 1– 20.
5. C. E. Malmberg: The off-road vehicle. (Volume 1) Atlanta, USA, Montreal, Canada, 1989., s.1 573.
6. C. E. Malmberg: The off-road vehicle. (Volume 2) Atlanta, USA, Montreal, Canada, 1989., s.1 463.
7. Conway, S., 1976: Logging practices., Principles of timber harvesting systems. Miller Freeman Publications, 1 – 432.
8. Selected professional and scientific papers published in scientific journals which are available for students in the libraries of Faculty of Forestry and Forest Engineering Institute.
9. MacDonald, A.J., 1999: Harvesting Systems and Equipment in British Columbia. FERIC, Handbook No. HB-12, 1 – 197.
10. Owende, P. M. O., Lyons, J., Haarlaa, R., Peltola, A., Spinelli, R., Molano, J., Ward, S. M., 2002: Operations protocol for Eco-efficient Wood Harvesting on Sensitive Sites. Project ECOWOOD, Funded under the EU 5th Framework Project (Quality of Life and Management of Living Resources) Contract No. QLK5-1999-00991 (1999-2002), 1 – 74.
11. Saarilahti, M., 2002A: Soil interaction model. Project deliverable D2 (Work package No. 1) of the Development of a Protocol for Ecoefficient Wood Harvesting on Sensitive Sites (ECOWOOD). EU 5th Framework Project (Quality of Life and Management of Living Resources) Contract No. QLK5-1999-00991 (1999-2002), 1 – 87.
12. Staff, K.A.G., Wiksten, N.A., 1984: Tree harvesting Techniques. Martinus Nijhoff/DR W. Junk Publishers, Dodrecht/Boston/Lancaster, 1 – 371.
13. Professional and scientific papers from international conferences deal with forest work mechanization according to the choice of lecturer (available in the library of Forest Engineering Institute).

### Forms of teaching

Lectures (45 h), exercises (30 h), field work

### Assessment methods

Written exam, oral ex

# APPLIED ZOOECOLOGY (code: 73827)

<b>Original course title</b>	Primijenjena zoekologija	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Josip Margaletić, PhD, Asst. prof. Marko Vucelja, PhD
<b>ECTS</b>	2	<b>Study level</b>	MSc

## Course content

Students are acquainted with the basic ecological factors which lead to the excessive reproduction of certain animal species which can result in significant damage in forest ecosystems. They are acquainted with ecological valences and ways in which a certain pest reacts to specific ecological factors, with the objective of successfully eliminating pest species and preventing damages which they can cause in forests.

## Learning outcomes

- ✓ Presenting analytical zoecology (ecological factors affecting the dynamics of animal populations in urban forests and protected forest areas, homotypic and heterotypic relationships within animal populations, animal population dynamics and methods determining abundance (primary, secondary, tertiary), spatial (micro distribution and macrodistribution) distribution of animal populations in urban forests.
- ✓ Determining the dynamics of animal populations (oscillations and fluctuation types, spatial aspect of population dynamics, population theory, sinocology, zoocenosis - species and dynamics, biological equilibrium ecosystem succession and equilibrium, animal population structural changes)

## Language

All teaching activities will be held in Croatian. Foreign students will have the opportunity to attend additional office hours with the lecturer and teaching assistants in English to help master the course materials. Foreign students will be provided to the corresponding literature in English, as well as give them the possibility of taking the associated exams in English.

## Literature

1. Androić, M. 1970. The basics of zoecology with a special emphasis on entomofaunus. Publishing-printing company 'A.G. Matoš ', Samobor. 152 p.
2. Elton, C. 1968. Animal Ecology, Methuen&Co. Ltd and Science Paperbacks, London, 207 pp.
3. Stoddart, D.M. 1979. Ecology of small mammals. Chapman and Hall Ltd., London. 279 pp.
4. Flowerdew, J.R., Gurnell, J., Gipps, J.H.W. 1985. The Ecology Woodland Rodents, Bank Voles and Wood Mice. The Zoological Society of London, Clarendon Press, Oxford. 409 pp.
5. Zabel, C.J., Anthonz, R.G., 2003. Mammal Community Dynamics, Cambridge University Press, 709 pp.

## Forms of teaching

Lectures (15 h)

## Assessment methods

Written exam. Term papers and student oral presentations.

# BEHAVIOURAL ECOLOGY (code: 73822)

<b>Original course title</b>	Behavioural ecology	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Josip Margaletić, Ph.D.
<b>ECTS</b>	2	<b>Study level</b>	MSc

## Course content

The course is planned in a way to cover the central features in behavioural ecology. Particular emphasis will be put on animal behaviour in evolutionary perspective. Course also handles different behavioural mechanisms, which are important for basic understanding of behavioural ecology (e.g. interaction between individual interests, social behaviour and life history and the role of behavioural ecology in conservation biology).

## Learning outcomes

- ✓ Identify the main scientists and their research that set the foundations of ethological research.
- ✓ Identify the difference between the ultimate and proximal causes of animal behavior.
- ✓ List the types of innate and learned behaviors.
- ✓ Identify the mechanisms responsible for the innate and learned behavior.
- ✓ Identify examples of natural and sexual selection and the impact of both on the development and behavior of animal species.
- ✓ Identify in nature different types of behavior and appearance of animals due to natural and sexual selection.
- ✓ Classify different reproductive strategies of animals with an emphasis on monogamy and polygamy.
- ✓ Identify various mechanisms in females and males responsible for brood care.
- ✓ Identify sexual dimorphism and identify intrasexual and intersexual selection.
- ✓ Recognize types of animal behavior in nature depending on their habitats.
- ✓ Recognize link between the importance of habitat adaptation and the protection of animal species.
- ✓ Summarize the main hormones with an emphasis on sex hormones and their role in animal behavior.

## Language

All teaching activities will be held in Croatian. Foreign students will have the opportunity to attend additional office hours with the lecturers and be provided with teaching materials and literature in English.

## Literature

1. Alcock J. Animal Behavior: An Evolutionary Approach. Seventh Edition. Sunderland (MA): Sinauer Publishers, 2001
2. Eibel-Eibesfeldt, I. Grundriss der vergleichenden Verhaltensforschung. München : Verlag Piper, 1969.
3. Pullin, A. S. Conservation Biology. Cambridge University Press, 2002.

## Forms of teaching

Lectures (15 h)

## Assessment methods

Written exam. Term papers and student oral presentations. Obligatory class attendance



# ETHOLOGY (code: 86139)

<b>Original course title</b>	Ethology	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Josip Margaletić, PhD
<b>ECTS</b>	2	<b>Study level</b>	MSc

## Course content

The course is planned in a way to cover the central features of ethological studies. Emphasis will be put on species behaviour according to its own environment. Different behavioural mechanisms which determine survival of species as well as continuous adaptations of behaviour will be handled with emphasis on learning in animals. Course should also provide an insight into importance of human behaviour and its impact on natural ecosystems and urban environment.

## Learning outcomes

- ✓ Identify the main scientists and their work that set the foundations of ethological research.
- ✓ Identify the difference between the ultimate and proximal causes of animal behaviour.
- ✓ Identify innate behaviours in animals.
- ✓ Identify different animal learning mechanisms.
- ✓ Identify examples of natural and sexual selection and the impact of both on the development and behaviour of animal species.
- ✓ Link the behaviour of animals in nature depending on their reproduction or survival.
- ✓ Classify different reproductive strategies of animals with emphasis on monogamy and polygamy.
- ✓ Identify sexual dimorphism and identify intrasexual and intersexual selection.
- ✓ Identify various mechanisms in females and males responsible for their own offspring.
- ✓ Recognize different types of animal behaviour in nature depending on their habitats.
- ✓ Recognize relationship between the importance of habitat adaptation and the protection of animal species.
- ✓ Summarize the main hormones with an emphasis on sex hormones and their role in animal behaviour.

## Language

All teaching activities will be held in English as well as all learning material in English will be provided to the students.

## Literature

1. Alcock J. Animal Behavior: An Evolutionary Approach. Seventh Edition. Sunderland (MA): Sinauer Publishers, 2001
2. Bolton, M. Conservation and the Use of Wildlife Resources. Chapman & Hall, 1997.
3. Caro, T., ed. Behavioral ecology and conservation biology. Oxford University Press, New York, 1998.

## Forms of teaching

Lectures (15 h)

## Assessment methods

Written exam. Term papers and student oral presentations. Obligatory class attendance.

# GENERAL AND LANDSCAPE ECOLOGY (code: 197348)

<b>Original course title</b>	General and Landscape Ecology	<b>Status</b>	compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Ivica Tikvić, PhD; Assoc. Prof. Damir Ugarković, PhD
<b>ECTS</b>	6	<b>Study level</b>	MSc

## Course content

The course General and Landscape Management covers the basics of ecology, the historical development of ecology and its sub-branches, relationship and position of ecology with other scientific disciplines, significance of ecology for human civilization, global and regional ecological problems. Introduction into landscape ecology, concept of landscape, definition of landscape, function and changes to landscape, elements of landscape. Concept of ecosystem, the main types of ecosystems on Earth, biological relationship, processes of production and decomposition in ecosystems, homeostatic relationships in ecosystems, endangerment and decay of ecosystems. Landscape diversity, energy cycling, changes and stability of landscapes. Types of biogeochemical cycling of matter, ecological patterns, physical factors crucial for the development of organisms, temperature, light, radiation, water, climate, nutrients, organisms in ecosystems, plants, animals, microorganisms, relationships of organisms at the population and community levels, types of interactions and types in ecosystems. The ecology of fresh water systems, ecological relationships in lakes and streams, ecology of the sea, organisms and zones in seas. Ecology of terrestrial ecosystems on earth, tundra, evergreen forests of northern regions, rainforests of North America, forests in moderate regions, subtropical deciduous forests, grasslands of moderate regions, tropical savannas, tropical rain forests, deserts. Influence of agriculture, forestry and hunting on natural resources. Ecology of man, landscape structures, analysis of landscape elements, natural processes in landscapes, forms of relief, hydrological systems, geological foundations, anthropogenic influences. Landscape planning and management.

## Learning outcomes

- ✓ Adopt basic principles for the protection of forests against abiotic and biotic factors and to apply the basic procedures and means for forest protection.
- ✓ Participate in the realization of a program of management of protected nature facilities.
- ✓ Collaborate on the development of environmental studies and environmental spatial plans.
- ✓ Plan and organize an integrated environmental management.
- ✓ Plan and organize professional tasks of the implementation of economic programs of protected nature facilities.

## Language

All teaching activities will be held in English as well as all learning material in English will be provided to the students.

## Literature

1. EKOLOŠKI LEKSIKON, Glavni urednik Oskar Springer, Zagreb: Barbat, Ministarstvo zaštite okoliša i prostornog uređenja Republike Hrvatske, 2001., 361 str.
2. Vjekoslav Glavač, 1999. UVOD U GLOBALNU EKOLOGIJU, Državna uprava za zaštitu prirode i okoliša : Hrvatske šume. 207 str., Zagreb.
3. Mihovil Gračanin, Ljudevit Ilijanić, UVOD U EKOLOGIJU BILJA, Školska knjiga, Zagreb 1977.
4. ŠUMARSKA ENCIKLOPEDIJA, Jugoslavenski leksikografski zavod, Zagreb, Knjiga 1,1980, Knjiga 2, 1983, Knjiga 3, 1987.
5. Daniel B. Botkin, Edward A. Keller: ENVIRONMENTAL SCIENCE EARTH AS A LIVING PLANET (1-649 str.)

6. Eugene P. Odum, 1971.: FUNDAMENTALS OF ECOLOGY (1-574 str.)
7. Robert E. Ricklefs, 1990.: ECOLOGY (1-885 str.)
8. Biološka i krajobrazna raznolikost Hrvatske, Državna uprava za zaštitu prirode i okoliša, Zagreb 1999, str. 151.
9. Richard T.T. Forman, Michel Godron, 1986: Landscape Ecology. John Wiley and Sons, Inc. New York, p. 1-620.
10. Biodiversity, E.O.Wilson, Editor, National Academy of Science, 1988, p. 521

### Forms of teaching

Lectures (30h)

Exercises (15h)

Field work (2 days)

### Assessment methods

Written tests, passive grades from exercises, passive grades from lectures, exercises, and field work attendance, oral exam

## INNOVATIONS IN FORESTRY (code: 33956)

<b>Original course title</b>	Inovacije u šumarstvu	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Mario Šporčić, PhD.
<b>ECTS</b>	2	<b>Study level</b>	MSc

### Course content

Future for those who live on income earned in forestry greatly depends on how decision-makers (forest owners, forest managers, institutions, state authorities and research organizations) respond to transition and globalization changes. An appropriate approach to new understandings and application thereof is an essential condition of forest development. Changes will be initiated by establishing continuous cooperation with the INNOFORCE Regional Project Centre with the purpose of creation a system in a totally unregulated forestry sector in Croatia. Students will „see through“ case study presentations dealing with product innovations, service innovations, technology innovations and organization. Through interactive work they will become acquainted with the following cycle: „What is an innovation? Innovation created through permanent employment status, institutional support to innovation activities (authorised ministries and institutes, Croatian Government; local self-government, chamber system; non-profit sector, innovators; concentrated technological development centres; consultant networks, legislation dealing with intellectual ownership protection).“ After the work has successfully been carried through, every student will be able to understand that: „To conceptualize something different from the already seen does not necessarily make an innovator, because innovators differ from others on the basis of their objectives, professionalism level, level of affiliation and level of organization. RPC INNOFORCE (<http://www.boku.ac.at/innoforce/>) will become and remain a point of „frequent visiting“ for majority of students“!

### Learning outcomes

- ✓ Depict the state of innovation and innovativeness in forestry (significance, role and division of innovations, stages of innovation process, innovation systems and monitors, company-level innovations, factors of innovation activity, conditions for innovation activity, innovation behavior, sources of impulses and information for innovation, support and innovation constraints).
- ✓ Explain creativity and inventiveness (features of creativity and inventiveness, process and stage of creative thinking, characteristics of creative people, techniques of encouraging creative thinking, evaluation and choice of ideas/solutions).
- ✓ Expose institutional support for innovation activities and examples of good practice.

### Language

All teaching activities will be held in Croatian. However, foreign students will have the opportunity to attend additional office hours with the lecturer in English. Additionally, the lecturer will refer foreign students to the corresponding literature in English, as well as give them the possibility of taking the associated exams in English.

### Literature

1. Srića, V.: Creativity and Innovation Management: A storytelling approach. Kindle Edition, 2016. 177 p.
2. Šporčić, M., Posavec, S., Landekić, M., Pentek, T., Poršinsky, T., Lepoglavec, K., 2014: Development and Implementation of Innovations in Croatian Forestry.
3. Proceedings of JOINT 5th FEC & 47th FORMEC conference „Forest Engineering: Propelling the Forest Value Chain“, Gerardmer, France, 23-26 September 2014, 8 p.
4. Martinić, I., Vondra, V., Šporčić, M., 2007: Development of a new concept for improvement of forest techniques in Croatia – Areas of possible contributions. Croatian Journal of Forest Engineering, vol. 28 (1): 47-55.
5. Martinić, I., Šporčić, M., Vondra, V., 2006: Inovacijski procesi kao ključ provedbe Hrvatske šumarske politike. Glasnik za šumske pokuse, pos. izdanje 5: 703-715.
6. Rametsteiner, E., Weiss, G., Kubeczko, K.: Innovation and entrepreneurship in forestry in central Europe. Leiden Brill Academic Publishers, 2005., 179 p.
7. OECD, 2005: Guidelines for Collecting and Interpreting Innovation Data. Oslo Manual, 3rd edition. OECD, Luxembourg, 162 p.
8. Srića V.: Kako postati pun ideja. M.E.P. Consult, Zagreb, 2003.

### Forms of teaching

Lectures, student presentations, solving of individual problem tasks (15 h).

### Assessment methods

The evaluation of students` knowledge and achievements has been conducted during the classes and by written exams

## METHODS OF PLANT TAXONOMY (code: 197792)

<b>Original course title</b>	Methods of Plant Taxonomy	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Jozo Franjić PhD, Prof. Željko Škvorc PhD, Assist. Prof. Martina Temunović PhD
<b>ECTS</b>	2	<b>Study level</b>	MSc

### Course content

Taxonomy definition - the relationship between taxonomy and other scientific disciplines, basic taxonomic terminology. Phylogeny. Nomenclature, understanding of the taxon concept. Taxonomic ranks (above and below the rank of species). The process of speciation, apomixis, hybridization, introgression, polyploidy. Identification of plants, usage of plant identification keys and floristic handbooks. Significance of herbarium collections. Methods of collecting and processing various types of taxonomic data – comparative morphology, paleobotany, geography, cytology, serology, biochemistry, molecular taxonomy and systematics, cladistics. Statistical analysis methods of taxonomic data from various sources. Data analysis software.

### Learning outcomes

- ✓ To explain basic principles and terminology in plant taxonomy (phylogeny, plant nomenclature, understanding of the taxon concept, evolution, speciation)
- ✓ To use plant identification keys, floristic handbooks, herbarium collections and herbarium material for plant identification.
- ✓ To define taxonomic problems and to recommend appropriate methods of collecting and processing suitable types of taxonomic data (morphology, anatomy, cytology and biochemistry, phytogeography, paleobotany, molecular taxonomy).
- ✓ To analyse taxonomic data and to interpret the obtained results.

### Language

All teaching activities will be held in English.

### Literature

1. Vidaković, M., J. Franjić, 2004: Golosjemenjače. Sveučilište u Zagrebu-Šumarski fakultet. Zagreb
2. Franjić, J., Ž. Škvorc, 2010: Šumsko drveće i grmlje Hrvatske. Sveučilište u Zagrebu – Šumarski fakultet, 432 str. Zagreb.
3. Franjić, J., Ž. Škvorc, 2014: Šumsko zeljasto bilje Hrvatske. Sveučilište u Zagrebu – Šumarski fakultet, 626 str. Zagreb.
4. Judd, W. S., C. S. Campbell, E. A. Kellogg, P. F. Stevens 2007: Plant Systematics. A Phylogenetic Approach. 3rd edition. Sinauer Associates. Sunderland.
5. Stuessy, T. F. 2009: Plant taxonomy: The systematic evaluation of comparative data. 2nd edition. Columbia University Press, New York.
6. Nikolić, T., 1996: Herbarijski priručnik, 1-167. Zagreb.
7. Nikolić, T., 2013: Sistematska botanika - Raznolikost i evolucija biljnog svijeta. Alfa d.d., 882 str. Zagreb.
8. Domac, R., 1994: Flora Hrvatske, priručnik za određivanje bilja. Školska knjiga, Zagreb.
9. Singh, G. 2016: Plant Systematics, 3rd edition: An Integrated Approach. CRC Press.
10. Besse, P. (ur.) 2014: Molecular plant taxonomy: methods and protocols. Humana Press.
11. Winston, J.E. 1999: Describing Species, Practical Taxonomic Procedure for Biologist. Columbia University Press, New York
12. Clive, S., 2005: Plant taxonomy and biosystematics-does DNA provide all the answers? Taxon 54: 999-1007.

### Forms of teaching

Lectures (15 h)

### Assessment methods

Written exam

## PLANNING OF TECHNOLOGICAL OPERATIONS (code: 33955)

Original course title	Planiranje tehnoloških operacija	Status	elective
Semester	winter	Course teacher	Prof. Tomislav Poršinsky, PhD.
ECTS	2	Study level	MSc

### Course content

Methods of planning technological operations of tree felling, processing, skidding and a long-range transport, work preparation, applied methods planning and preparation of forest utilisation works, classical sources of data

for planning, computer database, introduction of contemporary technologies and possibility of GIS and GPS technology application, logical connection of participants in the production process and a long-range wood transport in the system – forest administration, forest management, working site, auxiliary storage place, buyer, mean of transport, logistics, logistics in top technologies, working design of the site by classical and contemporary technologies.

### Learning outcomes

- ✓ Analyse elements of strategic-tactical planning of timber harvesting (terrain classification for forestry operations and mobility model of a cable skidder).
- ✓ Evaluate the tactical-operational planning of timber harvesting operations (components of tactical-operational planning of timber harvesting, timber harvesting operations in space and time, operational planning and supervision of timber harvesting procedures, logistics of timber harvesting in a harvester – forwarder system).
- ✓ Determine the cost calculations for timber harvesting (types of costs and methods of cost calculations).

### Language

All teaching activities will be held in Croatian and foreign students will have the opportunity to attend additional office hours with the lecturer and teaching assistants in English to help master the course materials.

### Literature

1. Anon., 2001: Forest Development Plan Guidebook. Forest Practices Code of British Columbia, 1 – 113.
2. Chipping, D.H., 1999: Timber Harvesting Plan Handbook. California Native Plant Society, 1 – 47.
3. Shaffer, R.M., 1997: A Logger's Guide to Harvest Planning. Virginia Cooperative Extension, Publication 420-088, 1 – 4.
4. Silversides, C.R., Sundberg, U., 1989: Operational Efficiency in Forestry – Volume 2: Practice. Kluwer Academic Publishers – Forest Sciences, Dordrecht/Boston/Lancaster, 1 – 169.
5. Staff, K.A.G., Wiksten, N.A., 1984: Tree harvesting Techniques. Martinus Nijhoff/DR W. Junk Publishers, Dordrecht/Boston/Lancaster, 1 – 371.
6. Sundberg, U., Silversides, C.R., 1988: Operational Efficiency in Forestry – Volume 1: Analysis. Kluwer Academic Publishers – Forest Sciences, Dordrecht/Boston/Lancaster, 1 – 219.

### Forms of teaching

Lectures (15 h)

### Assessment methods

Designing seminar papers, final exam

# ZOOECOLOGY IN FOREST ECOSYSTEMS

## (code: 73826)

<b>Original course title</b>	Zoekologija u šumskim ekosustavima	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Josip Margaletić, Ph.D., Assistant Prof. Marko Vucelja, Ph.D.
<b>ECTS</b>	2	<b>Study level</b>	MSc

### Course content

Students are acquainted with the basic ecological factors which lead to the excessive reproduction of certain animal species which can result in significant damage in forest ecosystems. They are acquainted with ecological valences and ways in which a certain pest reacts to specific ecological factors, with the objective of successfully eliminating pest species and preventing damages which they can cause in forests.

### Learning outcomes

- ✓ Presenting analytical zoecology (ecological factors affecting the dynamics of animal populations in forest ecosystems, homotypic and heterotypic relationships within animal populations, animal population dynamics and methods determining abundance (primary, secondary, tertiary), spatial (micro distribution and macrodistribution) distribution of animal populations in forests.
- ✓ Determining the dynamics of animal populations (oscillations and fluctuation types, spatial aspect of population dynamics, population theory, sinocology, zoocenosis - species and dynamics, biological equilibrium ecosystem succession and equilibrium, animal population structural changes).

### Language

All teaching activities will be held in Croatian. Foreign students will have the opportunity to attend additional office hours with the lecturers and be provided with teaching materials and literature in English.

### Literature

1. Androić, M. 1970. Osnovi zoekologije s osobitim osvrtom na entomofaunu. Izdavačko-tiskarsko poduzeće 'A.G. Matoš', Samobor. 152 str.
2. Elton, C. 1968. Animal Ecology, Methuen&Co. Ltd and Science Paperbacks, London, 207 pp.
3. Stoddart, D.M. 1979. Ecology of small mammals. Chapman and Hall Ltd., London. 279 pp.
4. Flowerdew, J.R., Gurnell, J., Gipps, J.H.W. 1985. The Ecology Woodland Rodents, Bank Voles and Wood Mice. The Zoological Society of London, Clarendon Press, Oxford. 409 pp.
5. Zabel, C.J., Anthonz, R.G., 2003. Mammal Community Dynamics, Cambridge University Press, 709 pp.

### Forms of teaching

Lectures (15 h)

### Assessment methods

Written exam. Term papers and student oral presentation

# ENVIRONMENTALLY SOUND TECHNOLOGIES

## (code: 52493)

<b>Original course title</b>	Okolišno prihvatljive tehnologije	<b>Status</b>	compulsory
<b>Semester</b>	summer	<b>Course teacher</b>	Prof. Tomislav Poršinsky, PhD., Assist. Prof. Andreja Đuka, PhD., Assist. Prof. Zdravko Pandur, PhD.
<b>ECTS</b>	4	<b>Study level</b>	MSc

### Course content

The basic task of the subject is to inform about the efficient and environmentally acceptable machine methods of wood logging, building forest roads, ecologically acceptable methods of work used in that and the consequences of the use of techniques and technologies in a forest ecosystem. In this, students are taught in details about the various kinds of damaging forest soil, trees and second growth during the work with classical forest technologies as well as with consequences of the use of environmentally acceptable technologies. Procedures of decreasing degree of damaging (choice of technology, organisation of work, choice of a machine, planning method, etc.) as well as a method of rehabilitation make a significant component of the subject.

The subject Environmentally acceptable technologies informs students about the advantages and shortcomings of building forest roads in the natural environment – forest ecosystem. Negative consequences of building forest roads for habitat components are analysed, but possibilities of decrease of damages, i.e. their rehabilitation are suggested. The environmental-ecological and sociological aesthetic aspect of planning primary and secondary forest roads is observed separately. Methods of determining endangered (risky) areas are described using GIS. Ecologically acceptable technologies of wood logging are discussed, as well as building of forest roads on sloped terrains and in a lowland area. Conventional and non-conventional methods of soil stabilisation are also considered. Students also learn about biologically-technical methods of rehabilitation of a dam slope and a slope of a forest road excavation.

One of the tasks of the course is to inform students about the basic features of force transmission from the movement system to the soil, tensile features of a vehicle and consequences of a vehicle activity on the soil by normal and tangential forces. The course includes basic analysis of forest vehicles, their dimensional and mass features (morphological analysis). Evaluation methods of a tensile feature and soil compaction are dealt with. Students learn about the measuring equipment for the estimate of soil compaction.

The subject includes lectures, field classes, exercises, computer exercises and seminar papers conceived in a contemporary way and with the use of contemporary teaching methods. Students will be assessed through colloquiums, written and oral part of the examination.

### Learning outcomes

- ✓ Analyse soil compaction and rutting (soil bearing capacity, critical comment on methods of measuring soil bearing capacity, soil penetration resistance and cone index, wheel index, assessment of vehicle mobility according to WES method, soil compaction – reasons and consequences).
- ✓ Present and describe stand damage (type of erosion processes and consequences for forest stand, soil erosion as a result of timber harvesting operations, erosion intensity in different timber harvesting systems, methods and measures for the protection of waterways).



- ✓ Recommend technology for the construction of forest roads in different terrain categories (mechanical and classical chemical stabilisation of the soil, contemporary chemical stabilisation of soil, soil stabilisation with geo-synthetics).
- ✓ Analyse maintenance and reconstruction of forest roads (criteria, reasons/needs, priorities, justification, technological process, schematic/graphical display, technical documentation, adaptation of the procedure of timber harvesting, forest road closing and forest road conversion, removal of forest roads and stand revitalisation, study of modernisation of forest road pavement structure).
- ✓ To evaluate the environmental benefits of forest machines (environmental pollution with exhaust gases and pollutants from forest machines, impact of working conditions on fuel consumption, ecological norms for exhaust gases, technical solutions for reducing the amount of harmful exhaust gases, energy balance, ecologically acceptable wood harvesting technologies, application of bio-fuels and bio-oils in forest vehicles).
- ✓ To analyse development of forest vehicles (development and construction of forest vehicles with hybrid drive, remote monitoring systems for forest machines and vehicles).

## Language

All teaching activities will be held in Croatian. However, foreign students will have the opportunity to attend additional office hours with the lecturer and teaching assistants in English to help master the course materials. Additionally, the lecturer will refer foreign students to the corresponding literature in English, as well as give them the possibility of taking the associated exams in English.

## Literature

1. Powerpoint lectures Anon., 2012: FP Inovation. Timber Transport Research – FERIC's Star Truck Project. Logging-on newsletter. Available on [http://www.loggingon.net/timber-transport-research-ferics-star-truck-project\\_news\\_op\\_view\\_id\\_43](http://www.loggingon.net/timber-transport-research-ferics-star-truck-project_news_op_view_id_43)
2. Heinemann, H. R. 1998: Opening-up planning taking into account environmental and social integrity, Proceedings of the Seminar on Environmentally sound forest roads and wood transport, Sinaia (Romania), 17-22 June 1996., p. 62-72.
3. Pentek, T., Pičman, D., Nevečerel, H. 2004: Environmental – ecological component of forest road planning and designing International scientific conference: Forest constructions and ameliorations in relation to the natural environment, Technical University in Zvolen, Slovakia, 16th – 17th September 2004. Proceeding CD/DVD MEDIJ, p. 94-102.
4. Winkler, N. 1998: Environmentally Sound Road Construction in Mountainous Terrain, Food and Agriculture Organization of the United Nations, Rome, p.1-54.
5. Arnup, R.W., 1999: The extent, effect and management of forestry-related soil disturbance, with reference to implications for the Clay Belt: a literature review. Ontario Ministry of Natural Resources, Northeast Science & Technology, TR-37, 1 – 30.
6. Häyrinen, T., 1998: Forest road planning and landscaping, Proceedings of the Seminar on „Environmentally sound forest roads and wood transport“, Sinaia (Romania), 17-22, June 1996., p. 50- 61.
7. Heinrich, R., 1998: Recent developments on environmentally friendly forest road construction and wood transport in mountainous forests, Proceedings of the Seminar on Environmentally sound forest roads and wood transport“, Sinaia (Romania), 17-22, June 1996., p. 366-376.
8. Hori, T., Y. H. Li, 1989: Terrain classification for forest road network planning by using slopegradient distribution. I. Investigation of terrain indices, Journal of the Japanese Forestry Society. 1989, 71: 8, p. 303-308.
9. Hori,T., Y. H. Li, 1990: Terrain classification for forest road network planning by using slope gradient distribution. II. Supplementary investigation of terrain indices and slope gradient percentages, Journal of the Japanese Forestry Society. 1990, 72: 2, p. 151-153.
10. Pičman, D., Pentek, T., Poršinsky, T. (2001): Relation between Forest Roads and Extraction Machines in Sustainable Forest Management, FAO/ECE/ILO & IUFRO Workshop on „New Trends in Wood Harvesting with Cable Systems for Sustainable Forest Management in the Mountains“, Osiach, Austrija, 18-24.06. Workshop Proceedings, June 2001., p. 185-191.
11. Pičman, D., Pentek, T., Poršinsky, T. (2002): Some Consequences of Secondary Forest Roads Construction in Mountainous Area, Proceedings of International conference „Logistics of wood technical production in the Carpathian mountains“, p. 191-198, Zvolen, Slovakia, 09-10.09.2002.

12. Saarilahti, M., Anttila, T., 1999: Rut depth model for timber transport on moraine soils. Proceedings of 13th International Conference of the ISTVS, September 14 – 17, 1999, Technische Universität München, Germany, Volume I: 29 – 37.
13. Saarilahti, M., 2002A: Soil interaction model. Project deliverable D2 (Work package No. 1) of the Development of a Protocol for Ecoefficient Wood Harvesting on Sensitive Sites (ECOWOOD). EU 5th Framework Project (Quality of Life and Management of Living Resources) Contract No. QLK5- 1999-00991 (1999-2002), 1 – 87.
14. Saarilahti, M., 2002B: Dynamic terrain classification – Modelling of the seasonal variation of the trafficability on forest sites. Soil interaction model, Appendix Report No 1, 1 – 22.
15. Saarilahti, M., 2002C: Evaluation of the WES-method in assessing the trafficability of terrain and the mobility of forest tractors – Part 1: WES mobility models. Soil interaction model, Appendix Report No 2, 1 – 39.
16. Saarilahti, M., 2002D: Evaluation of the WES-method in assessing the trafficability of terrain and the mobility of forest tractors – Part 2: Comparison of the different WES-models. Soil interaction model, Appendix Report No 3, 1 – 28.
17. Saarilahti, M., 2002E: Evaluation of the WES-method in assessing the trafficability of terrain and the mobility of forest tractors – Part 3: Interpretation and application of results. Soil interaction model, Appendix Report No 4, 1 – 15.
18. Saarilahti, M., 2002F: Modelling of the wheel and tyre, 1. Tyre and soil contact – Survey on tyre contact area and ground pressure models for studying the mobility of forest tractors. Soil interaction model, Appendix Report No 5, 1 – 43.
19. Saarilahti, M., 2002G: Modelling of the wheel and tyre, 2. Tyre stiffness and deflection – Survey on tyre deflection models for studying the mobility of forest tractors. Soil interaction model, Appendix Report No 6, 1 – 15.
20. Saarilahti, M., 2002H: Modelling of the wheel and tyre, 3. Tyre/soil models for predicting rut formation and soil compaction – Survey on soil deformation models for studying the mobility of forest tractors. Soil interaction model, Appendix Report No 7, 1 – 19.
21. Saarilahti, M., 2002I: Modelling of the wheel and soil, 4. Forest soil properties – Survey on forest soil properties and soil compaction for studying the mobility of forest tractors. Soil interaction model, Appendix Report No 8, 1 – 37.
22. Owende, P. M. O., Lyons, J., Haarlaa, R., Peltola, A., Spinelli, R., Molano, J., Ward, S. M., 2002: Operations protocol for Eco-efficient Wood Harvesting on Sensitive Sites. Project ECOWOOD, Funded under the EU 5th Framework Project (Quality of Life and Management of Living Resources) Contract No. QLK5-1999-00991 (1999-2002), 1 – 74. 146
23. Yoshimura, T. & K. Kanzaki 1998: Fuzzy expert system laying out forest roads based on the risk assesment, Proceedings of the Seminar on „Environmentaly sound forest roads and wood transport“, Sinaia (Romania), 17-22 June 1996., p. 144-150.
24. Wolf, W., 1998: Assessment of forest roads alternatives with special emphasis on environmentalprotection, Proceedings of the Seminar on „Environmentaly sound forest roads and wood transport“, Sinaia (Romania), 17-22 June 1996., p. 130-143.

#### Forms of teaching

Lectures (30 h), exercises (30 h), field work (3 days)

#### Assessment methods

Written exam, oral exam

## FOREST ACCESSIBILITY (code: 33904)

<b>Original course title</b>	Otvaranje šuma	<b>Status</b>	compulsory
<b>Semester</b>	summer	<b>Course teacher</b>	Prof. Tibor Pentek, PhD., Prof. Tomislav Poršinsky, PhD., Assist. Prof. Ivica Papa, PhD.
<b>ECTS</b>	6	<b>Study level</b>	MSc

### Course content

The aim of this course is to transfer the knowledge to students on the first phase of establishing a forest road network – planning. The emphasis is placed on the importance of planning of primary and secondary forest roads for rational forestry management with a survey of the historical development of forest accessibility in Croatia and the world. Different systems of primary and secondary forest accessibility are defined. The course defines classical accessibility, relative openness and target forest accessibility as well as the average timber extraction distance. Students get acquainted with optimal forest accessibility and different calculation models for its calculation. The course presents a functional approach to forest accessibility with economic, technical-technological, environmental-ecological, sociological and aesthetic and overall optimization. Geographical information system (GIS) is introduced and defined as the basis for making the best forest accessibility decisions. Students are acquainted with the global positioning system (GPS) and its application in the development of forest road registers. Detailed description is given of methodological studies of primary and secondary forest accessibility, determining precisely the phases and methods of work. Information is given on computer models of forest accessibility and computer simulations of individual solutions.

### Learning outcomes

- ✓ Analyze strategic and tactical planning of forest roads (types of plans and planning – strategic, tactical and operational planning, strategic and tactical planning of forest roads, study of primary forest accessibility (level of management unit), study of secondary forest accessibility (level of a group of departments), upgrading and optimization of primary and secondary forest road infrastructure).
- ✓ Present the mean timber extraction distance and forest area accessibility (central and parallel extraction, values of correction factors of specific relief areas, actual and target mean timber extraction distance, advantages and deficiencies of the parameter mean timber extraction distance, primary and secondary forest accessibility, efficiency coefficient, advantages and deficiencies of the parameter forest accessibility, optimal forest accessibility and models of its calculation).
- ✓ Assess forest road density, as well as primary and secondary forest accessibility of different relief areas (register of primary and secondary forest road infrastructure, criteria for estimating optimal primary forest road infrastructure, economic, technicaltechnological, environment (ecological/aesthetic) criteria of optimization, primary and secondary forest accessibility for timber harvesting by skidding (lowland forests, hilly and mountainous forests), primary and secondary forest accessibility on sloped terrain for timber forwarding).
- ✓ Present the classification of the actual network of primary forest roads, criteria for estimating the optimum conditions (methodology study of primary forest accessibility, determination of the actual geometric (Euclidian) distance of timber extraction, criteria for estimating the optimum conditions and classification into priority levels).
- ✓ Define the optimization of the primary forest road network - horizontal and vertical (analysis of selected possible routs of future forest roads and achieving the target primary classical accessibility, optimization of newly planned routes of forest roads in view of vertical development of individual forest road routes, development of the register of upgraded network of primary forest traffic infrastructure, analysis of quantity and quality of upgraded network of primary forest traffic infrastructure).

- ✓ Present methodological study of secondary forest accessibility (design and establishment of GIS on such area, analysis of the actual work on secondary forest traffic infrastructure, selection of possible routes and analysis of future secondary forest roads, optimization of newly planned network of secondary forest roads, construction of planned routes).

### Language

All teaching activities will be held in Croatian. However, foreign students will have the opportunity to attend additional office hours with the lecturer and teaching assistants in English to help master the course materials. Additionally, the lecturer will refer foreign students to the corresponding literature in English, as well as give them the possibility of taking the associated exams in English.

### Literature

1. Pentek, T., 2009: Otvaranje šuma (\*.pptx predavanja 1-15), Šumarski fakultet Sveučilišta u Zagrebu.
2. Pentek, T. 2002: Računalni modeli optimizacije mreže šumskih cesta s obzirom na dominantne utjecajne čimbenike, Disertacija, Šumarski fakultet Sveučilišta u Zagrebu, Zagreb, s. 1-271.
3. Pičman, D., 2007: Šumske prometnice (sveučilišni udžbenik), Šumarski fakultet Sveučilišta u Zagrebu, s. 1-460, odabrana poglavlja.
4. Dietz, P., H. Löffler, & W. Knigge, 1984: Walderschließung, Eine Lehbruch für Studium und Praxis unter besonderer Berücksichtigung des Waldwegebbaus. Verlag Paul Parey, Hamburg und Berlin, p. 1-196, odabrana poglavlja

### Forms of teaching

Lectures (30 h), exercises (30 h), field work

### Assessment methods

Oral exam

## HUNTING MANAGEMENT I (code: 33891)

<b>Original course title</b>	Lovno gospodarenje I	<b>Status</b>	compulsory
<b>Semester</b>	summer	<b>Course teacher</b>	Prof. Marijan Grubešić, Ph.D., Prof. Krešimir Krapinec, Ph.D., Assistant Prof. Kristijan Tomljanović, Ph.D.
<b>ECTS</b>	3	<b>Study level</b>	MSc

### Course content

Student will be educated as future makers, operators and persons participating in supervision of hunting management bases, breeding programs and game protection programs. Detailed exploring of the hunting ground i.e. the habitat of game, elements of hunting ground and the criteria, which must be met by certain hunting grounds for certain game species. Procedure for establishment of habitat quality, establishment of hunting ground capacity for certain game species. Preservation of an optimum proportion between the genders and age structures among game as the basis for a lasting management and population stability. Increase planning and intervention in the population by Plan Act – LGO. Game breeding and protection measures contain elements of technical hunting ground arrangement, provision of game feed and monitoring of health condition in game. Apart from the economic game species, students will also get to know protected animal species, plans for their

protection and revitalization of endangered species. The aim of this subject is to prepare the students for their future duties in terms of an integrated management of habitat and fauna, under the use of the technique and the technology for an optimum use of the area and the fauna, under application of measures for protection and preservation of habitats and animal species. Through exercises and teaching in the field students will directly get to know the manner for preparing and implementation of management plan acts, as well as habitat and animal species protection measures on the example of our national parks and nature parks.

### Learning outcomes

- ✓ Define wildlife habitat, hunting ground, and hunting grounds for certain game species (determining hunting productive areas, habitat quality for large and small game, determining the hunting capacity for each species of game).
- ✓ Presenting game management (optimum sex and age structure of game in the population, growth and recharge, dump, waste, development of large and small game stocks, planning the required amount of game food).
- ✓ Comply with the technical arrangement of hunting grounds (hunting grounds - feeding tanks, dormitories, eating areas, food storage, dummies, observatories and checkers, ...).
- ✓ Establish protected species (protection and revitalization plans of endangered species, wildlife conservation programs, action plans, management plans).

### Language

All teaching activities will be held in Croatian. However, foreign students will have the opportunity to attend additional office hours with the lecturer in English. Additionally, the lecturer will refer foreign students to the corresponding literature in English, as well as give them the possibility of taking the associated exams in English.

### Literature

1. Pascal Durantel, P. 2007: Enciklopedija lovstva, Sveučilišna knjižnica Rijeka, 607 str.
2. Pascal Durantel, P. 2007: Praktična enciklopedija lovstva, Sveučilišna knjižnica Rijeka, 285 str.
3. Whitehed, G. K. (1993): The Whitehead Encyclopedia of Deer. Swan Hill Press, Shrewsbury, UK, 597 str.
4. Blüchel, K.G.: Die Jagd, 652 str.

### Forms of teaching

Lectures (30 h), exercises (15 h), field work

### Assessment methods

Written exam. Term papers and student oral presentations

# STATISTICAL METHODS AND MODELING IN FORESTRY (code: 33843)

<b>Original course title</b>	Statističke metode i modeliranje u šumarstvu	<b>Status</b>	compulsory
<b>Semester</b>	summer	<b>Course teacher</b>	Prof. Anamarija Jazbec, PhD; Assistant prof. Mislav Vedriš, PhD
<b>ECTS</b>	4	<b>Study level</b>	MSc

## Course content

Questionnaire. Sampling methods. Choosing the sample size. Analysis of contingency tables. ANOVA (analysis of variance): requirements and assumptions. Multiple comparisons. Correlation analysis. Linear regression: Least squares method, parameter estimation, determination coefficient. Univariate and multivariate models. Model building methods (*Forward, stepwise, backward*). Testing model goodness of fit. Modelling interactions. Choice of optimum model. Nonlinear models. Growth models.

## Learning outcomes

- ✓ Design survey questionnaire and determine the sample size (composing the questionnaire, creating and organizing database, sampling methods, determination of sample size for desired precision of estimate – mean and proportion, determination of sample size for binomial distribution)
- ✓ Explain comparison of two frequency distributions (chi-square test)
- ✓ Present correlation analysis (define correlation in population and estimate correlation coefficient; testing statistical significance of correlation coefficient based on random sample)
- ✓ Formulate analysis of variance: comparing more than two population means; parametric (ANOVA) and non-parametric test (Kruskal-Wallis), defining multiple comparison (post-hoc) test of difference between populations; graphical presentation using statistical software
- ✓ Present regression analysis: define and classify types of regression, model building methods, indicators and tests for model goodness of fit, testing statistical significance of estimated parameters, graphical presentation using statistical software

## Language

All teaching activities will be held in Croatian. Foreign students will have the opportunity to attend additional office hours with the lecturers and be provided with teaching materials and literature in English.

## Literature

1. Statistical Methods and Modelling in Forestry: course on e-learning system Merlin
2. Sokal, RR., Rohlf, FJ., 1995: Biometry. Freeman and Company. New York. 880 pp.
3. Jongman, R.H.G., Braak, C.J.F., van Tongeren, 2002: Data Analysis in Community and Landscape Ecology, Cambridge University Press

## Forms of teaching

Lectures (15 h), exercises (30 h)

## Assessment methods

Evaluation of exercise assignments, partial exams, written and oral final exam

# WILDLIFE FEEDING (code: 33924)

<b>Original course title</b>	Ishrana divljači	<b>Status</b>	elective
<b>Semester</b>	summer	<b>Course teacher</b>	Prof. Krešimir Krapinec, Ph.D., Prof. Marijan Grubešić, Ph.D.
<b>ECTS</b>	2	<b>Study level</b>	MSc

## Course content

Contemporary hunting ground management includes a whole series of activities for habitat preservation (various international conventions), so as to ensure protection of species, habitat, but also a relevant trophy and physical structure in the population of single animal species. Therefore, this course of lectures intends to direct the students towards such manners of habitat management, aiming at upgrading of nutritional and legal factors, which will ensure a lasting fauna management.

## Learning outcomes

- ✓ Managing and autonomous making decision in wildlife/game management

## Language

All teaching activities will be held in Croatian. Foreign students will have the opportunity to attend additional office hours with the lecturers and be provided with teaching materials and literature in English.

## Literature

1. Weis, G. B., 1997: Anlage und Pflege von Wildäsungsflächen. Nimrod – Verlag, Suderburg., 320 pp.
2. Černe, L., 1990: Ureditev lovišč za malo divjad; Lovska zveza Slovenije; Ljubljana; 70 pp.
3. Randal, D., Burggren, W., French, K., 1998: Eckert animal physiology: mechanisms and adaptations; W.H. Freeman and Company; New York; 824 pp.
4. Schwartz, M.W., 1997: Conservation in highly fragmented landscapes; Chapman & Hall; New York; 436 pp.
5. Bookhout, T.A., 1996: Research and management techniques for wildlife and habitats; The Wildlife Society Bethesda; Maryland; 740 pp.
6. \*\*\*, 1986: Lehrbuch Jägerprüfung, Bänden 1-5, Paul Parey, Berlin und Hamburg, 1017 pp.
2. Ian McCall, I., 1988: Woodlands for Pheasants. The Game Conservancy, Fordingbridge, 99 pp.
3. Robertson, P. A., 1992: Woodland Management for Pheasants. Forestry Commission Bulletin 106, London, 18 pp.
4. Anon., 1994: Game and shooting crops. The Game Conservancy, Fordingbridge, 97 pp.

## Forms of teaching

Lectures (15 h)

## Assessment methods

Oral exam. Obligatory class attendance.

## Department of Wood Technology Courses - Undergraduate Study Programmes (BSc)

### **TRANSPORT EQUIPMENT IN WOOD INDUSTRY (code: 33637)**

<b>Original course title</b>	Transportna tehnika u drvnoj industriji	<b>Status</b>	compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Ružica Beljo Lučić, Assist. Prof. Matija Jug
<b>ECTS</b>	5	<b>Study level</b>	BSc

#### **Course content**

Purpose and task of transport. Historical development of transport. Basic forms of transport and transport equipment. Maximum load and capacity of means of transport of periodical and continuous supply. Measures of assessment of transport activities. Equivalent resistance coefficient. Characteristics of transported materials in wood industry. Types of loads of transport constructions. Components of transport equipment. Driving mechanism of the means of transport in wood industry. Means of transport in wood industry. Means of periodical supply. Winches. Lifts. Cranes. Industrial vehicles. Hand-operated industrial vehicles. Motor-operated industrial vehicles. Road vehicles. Manipulators, industrial robots. Means of continuous supply. Conveyors. Mechanical conveyors with a hauling element (belt conveyors, track conveyors, chain conveyors, elevators). Mechanical conveyors without a hauling element (roller, vibrating, worm, and gravity conveyors). Air conveyors. Components of air conveyors. Control of an exhaust system. A means of transport in the function of the production technological process. Transport systems in a sawmill, in production plants of particle boards, in production plants of veneer and plywood and in production plants of furniture. Characteristics of transport equipment important in terms of choice and efficient application. Storage facilities in wood industry.

#### **Learning outcomes**

- ✓ Calculate the basic characteristics of transported materials in the wood industry that are important for transport and storage: volume, mass, density, bulk density, bulk angle, granulation.
- ✓ Analyze influential factors on the basic characteristics of transported materials.
- ✓ Calculate the required capacity of transport equipment in the woodworking and processing industry: capacity of conveyors (belt conveyors, scraper conveyors, elevators, roller conveyors, chain conveyors), cranes and industrial vehicles depending on the parameters of the technological processing of wood.
- ✓ Evaluate the transport losses expressed in percentage relative to the transported weight. Calculate the required driving power of the transport equipment in the woodworking process.
- ✓ Calculate the dimensions (diameter, cross-sectional area) and select the appropriate components of the steel rope and chain according to the appropriate standards depending on the load weight, rope and chain strength and load mode.
- ✓ Control the operation of the air conveyor system – determine static pressure drop in the system, dynamic pressure, air flow rate, and calculate the fan's utility and system utility.
- ✓ Select the ventilator for the air conveyor system depending on the system parameters.



## Language

Individual tasks and lectures in English.

## Literature

1. Sever, S. 1988: Transport u drvojn industriji, autorizirani rukopis, Zagreb, 1 - 26, 50 - 231.
2. Oluić, Č. 1991: Transport u industriji, Rukovanje materijalom I. dio, Sveučilišna naklada, Zagreb, 1 - 278.
3. Koharić, V.: Mehaničke operacije, Sveučilište u Zagrebu, Fakultet strojarstva i brodogradnje, 1994.
4. Sandor, N.: Woodshop Dust Control, The Taunton Press, 2002.
5. Beljo Lučić, R. 2014: Transport in wood industry, presentation in Power Pointu (in English).

## Forms of teaching

Lectures (30 h), exercises (45 h)

## Assessment methods

Written – calculations, oral – in case of a negative result or if students have not taken exams in the course of the lectures.

# WOOD AS A BUILDING MATERIAL (code: 33647)

<b>Original course title</b>	Drvo u graditeljstvu	<b>Status</b>	compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Hrvoje Turkulin, PhD, Assist. prof. Vjekoslav Živković, PhD
<b>ECTS</b>	4	<b>Study level</b>	BSc

## Course content

Significance of production of wood building components in Croatia and in Europe. Specific requirements for exterior application of wood: synergistic actions of light, climatic and biological degradative factors. Technical properties of importance for building applications, availability of the species: wood properties and durability. Principles of technical design of wood products for their durability: physical protection, technical detailing, surfacing and finishing, renovation of weathered products. Dimensional limitations of wood and laminating technique: technical principles, technical design of components, materials used, basics of the manufacturing process. Basics of building physics and principles of acoustic and thermal insulation of windows, floors, doors, walls. Windows and doors: function and design, forms and types, general functional requirements: ventilation, lighting, passage, insulation, passage. Wooden floors – physical conditions during completion and use for sports and residential floors, materials for gluing and sealing. Review of other classes and types of wood building components and products: houses, laminated beams, wooden structures, bridges, noise barriers, cladding and facades etc.

## Learning outcomes

- ✓ To identify the main families of wood construction products and connect their use requirements with design and construction types. Connect the usable properties of the product with the technical properties of wood.

- ✓ To distinguish and group the technical properties of wood essential for construction (mechanical, physical, chemical, fire resistance), to explain the aesthetic, economic and traditional values of wood for construction.
- ✓ Appoint and compare window and door functions according to the purpose, the opening mode, according to the construction types and associate them with the usage values: illumination, visual, mental and physical connection to the environment, ventilation, climate, sound, heat insulation.
- ✓ Formulate the technological process (technological map and description of operations) in industrial window and door manufacturing - Calculate and propose technical or technological parameters in industrial window or door manufacturing and formulate a way of measuring technological parameters in production.
- ✓ To describe and interpret lamination technique for construction wood. Design the process of manufacturing laminated building products.
- ✓ Appoint, define and compare the technical properties of interior floor components and connect them to the inner floor panel with individual elements of wood flooring: floor boards, lamel flooring, lam parquet, finished / finished parquet elements, prisms, laminate flooring.
- ✓ Appoint and interpret the technological parameters of production, measure the technological parameters and evaluate the approximation of measured dimensions in the production of floor elements of wood.
- ✓ Define, analyse and evaluate the physical conditions of wooden floors - substrates, insulation layers, wood flooring, surface treatment, ambient conditions: air humidity, equilibrium moisture content, temperature, dimensional changes.
- ✓ Appoint and interpret the basic functional properties of different types of wood houses and laminated beams.
- ✓ Demonstrate the technical principles and the design of the laminated structure and the general technological process of making a wooden house: mechanical processing and surface treatment, transportation, construction, supervision and control in use.

### Language & forms of teaching

Individual consultations and seminars in English, laboratory work in bilingual explanations by associate teachers for exercises.

Lectures (45 h), exercises (45 h), field work

### Literature

1. Turkulin i dr. 2002: Durability of wooden facades. *Drvna ind.* 53(1):33-48 i 53(3): 44-54.
- 2.\*\*\* 2005: Collection of offprints on the topic of durability and surface protection of wood in building. Faculty of Forestry, Zagreb University
- 3.\*\*\* 1993: Wood building technology. Ottawa: Canadian Wood Council. 3. Tomašević, J. (1999): Wood in flooring structures. Zagreb: Author's edition
4. PROHOLZ: Wood as construction material. ProHolz Austria, Vienna 2013.

### Assessment methods

Verbal examination. Preconditions: positive consultations and revision of written reports.

# WOOD CHEMISTRY (code: 46405)

<b>Original course title</b>	Kemija drva	<b>Status</b>	compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	Associate Professor Alan Antonović, PhD.
<b>ECTS</b>	8	<b>Study level</b>	BSc

## Course content

Wood structure, density of wood, water content, chemical composition of wood, analysis of elements in wood, analysis of wood age, inorganic substances in wood, content and role of inorganic substances, wood ash, chemical reaction of wood, fundamentals of carbohydrate chemistry, monosaccharides, oligosaccharides, polysaccharides, cellulose, molecular and supramolecular properties, nature and classification of polyoses, xylans, mannans, glucans, galactans, pectins, fundamentals of aromatic compounds, phenols, precursors of lignin, synthesis and role of lignin, structure and properties of lignin, instrumental and chemical methods analyses of cellulose and lignin, extractives, extractives of softwood, extractives of hardwood, extractives from foliage, buds and fruits, acidity of wood, measuring the pH of wood, chemical composition of bark, cellulose, polyoses, lignin, polyphenoles, suberin, extractives, combustion and pyrolysis of wood, degradation of wood.

## Learning outcomes

- ✓ Use the knowledge acquired in different areas of wood technology, and to solve technological and qualitative tasks and problems in the wood industry.
- ✓ Explain the chemical composition and properties of wood and apply the same during the basic working and processing of wood
- ✓ Analyze and isolate all chemical components, whether analytically or instrumentally, related to determining different properties or for further working and processing of wood.

## Language

Teaching will be conducted in English and forms of instruction are a combination of presentations and practical work in chemistry lab. Studying the student's knowledge is done by the tasks they need to do during the classes and they need to write a "Chemical log". The final evaluation of the knowledge is done by written and oral exam.

## Literature

1. J. Baeza, J. Freer, Chemical Characterization of Wood and Its Components in Wood and Cellulosic Chemistry, ed: D. N.-S. Hon, N. Shiraishi, Marcel Dekker, Inc., New York, 2001., pp. 275. - 384.
2. D. Fengel, G. Wegener, WOOD, Chemistry, Ultrastructure, Reactions, Walter de Gruyter, Berlin-New York, 1989.
3. D. N.-S. Hon, N. Shiraishi, Wood and Cellulosic Chemistry, Marcel Dekker, Inc. New York, 2001.

## Forms of teaching

Lectures (45 h), exercises (45 h)

lectures, practical work in chemical lab, individual project tasks

## Assessment methods

Partial exams, written exam, oral exam

# FURNITURE DESIGN (code: 33661)

<b>Original course title</b>	Oblikovanje namještaja	<b>Status</b>	elective
<b>Semester</b>	summer	<b>Course teacher</b>	Danijela Domljan, PhD, assistant professor; Ivica Grbac, PhD, full professor
<b>ECTS</b>	3	<b>Study level</b>	BSc

## Course content

History of furniture development. Characteristics of worldwide and European styles in furniture manufacture. Use and purpose of various designs, materials and constructions in different styles throughout history. Contemporary trends in furniture design. Development of modern design. Introduction to product design. Theory of shapes. Shape elements and principles. Aesthetic components of a product. Product view. Means of expression in industrial design. Industrial design elements – Design principles. Functional principles. Aesthetic principles. Technical-technological principles. Human principles. Economical principles. Ecological principles. Theoretical, practical and methodological design principles. Role and significance of a well designed product. Relation between a designer and a company. Design methods. Design and Interdisciplinarity. Product quality. Design and standardization. Design and ergonomomy. Anthropometry. Ergonomical methods. Design and marketing. Design and marketing functions. Validation of design in marketing. Design and visual communication. Role of visual culture in communication with a product. Environmental design. Physical and communication environment. Design and IT. Role of IT in product development. IT applications in furniture design. Furniture vs. dedicated space. Basic principles of interior design. Functional groups of rooms and furniture. Ground-plan communication of rooms with furniture. Elements of architectural design.

## Learning outcomes

- ✓ Identify and apply the features of historical styles and heritage in furniture design.
- ✓ Follow trends and innovations (internet, magazines, books) in design and apply them in designing new furniture design solutions.
- ✓ Evaluate the theoretical, practical and methodological goals and design methods of furniture as part of a complex interdisciplinary design process on a given example.
- ✓ Identify and apply design elements (expression tools) and principles of industrial design in contemporary furniture (functional, aesthetic, technical-technological, human, economic, ecological principles, etc.).
- ✓ Explain the importance of interdisciplinary approach and the involvement of other professionals in the design of furniture.
- ✓ Identify and explain the term good design using parameters of good design.
- ✓ Develop and design furniture and other wood products by default features (input data)
- ✓ Apply design research methods in the design of furniture and wood products (analysis of users and needs, problem analysis, market and products analysis (index design), analysis of the concept and communication with potential customers and others).
- ✓ Evaluate and compare product quality and valid standards through ideally designed furniture solutions.
- ✓ Define the characteristics of future products (aesthetic, structural, technical, economic, ergonomic and other) to the needs of the target groups of users.
- ✓ Distinguish and valorise aesthetic components of a product in relation to furniture design.

- ✓ Use innovation and new materials and technologies in shaping the conceptual design of furniture on a given topic.
- ✓ Apply knowledge of aesthetics, ergonomics, anthropometrics, ecology, new materials, and technology, marketing, and visual identity in designing furniture according to the requirements.
- ✓ Sketch the design conceptual design of furniture and other wood products using design drawing methods.
- ✓ Apply appropriate standards and dimensions to designing a new product.
- ✓ Show variants of conceptual furniture solutions with functional design drawing in perspective (space-based or computer).
- ✓ Choose and explain the optimal design idea of furniture.
- ✓ Define the design-functional, structural-technological and other features of the furniture design.
- ✓ Apply the knowledge of design drawing and program packages in the presentation of a design solution of molded furniture.
- ✓ Present the final solution of furniture design in all phases of product development.

### Language

Teaching will be conducted in English. All forms of instruction are a combination of implementation of theoretical and practical skills in project tasks, gaining the knowledge of the teamwork, discussions, design methods (brainstorming, design analyses, etc.), presentations and exercises. The final evaluation of the knowledge is done by project presentation (oral presentation and final project map) of the student.

### Literature

1. Ashby, M., Johnson, K ( 2002). *Materials and Design, The Art and Science of Material Selection in Product Design*. Oxford, UK: Elsevier Butterworth-Heinemann.
2. Lefteri C. (2007): *Making it. Manufacturing techniques for product design*, London, UK: Laurence King Publ. Ltd.
3. Neufert, E.; Neufert P. (2000): *Architect's Data*, 3rd ed., Blackwell, Science.
4. Panero, J.; Zelnik, M. (1979): *Human dimensions & interior space. A Source Book of Design Reference Standards*. Arch. Press, London.
5. Papanek, V. (1972): *Design for the real world*. Pantheon Books.
6. Pevsner, N. (2011): *Pioneers of Modern Design, From William Morris to Walter Gropius*, Penguin, London.
7. Quarante, D. (1994.): *Elements du design industriel*. Zieme Edition, Paris, Ed. Maloine. (in croatian: (1991). *Osnove industrijskog dizajna*, Arhitektonski fakultet, Interfakultetski studij dizajna, Zagreb).
8. Thompson, R. (2007): *Manufacturing processes for design professionals*, Thames & Hudson, London, UK.
9. Thompson, R. (2011): *Product and furniture design, the manufacturing guides*, London, UK: Thames & Hudson.
10. Design journals and reviews

### Forms of teaching

Education is provided in forms of course attendance and practical seminar and project tasks which follow the program units. Student is obliged to solve individual seminars and teamwork project tasks (furniture design concepts), to do field research, consultations, learn and use design methods to solve problems in design process.

- Project task;
- Seminar works;
- Field work (visit of exhibitions, fairs or event related to arts or to furniture manufacture or design).

Lectures (30 h), exercises (30 h)

### Assessment methods

Seminar presentation; Project presentation (map); Oral exam - Final presentation of the design concept in the project.

# Department of Wood Technology Courses - Graduate Study Programmes (MSc)

## **TECHNOLOGICAL PRODUCTION MANAGEMENT (code: 33707)**

<b>Original course title</b>	Tehnološka priprema rada	<b>Status</b>	Compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Denis Jelačić, Ph.D.
<b>ECTS</b>	5	<b>Study level</b>	MSc

### **Learning outcomes**

- ✓ To establish the position and activities of production management within management system;
- ✓ To create production order as a main holder of production management information;
- ✓ To establish material standards and requirements for production;
- ✓ To establish time standards and requirements for production;
- ✓ To establish capacity requirements for production;
- ✓ To prepare and make complete technological documentation as a part of management information system in company;

### **Course content**

Goals and tasks of production management in wood processing and furniture manufacturing. Technological and operational technology management and work allocation. Production management as a part of management subsystem. Production order as a basic information carrier for production management. Planning, launching, executing and control of production orders. Technological production management. Preparing of products constituents and their types. Material quantity estimation. Time cycle estimation, unit production time, production cycle time. Estimation of flow coefficient. Production cycle planning. Production order priorities. Material requirements planning. Optimal stock quantities methods. Capacity requirements planning. Production processes control and registration. Work allocation and production order settlement. Completing and launching of production documentation. Reporting and analysis of production plan fulfilment. Production statements, production order statements and analysis of fulfilment.

Production management documentation. Production management documentation flow-chart as a part of information subsystem. Management-information system designing in wood processing and furniture manufacturing. Basics for management-information system designing. Systematical, analytical and synthetical approach to designing.

### **Language**

In agreement with the students enrolled in the course, the lecturer will provide as many teaching elements in English as possible, or in both English and Croatian for mixed groups (i.e., bilingual teaching materials and bilingual exams). Level 2 also includes additional individual consultations with foreign students (as in Level 1) for the teaching elements which will be held in Croatian.

### **Literature**

1. Reid, R.D., Sanders, N.R.: Operations Management, Wiley, 2002.
2. Evans, J.R.: Applied Production and Operations Management, West, 1993.
3. Meredith, J.R.: The Management of Operations; A Conceptual Emphasis, Wiley, 1992.

## Forms of teaching

Lectures (30 h), exercises (30 h), field work

## Assessment methods

Knowledge will be checked constantly by tracking students achievements, by evaluation of project tasks and seminars and by final written and oral exams (if necessary).

# TECHNOLOGY OF WOOD BUILDING COMPONENTS (code: 33697)

<b>Original course title</b>	Tehnologija drvnih proizvoda za graditeljstvo	<b>Status</b>	Compulsory
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Hrvoje Turkulin, PhD
<b>ECTS</b>	5	<b>Study level</b>	MSc

## Course content

Wooden windows and doors: function, general service requirements, types of products. Building physics – technical details in design of acoustic and thermal insulation of windows, doors, walls, floors. Principles of technical design and detailing of the most important types of windows and doors. Processes of small-scale manufacturing and large industrial production processes for windows and doors: choice of machines and equipment, material, accessories, analysis of specific machining operations. Technical design, detailing and specific production operations in manufacturing of entrance doors, panel doors, wooden floors, wooden laminated beams, bridges, wooden prefabricated houses. Stages in transportation, building, maintenance and restoration.

## Learning outcomes

- ✓ Appoint and interpret the technical properties of wood for construction, technological ways of eliminating wood shortcomings when used as a building material and link them with the technical requirements for individual construction products
- ✓ Describe and interpret the features of traditional wood construction in Croatia and link them with the technical features of modern wood products for constructions - beams and profiles, truss girder, laminated beams, cross laminated panels, stairwells and cassette walls, bridge elements, special construction panels.
- ✓ Define and explain the fundamentals of building physics: describe and interpret acoustic, thermal and hygrotechnical phenomena in construction. Categorize and design the models of walls, roofs, windows, doors, floors according to construction-insulation requirements.
- ✓ Appoint and compare the window and door functions according to its purpose, the opening mode, according to the construction types and to associate them with the usage values: illumination, visual, psychological and physical connection to the environment, ventilation, climate, sound, heat insulation.
- ✓ Interpret the link between the function, the economy and the technical concept of the product - windows or balcony doors, interior doors, entrance doors by sketching the structure of window and door frames: details and dimensions of the frame profile, the door leaves of the type and properties of corner joints, auxiliary parts and materials on the windows; doors: gaskets, gaskets and whales, glass, anchors and connectors, ventilation and shading elements.

- ✓ Connect and interpret the link between the construction and the technology of windows and doors in different window and door production processes, production and furnishing with additional window elements; selecting and recommending materials and technological processes for lacing, spinning, surface finishing, sealing and spinning, packaging and transportation, as well as window and door installation.
- ✓ Formulate the technological process (technological map and description of operations) in industrial window and door manufacturing – Calculate and propose technical or technological parameters in industrial window or door manufacturing and formulate a way of measuring technological parameters in production.
- ✓ Appoint, define and compare the technical properties of interior floor components (structural support, heat insulation, sound and water vapor, substrate, coating, binder, top layer) and connect them to the inner floor panel with individual elements of wood flooring: floor boards, lamel flooring, lam parquet, finished / finished parquet elements, prisms, laminate flooring. Special floor coverings - mosaic floors, cork, laminate, combination with metals and mineral coatings.
- ✓ Appoint and interpret the technological parameters of production, measure the technological parameters and evaluate the approximation of measured dimensions (dimensional and shape accuracy, surface smoothness, density, moisture content and hardness of wood, glue application, pressure temperature and duration of adhesive hardening, surface treatment and hardening dynamics in the production of floor elements of wood.
- ✓ Define, analyse and evaluate the physical conditions of wooden floors - substrates, insulation layers, wood flooring, surface treatment, ambient conditions: air humidity, equilibrium moisture content, temperature, dimensional changes.
- ✓ Design, evaluate and valorise the compatibility of technological features of different interior floor finishes (screed-glue-classical parquet, screed-floor-finished parquet, floor-wood-flooring, sports floor, floor): compare functionality, technology and cost-effectiveness of the floor.
- ✓ Appoint and interpret the basic functional properties of different types of beams (load bearing capacity, stability, compatability with room function, compatibility with other building elements, safety requirements, fire resistance and protection).
- ✓ Demonstrate the technical principles and the design of the laminated structure and the general technological process of making a wooden house: mechanical processing and surface treatment, transportation, construction, supervision and control in use.

### Forms of teaching

Lectures (60 h), exercises (30 h), field work (2 days)

### Language

Individual consultations and seminars in English, laboratory work in bilingual explanations by sssociate teachers for exercises.

### Literature

1. Turkulin i dr. 2002: Durability of wooden facades. Drvna ind. 53(1):33-48 i 53(3): 44-54.
- 2.\*\*\* 2005: Collection of offprints on the topic of durability and surface protection of wood in building. Faculty of Forestry, Zagreb University
- 3.\*\*\* 1993: Wood building technology. Ottawa: Canadian Wood Coiuncil. 3.Tomašević, J. (1999): Wood in flooring structures. Zagreb: Author's edition
4. PROHOLZ: Wood as construction material. ProHolz Austria, Vienna 2013.

### Assessment methods

Written and verbal examination. Preconditions: positive consultations and revision of written reports.



# FURNITURE AND INTERIOR DECORATION

## (code: 33711)

<b>Original course title</b>	Namještaj i opremanje prostora	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Danijela Domljan, PhD, assistant professor; Ivica Grbac, PhD, full professor
<b>ECTS</b>	4	<b>Study level</b>	MSc

### Course content

Introduction to space design – a designers’ approach. Typology and requirements of the space. Aesthetic and functional components of space. Basic principles of interior design. Public Spaces and Private Spaces. Functional groups of rooms and furniture. Elements of architectural design. - Etiological review through interior design. - Introduction to theory of space planning. Organization and design of space. Ground-plan communication of rooms with furniture. Design principles and elements of dwelling space. Analysis of dwelling units and their function. – Modulor: Human being as organizational module of a space. - Design principles of space and furniture. Trends in designing contemporary space and furniture. Modern components in quality validation of practical and technical objects of industrial design in interior. Functional and design analysis of contemporary furniture and objects for use. Colours and materials in space. - Characteristics of the use and equipment for public work space. Relation between furniture and dedicated space. Analysis of functional groups of furniture vs. specific public space unit. Urban equipment.

### Learning outcomes

- ✓ Distinguish types, typology and tasks of housing and public space
- ✓ Analyze and compare the aesthetic and functional components of space in some historical style periods (from antiquity to 21 centuries)
- ✓ Identify and apply components, principles and elements of space design (color, texture, light, materials, orientation)
- ✓ Distinguish the etiological contents, the culture of residence and the historical styles of interior and exterior design
- ✓ Evaluate and implement features of Croatian heritage in designing the space content and interior furnishing with appropriate furniture.
- ✓ Apply the theory and criteria of spatial planning and architectural design in space furnishing
- ✓ Apply human measures as a module of space organization
- ✓ Evaluate and apply the principles of contemporary design of space and furniture (aesthetic, functional, social, psychological and social, technicaltechnological, ecological and ethnological) in relation to the needs and habits of the user
- ✓ Identify and interpret culture kitsch, trends, authenticity and tradition in the design of furniture and space.
- ✓ Analyze and create public space interiors with the application of modern principles of design furniture and equipment space.
- ✓ Define, differentiate and valorize the characteristics of living and furnishing housing.
- ✓ Design, organize and analyze functional units of modern housing units in relation to the needs of users (working, bedroom, living room, entrance, kitchen, dining room, living room, bedroom and children's room, office, bathroom etc).

- ✓ Recommend and design a functional furniture group in relation to the specified spatial unit for residential or public use and user needs.
- ✓ Analyze individual spatial units and their functions in the public space (common space, private (space), work space, socializing, communication, rest, etc.)
- ✓ Suggest and design new solutions for urban equipment for exterior furnishing (bench, waste bin, lighting fixture, bulletin board, bike rack etc.)
- ✓ Apply design sketching or computer design in presentation of the design solution of furniture and equipment
- ✓ Present a solution of well-equipped space and shaped furniture to a group of people (potential clients, teachers, colleagues etc.)

## Language

Teaching will be conducted in English. All forms of instruction are a combination of implementation of theoretical and practical skills in project tasks (interior design field project), gaining the knowledge of the teamwork, discussions, design methods (brainstorming, design analyses, etc.), presentations and exercises. The final evaluation of the knowledge is done by project presentation (oral presentation and final project map) of the student.

## Literature

1. Asensio, P. (2002): Furniture design/Möbel Design/ Design de meubles/Meubles de diseño, teNeues Publishing Group, NewYork US, Dusseldorf Germany, London Uk, Barcelona Spain.
2. Ashby, M., Johnson, K ( 2002). Materials and Design, The Art and Science of Material Selection in Product Design. Oxford, UK: Elsevier Butterworth-Heinemann.
3. Cerver, F. A. (2000): Modernes wohnedesign; Könnemann, Köln
4. Lefteri C. (2007): Making it. Manufacturing techniques for product design, London, UK: Laurence King Publ. Ltd.
5. Neufert, E.; Neufert P. (2000): Architect's Data, 3rd ed., Blackwell, Science.
6. Panero, J.; Zelnik, M. (1979): Human dimensions & interior space. A Source Book of Design Reference Standards. Arch. Press, London.
7. Thompson, R. (2007): Manufacturing processes for design professionals, Thames & Hudson, London, UK.
8. Thompson, R. (2011): Product and furniture design, the manufacturing guides, London, UK: Thames & Hudson
9. \*\*\* (1999): Living spaces, Ecological Building and Design, Öko test, Könnemann, English Edition, (Edit.: Schmitz-Gunther T.), Mladinska knjiga tiskarna d.d., Ljubljana.
10. Design journals and reviews

## Forms of teaching

Education is provided in forms of course attendance and project tasks which follow the program units. Student is obliged to solve individual tasks (seminars) and teamwork project tasks, to do field research upon field project, consultations, learn and use design methods to solve problems in interior design process. - Project tasks; - Seminar works;- Field work (interior design field project; visit of exhibitions, fairs or event and companies related to arts, design and furniture production).

Lectures (30 h), exercises (15 h), field work (1 day)

## Assessment methods

Seminar presentation; Project presentation (map); Written exam; Oral exam - Final presentation of the design concept in the project.

# PHISYCAL AND MECHANICAL PROPERTIES OF WOOD (code: 33945)

<b>Original course title</b>	Osnove tehnologije drva	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Tomislav Sinković, PhD.
<b>ECTS</b>	2	<b>Study level</b>	MSc

## Learning outcomes

- ✓ Determination and evaluation of macroscopic characteristics of wood in application of conditional characteristics of trees.
- ✓ Determination and evaluation of physical properties of wood in the application of conditional characteristics of trees.
- ✓ Determination and evaluation of mechanical properties of wood in application of conditional characteristics of trees.
- ✓ Determination and valuation of wood defects in application of conditional characteristics of trees.
- ✓ Evaluation and comparative analysis of macroscopic characteristics, physical and mechanical properties of timber derived from certain stands on the usability of wood for the manufacture of wood products.

## Course content

Knowledge about commercial wood species. Segments and form of tree. Factors, forms and modification of tree. Chemical structure of wood and its influence on wood properties. The wood structure and its influence on wood properties. Properties of wood sections. Sapwood and heartwood. Process of heartwood forming. Theories. Classification. Earlywood, latewood and percentage of latewood. Closeness of grain. Macroscopic properties of domestic commercial wood species. Color and lustre of wood. Odour of wood. Texture of wood. Density and specific gravity of wood. Distribution of density inside the wood and tree. Wood and water, types of water in wood. The method of determining of moisture content. Fiber saturation point. Maximum moisture content of wood. Shrinkage and swelling. Anisotropy of shrinkage and swelling. Thermal properties of wood. Specific heat. Electrical properties of wood. Distribution of physical properties in tree and between trees same species. Hooks law, modulus of elasticity, Poisson ratios, plasticity and creep. Static bending, tensile strength, compression strength, impact test, torsion strength, shearing strength, hardness and abrasion resistance. The wood structure and its influence on mechanical properties of wood. The influenced factors on mechanical properties of wood. Distribution of mechanical properties in tree and between trees same species. Defects of wood. Classification. Natural defects, reaction wood, compression and tension wood, cross grain, variations in log form and shakes.

## Language

Teaching will be conducted in English and forms of instruction are a combination of presentations and exercises. Studying the students' knowledge is done by the tasks they need to do during the classes. The final evaluation of the knowledge is done by interviewing the student.

## Literature

1. Giordano, G.: Tecnologia del legno, Volume I, Torino, 1971, str. 1-1086.
2. Giordano, G.: Tecnologia del legno, Volume 111, Torino, 1976, str. 1-1351.
3. Kollmann F. R., Cote, :Principles of Wood Science and Technology I solid Wood, New York,1968,str.1-592.
4. Walter, F.: Pruftechnikin der Holzindustrie, Leipzig, 1977, str. 1-318.
5. Tsoumis, G.: Science and Technology of Wood, New York,1991, str. 1-233.

## Forms of teaching:

Lectures (15 h)

## Assessment methods:

oral exam

# PROJECT MANAGEMENT (code: 33728)

<b>Original course title</b>	Upravljanje projektima	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Denis Jelačić, PhD.
<b>ECTS</b>	4	<b>Study level</b>	MSc

## Course content

Projects within production system. Activities in the projects, project management, project management methods and techniques, Gantt charts forwards and backwards, network charts, network charts types and their application, resources necessary to do the project in wood processing and furniture manufacturing. Plan and project. Business plan and project approach, business plan, enterprise, project, investment project and investment study with examples from wood processing and furniture manufacturing. Entrepreneurial projects. Entrepreneur – investor information, analysis of purchase and sale markets with examples from wood branches, technical-technological analysis of production organization in wood processing and furniture manufacturing, location analysis, financial preparation of a project, efficiency evaluation, purpose of a business plan, entrepreneurial business plan structure, optimal entrepreneurial decision making, important business and time components of projects and business plans. Company value. Company business restrictions in wood processing and furniture manufacturing, basics of business accounting, interest account, simple and complexed interest account, business with banks, loans, loan payments, economic evaluation of investments project. Time to pay-off of invested means, profits, profits rates.

## Learning outcomes

- ✓ To establish position and project activities within the management system;
- ✓ To establish time components of a project by using Gantt charts and network diagrams;
- ✓ To establish the resources for quality project implementation;
- ✓ To establish the parameters of business plan for given project;
- ✓ To make technical-technological analysis, location analysis of the business plan;
- ✓ To make financial preparation of a project with important time milestones;
- ✓ To make a project of management system in a company

## Language

In agreement with the students enrolled in the course, the lecturer will provide as many teaching elements in English as possible, or in both English and Croatian for mixed groups (i.e., bilingual teaching materials and bilingual exams). Level 2 also includes additional individual consultations with foreign students (as in Level 1) for the teaching elements which will be held in Croatian.

## Literature

1. Demeter, D., Stepić, D. 1990: Project management, Otvoreno sveučilište, Zagreb.
2. Maylor, H.: Project Management, Prentice Hall, 2010.
3. Meredith, J.R., Mantel, S.J.: Project Management; A Managerial Approach, Wiley, 2012.

## Forms of teaching

Education is provided in forms of course attendance and practical exercises which follow the program units. Beside that, student is obliged to solve individual project tasks, to do field research, different aspects of consulting asking for help in solving problems in project management.

Lectures (30 h), exercises (15 h), field work

## Assessment methods

Knowledge will be checked constantly by tracking students achievements, by evaluation of project tasks and seminars and by final written and oral exams (if necessary).

# QUALITY MANAGEMENT AND ASSURANCE (code: 33727)

<b>Original course title</b>	Upravljanje i osiguranje kvalitete	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Assistant professor Krešimir Greger, PhD
<b>ECTS</b>	4	<b>Study level</b>	MSc

## Course content

Introduction. Basic concepts of management and quality insurance. Development of quality control. Standards and standardisation (national and international). Normative determination of quality in wood processing and furniture manufacture. Implementation of quality and production process. Four elements of quality. Defining the capabilities of products and processes in wood processing and furniture manufacture. Individual authors and their opinions on management and quality insurance (Crosby, Juran, Taguchi, Ishikawa, etc.). Position of quality in an organisation. The definition of full quality control, quality insurance, quality management and full quality management; Quality management in wood processing and furniture manufacture; Process control – input, process, output; Quality management in wood processing and furniture manufacture; Control process – input; Position of quality in individual management systems of production and business; Information system for quality insurance. Development of management and quality insurance. Stages and steps in the development of management system and quality insurance; Comparison of traditional and modern firm organisation in wood processing and furniture manufacture. Methods and techniques of quality insurance; Quality circle, relation between production and process; Specific features of methods and techniques in management and quality insurance in plants for wood processing and furniture manufacture. International standard systems; New trends in the development of quality insurance and management; European standardisation procedure, certification, and co-ordination of standards; System of management and quality insurance; System of standards, requirements, control, supervision, and system certification.

## Learning outcomes

- ✓ Define terms of quality control, quality assurance, quality management, total quality management and business excellence.
- ✓ Explain the basic techniques of quality management (Deming PDCA circle-quality and brainstorming).
- ✓ Describe and explain the traditional tools for quality management (diagram of cause and effect, Pareto diagram, flow chart, examination sheet, histogram, scatter diagram, control charts).
- ✓ Describe and explain the new managerial tools for quality management (diagram affinity diagram interdependence, stratification, matrix diagram, a form of arrows, the software maps the decision-making process, a systematic diagram).
- ✓ Describe and explain quality management methods (QFD and FMEA).
- ✓ Explain the term integrated management systems.
- ✓ Explain the concept of quality costs and specify the kind of quality costs.
- ✓ Provide quality control positions in the production system (input, process and final quality control).
- ✓ Define processes and their interconnections in the given example (given example enterprise for production of furniture) and define the necessary documentation for the defined processes.
- ✓ Determine the critical processes in the given example.

- ✓ Choose the appropriate quality control method on the given example - apply quality control tools.
- ✓ Select the appropriate control chart for the given example; determine if the cause of the variation is common or special.
- ✓ Determine process capability indices Cp and Cpk, and assess the process spread and centering process.
- ✓ To evaluate suppliers in a given case.

### Language

All teaching activities will be held in Croatian. However, foreign students will have the opportunity to attend additional office hours with the lecturer and teaching assistants in English to help master the course materials. Additionally, the lecturer will refer foreign students to the corresponding literature in English, as well as give them the possibility of taking the associated exams in English.

### Literature

1. Figurić, M., (2000): Proizvodni i poslovni procesi u preradi drva i proizvodnji namještaja. Zagreb: Šumarski fakultet.
2. Gryna, F. M.; Chim Hai Chua, R.; De Feo, J. A. (2006): Juran's Quality Planning and Analysis: For, Enterprise Quality, McGraw-Hill Series in Industrial Engine, ISBN 0071254218.
3. Porter, L.; Tanner, S., (2012): Assessing business excellence, 2. izdanje, Routledge.
4. Dahlgaard, J. J.; Kristensen, K.; Khanji, G. K., 2007: Fundamentals of Total Quality Management, Routledge, UK.

### Forms of teaching

Students do projects on management and quality insurance in a firm. Field work in specific productions. Lectures (30 h), exercises (15 h), field work (1 day)

### Assessment methods

Tests in practical work, written exam, completed project, report on fieldwork, oral exam.

## WOOD MODIFICATIONS (code: 33666)

<b>Original course title</b>	Modifikacije drva	<b>Status</b>	elective
<b>Semester</b>	winter	<b>Course teacher</b>	Prof. Hrvoje Turkulin, PhD, Prof. Vlatka Jirouš-Rajković, PhD, Assoc. prof. Goran Mihulja, PhD
<b>ECTS</b>	4	<b>Study level</b>	MSc

### Course content

Analysis of the grounds for wood modification (natural shortcomings-hygroscopicity, liability to weathering and biological deterioration), and improvement of technical properties – mechanical, thermal, acoustic properties, adhesion and permeability. Review of the modification technologies: surface modifications (physical – roughness and plasma treatments, application of chemical treatments, irradiations, finishing). Bulk wood modifications (heat treatments, acetylation, densification, infiltration, cell wall modifications, enzymatic modifications). Theoretical and practical aspects of wood modification by laboratory heat treatment, acetylation, surface treatments (NaOH, citric acid, DMDHEU, HALS and UV primers), by impregnation (oil and PEG): measurements of the changes in dimensional stability, hydrophobicity (contact angle), colour fastness, surface integrity, strength changes, biological resistance. Review of the potential commercial applications of modified wood.

## Learning outcomes

- ✓ Differentiate unmodified wood from modified as well as modified from chemically protected and explain their advantages and disadvantages.
- ✓ Differentiate the different types of wood modification (thermal, chemical, ...) and the essential parameters of the modification regime.
- ✓ Select those properties of modified wood that are important for a particular product (eg, durability in external floors, dimensional stability in flooring in the interior).
- ✓ Recommend the type of wood and type of modification for a given product according to the hazard classes (HRN EN).
- ✓ Recommend the tests and independently test the selected properties of modified wood (test for loss of mass modification, examine biological resistance, hygroscopic properties, ...), interpret the obtained results and determine the durability class according to HRN EN norms.
- ✓ Compare the examined properties of modified wood and select the optimum for the desired product (eg loss of mass, dimensional stability, hardness, bending strength or tension, modulus of elasticity, loss of mass due to the action of fungi).
- ✓ Review the most important parameters and compare the effect of some modification parameters to suggest correction of modification regime to achieve the required properties (eg, correction of the temperature or treatment time required to achieve a certain degree of durability or color change level in thermal modification in the water vapor).
- ✓ Individually or in a team, make a durability insurance project for a new product from modified wood in terms of its use, to recommend the optimum modification procedure while respecting the ecological principles (eg, application of additional chemicals) and economic requirements (eg energy needs) and present it to a group of people.

## Language

All teaching activities will be held in Croatian. However, foreign students will have the opportunity to attend additional office hours with the lecturer and teaching assistants in English to help master the course materials. Additionally, the lecturer will refer foreign students to the corresponding literature in English, as well as give them the possibility of taking the associated exams in English.

## Literature

1. Hill, C. (2006) Wood Modification – Chemical, Thermal and Other Processes. John Wiley & Sons, Ltd.
- 2.\*\*\* 2005: Collection of offprints on the topic of wood modification processes and technology. Faculty of Forestry, Zagreb University
3. Modifiziertes Holz: Eigenschaften und Märkte. Beč: Institut fuer Holzforschung der Universitaet fuer Bodenkultur. (prijevod odabranih poglavlja).

## Formsof teaching

Lecturing: obligatory lectures, practica and completion of written reports. One day of field studies and completion of a written review. Examination: consultations and revision of written reports and reviews. Verbal examination.

Lectures (30 h), exercises (15 h)

## Assessment methods

Verbal examination. Preconditions: positive consultations and revision of written reports.

# INVESTIGATION OF PHYSICAL AND MECHANICAL PROPERTIES OF WOOD (code: 33714)

<b>Original course title</b>	Istraživanje fizikalnih i mehaničkih svojstava drva	<b>Status</b>	obligatory
<b>Semester</b>	summer	<b>Course teacher</b>	Prof. dr. sc. Tomislav Sinković
<b>ECTS</b>	5	<b>Study level</b>	MSc

## Course content

Knowledge about physical and mechanical properties of wood. Preparation for investigation of physical and mechanical properties of wood. Methods for the selective sampling of wood and general requirements for physical and mechanical tests on small clear test pieces. Instruments and devices for determination of physical and mechanical properties of wood. Macroscopic properties of wood. Optical methods, thomographi, ray x, b, g. Physical properties of wood. Methods for determination of dimensions and mass. Methods for determination of volume (regular dimensions, immersion). Methods for determination of density (according to standards, floatation. immersion, ray x, b, g). Methods for determination of moisture content (ove-drying, distillation, titration, electrical moisture meters, ray x, b, g). Methods for determination of fiber saturation point (sorption, shrinkage, mechanical properties, electrical properties, and thermal conductivity). Methods for determination of thermal, electrical and acoustical properties of wood. Destructive and nondestructive methods for determination of mechanical properties of wood. Comparing and determination of macroscopic, physical and mechanical properties of domestic and foreign commercial wood species.

## Learning outcomes

- ✓ Determination of the necessary parameters of trees for the selection of modal trees for the exploration of physical and mechanical properties of wood
- ✓ Selection and felling of trees for the exploration of physical and mechanical properties of wood
- ✓ Preparation of samples for research of physical and mechanical properties of wood
- ✓ Testing of physical and mechanical properties of wood
- ✓ Statistical treatment and evaluation of the results of the research of physical and mechanical properties of wood
- ✓ Collection of relevant data to display the results of research on physical and mechanical properties of wood for the purpose of displaying as scientific or professional work

## Language

Teaching will be conducted in English and forms of instruction are a combination of presentations and exercises. Studying the students' knowledge is done by the tasks they need to do during the classes. The final evaluation of the knowledge is done by interviewing the student.

## Literature

1. Giordano, G.: Tecnologia del legno, Volume I, Torino, 1971, str. 1-1086.
2. Giordano, G.: Tecnologia del legno, Volume 111, Torino, 1976, str. 1-1351.
3. Kollmann F. R., Cote, :Principles of Wood Science and Technology I solid Wood, New York, 1968, str. 1-592.
4. Walter, F.: Pruftechnikin der Holzindustrie, Leipzig, 1977, str. 1-318.
5. Tsoumis, G.: Science and Technology of Wood, New York,1991, str. 1-233.

## Forms of teaching

Lectures (30 h), exercises (30 h), field work



## INTERNATIONAL MARKET OF WOOD PRODUCTS (code: 197346)

<b>Original course title</b>	International Market of Wood Products	<b>Status</b>	elective
<b>Semester</b>	summer	<b>Course teacher</b>	Assist.prof. Andreja Pirc Barčič, Ph.D.
<b>ECTS</b>	4	<b>Study level</b>	MSc

### Course content

Wood economy. The basic facts of wood processing, furniture manufacture and paper manufacture and recycling. The basic facts of international market of wood products. The strategies of development and growth of wood economy on the international market. An aggregate demand and a multiplier model. International market research of furniture and other wood products. Different methods of collecting, systematizing and data processing of European and world wood products market. Measuring economic success of wood economy on the international market. The methods of calculating consumption, export, import and production on the international market of furniture and other wood products. Different techniques of presenting the processed data of international market research. The influence of macroeconomic policy of certain countries on the growth and development of wood economy. The criteria for evaluating the wood economy share in the complete economy. The share in industry and gross domestic product. Following the sale trends of certain wood products on the world market. The information about the employment record, the employees' structure, payments, the enterprise income and investments on the international market of wood and wood products.

### Learning outcomes

- ✓ To analyze the impact of the macroeconomic policies of individual countries on growth and development of the timber economy.
- ✓ To review the economic success of the wood industry in international wood products market with a view to achieving competitive advantages within the wood sector.
- ✓ To analyze production, export and import of furniture and other wood products on the international market.
- ✓ To calculate the consumption of furniture and other wood products on the international market using apparent consumption method
- ✓ To analyze information on employment trends, salaries, income and investments on the international furniture and wood products market.
- ✓ To analyze criteria for monitoring the share of the wood economy in the entire economy.
- ✓ To analyze the trade statistics regarding wood based European and world markets.
- ✓ To investigate possible activities to increase the share of wood products in the international market.

### Language

All teaching activities will be held in English.

## Literature

1. Dušak, M., Jelačić, D., Pirc Barčić, A., Novakova, R. (2017): Improvements to the Production Management System of Wood-processing in Small and Medium Enterprises in Southeast Europe. *BioResources*. 12 (2): 3303-3315.
2. Kotler, P; Wong, V; Saunders, J.; Armstrong, G: *Osnove marketinga*, 4. europsko izdanje. Mate, Zagreb.
3. Previšić, Ozretić Došen, Krupka: *Osnove međunarodnog marketinga*, Školska knjiga, Zagreb, 2012.
4. Sertić Basarac, Martina; Pirc Barčić, Andreja; Klarić, Kristina (2018): Economic determinants and analysis of the European Union wood industry SMEs employment. *Boiresources*. 13 (1): 522-534. DOI: 10.15376/biores.13.1.522-534
5. UNECE/FAO (2018): *Forest Products Annual Market Review*
6. UNECE/FAO (2017): *Forest Products Annual Market Review*
7. UNECE/FAO (2016): *Forest Products Annual Market Review*

## Forms of teaching

Except regular practice, students have to collect all the available data and information for an assigned practical work, they have to systematize the data and present all the received facts in a form of a project work.  
Lectures (30 h), exercises (15 h)

## Assessment methods

The evaluation of students' knowledge and achievements is going to be conducted during the classes and by written and oral exams.

# MECHANICAL TECHNOLOGIES OF WOOD PROCESSING (code: 33949)

<b>Original course title</b>	Osnove mehaničke preradbe drva	<b>Status</b>	elective
<b>Semester</b>	summer	<b>Course teacher</b>	Prof. Tomislav Sinković, PhD.
<b>ECTS</b>	2	<b>Study level</b>	MSc

## Course content

Knowledge about mechanical technologies of wood processing. Wood as final product of forestry and properties of wood important for mechanical technologies of wood processing. The influence of physical and mechanical properties of wood on sawmilling. Technologies of sawmilling. Products of sawmilling. Veneer. Technologies of veneers productions. . The influence of physical and mechanical properties of wood on veneers productions. Plywood. . Physical and mechanical properties of plywood. Composite boards. Physical and mechanical properties composite boards. Hydrothermic wood processing. . The influence of physical and mechanical properties of wood on hydrothermic wood processing.

## Learning outcomes

- ✓ Defining basic procedures of mechanical processing of wood.
- ✓ Determination and valuation of timber or logs for mechanical processing of wood.
- ✓ Determination and evaluation of wood quality from the field of mechanical processing of wood.
- ✓ Determination and valuation of wood defects in mechanical processing of wood.
- ✓ Valuation and comparative analysis of the properties and aspects of trees for mechanical processing of wood.

## Language

Teaching will be conducted in English and forms of instruction are a combination of presentations and exercises. Studying the students' knowledge is done by the tasks they need to do during the classes. The final evaluation of the knowledge is done by interviewing the student.

## Literature

1. Kollmann, F.R., Cote, W.A.Jr.: Solid wood, New York, 1968, str. 1-592.
2. Giordano, G. :Techologia del legno 2.,Le lavorazioni industriali, Torino, 1974, str. 1-1269.
3. Tsoumis, G.: Science and Technology of Wood, New York,1991, str. 1-233.

## Formsof teaching

Lectures (15 h)

## Assessment methods

oral exams

# SPECIAL PRODUCTS OF WOOD (code: 197759)

<b>Original course title</b>	Special Products of Wood	<b>Status</b>	elective
<b>Semester</b>	summer	<b>Course teacher</b>	Professor Tomislav Sinković, PhD.
<b>ECTS</b>	4	<b>Study level</b>	MSc

## Course content

Knowledge about pencils, history of pencils and wood species for pencils. Matches and wood species for its productions. Models and wood species for its productions. Heel and wood species for its productions. Barrels and wood species for its productions. Barrels for strongdrink and softdrink. Light barrels. Barrels manufactured from plywood. . Pacage and wood species for its productions. Parts of wooden pacages. Standards for wooden pacages. Wood densifying by commpresion (lignostone). Manufacturion of beech lignostone. Structure, density, variation of moisture content, swelling and shrinkage, straingth, impact bending strength. Birch lignostone. Use of lignostone. Wooden briquettes, wood species for its productions and productions. Houses made of wood, square timber, sawn timber, particleboard, plywood and sandwich composites. Musical instruments. Acoustical properties of wood. Compering of acoustical properties of wood species witch are used for musical instruments. Toys and wood species for its productions. Fancy wood articles. Clasification over use of fancy wood articles. Wood species for productions of fancy wood articles. Wood in shipbuilding. Forms of forest cultivated for shipbuilding. Wood species for shipbuilding. Ships and boats made of wood. Parts of ships and boats. Request of shipbuilding technique and construction. Properties of wood for shipbuilding. Select the wood species for shipbuilding. Carving and inlaid work. Wood species and its properties inportante for carving and inlaid work. Wood for sport equipments and props.

## Learning outcomes

- ✓ Determining the characteristics of special products of wood in use that affect the choice of wood species for the production of special products of wood
- ✓ Determination of the required parameters of trees and sawmill for making special wood products
- ✓ Determining the most characteristic properties of wood material for the production of special wood products
- ✓ Determination of timber properties relevant for the production of special wood products
- ✓ Defining the basic technological characteristics for the production of special wood products
- ✓ Valuation of technological characteristics for production of special wood products
- ✓ Collection of relevant data to display the basic technological characteristics for the production of special wood products for the purpose of displaying as scientific or professional work

## Language

The course is going to be taught in English. All forms of teaching are a combination of presentations and exercises. Students gain the knowledge by performing assigned tasks during the course. Final evaluation of the knowledge is done in the form of interview.

## Literature

1. Panshin, A.J.; deZeeuw. C., 1980: Textbook of wood technology, 4th edition. McGraw-Hill series in forest resources. McGraw-Hill book company, New York.

Forest Products Laboratory. 1999: Wood Handbook - Wood as an engineering material. Gen. tech. rep. FPL-GTR-113. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, WI.

WOOD Magazine. 1993: Classic woodworking; Woods and how to use them. better; Homes and gardens. Meredith Books, Des Moines, IA.

Jackson, A; Day, D., 1991: Good wood handbook - The woodworker's guide to identifying, selecting and using the right wood. Harper Collins publishers Ltd, London.

## Forms of teaching

Lectures (30 h), exercises (15 h), field work (1 day)

## Assessment methods

Oral exam

# WOOD FIBRES AND PAPER TECHNOLOGY

## (code: 197347)

<b>Original course title</b>	Wood Fibers and Paper Technology	<b>Status</b>	elective
<b>Semester</b>	summer	<b>Course teacher</b>	Prof. Vladimir Jambreković, PhD, Assist. Prof. Nikola Španić, PhD
<b>ECTS</b>	4	<b>Study level</b>	MSc

### Course content

The quality of wood fibres depending on the wood species. Technological processes of wood delignification. Impact of basic and modified methods of delignification on the quality of wood fibres. Thermo-mechanical and chemi-thermo-mechanical defibration. Defibration procedures and their impact on the quality of ground wood. Technological processes of producing semi-cellulose. Neutral sulphite delignification. Cold alkaline delignification. Technological processes of sulphite cellulose production. Comparison of sulphite and natrone procedures. Comparison of discontinuous and continuous chips cooking methods. Influence of white liquor composition and technological parameters on defibration efficiency. Methods and procedures of fibres bleaching. Wood fibres quality insurance. Influential efficiency factors of black liquor regeneration. Technological processes for production of recycled fibers. Wet-end and dry-end procedures of paper manufacturing technology. Paper surface protection and pigment coating methods. Paperboard and cardboard technologies. Paperboard and cardboard surface treatment, dispersion and extrusion protection and lamination methods. Mechanical and electronic printing methods. Technological processes control and paper quality insurance. Technological processes development in paper manufacturing. Methods of improving the properties of paper and fiber base products.

### Learning outcomes

- ✓ to compare and evaluate the quality of wood fibres as depending of the wood species
- ✓ to manage the technical processes of delignification
- ✓ to assess the impact of the basic and modified delignification method on the quality of wood fibres
- ✓ to explain the thermo-mechanical and chemi-thermomechanical defibration
- ✓ to evaluate the defibration processes and their impact on ground wood quality
- ✓ to describe technological processes of semi-cellulose production
- ✓ to recommend technological processes of sulphite cellulose production
- ✓ to manage the neutral sulphite processes of wood delignification
- ✓ to prepare the cold alkaline process of wood delignification
- ✓ to compare sulphate and natrone procedures
- ✓ to compare discontinuous and continuous chips cooking methods
- ✓ to re-examine the effect of the white liquor composition and technological parameters on the effectiveness of defibration
- ✓ to recommend the methods and bleaching procedures
- ✓ to determine and ensure the quality of wood fibres after production
- ✓ to evaluate influential factors affecting the black liquor regeneration
- ✓ to manage technological processes for production of recycled fibres

- ✓ to recommend wet and dry processes in paper production technology
- ✓ to select paper surface protection and pigment coating methods
- ✓ to recommend paperboard and cardboard production technologies
- ✓ to manage paperboard and cardboard surface treatment, dispersion and extrusion protection and lamination methods
- ✓ to evaluate mechanical and electronic printing methods
- ✓ to organise technological processes control and paper quality insurance
- ✓ to develop technological processes in papermaking
- ✓ to improve the properties of paper and fibre based products

### Language

All teaching activities including the exam will be held in English. All of the teaching materials (lectures, laboratory worksheets and instructions, etc.) will be written in English.

### Literature

1. Fengel, D., Wegener, G.: Wood - Chemistry, Ultrastructure, Reactions. Walter de Gruyter, New York, 1989.
2. Neimo, L.: Papermaking Chemistry. Fapet Oy, 2000.
3. Sjöström, E., Alén, R. (Eds.): Analytical Methods in Wood Chemistry, Pulping and Papermaking. Springer-Verlag, 1999.
4. Paluparo, H., Karlsson, M., Jokio, M.: Papermaking – Stock Preparation and Wet End, Drying and Finishing. Fapet Oy, 2000.
5. Hon, D.N.-S., Shiraishi, N.: Wood and Cellulosic Chemistry. Marcel Dekker Inc., New York-Basel, 2000.
6. Lewin, M., Goldstein, I. S.: Wood Structure and Composition. Marcel Dekker Inc., New York, 1991.
7. Stenius, P.: Forest Products Chemistry. Fapet Oy, 2000.
8. Oittinen, P., Saarelma, H.: Printing. Fapet Oy, 2000.
9. Sundholm, J., Gullichsen, J., Fogelholm, C.J., Göttsching, L., Pakarinen, H.: Mechanical and Chemical Pulping, Recycled fiber and deinking, 2000.

### Forms of teaching

Lectures (30 h), exercises (15), field work (2 days)

### Assessment methods

Written exam. Oral exam.