SVEUČILIŠTE U ZAGREBU, FAKULTET ŠUMARSTVA I DRVNE TEHNOLOGIJE
UNIVERSITY OF ZAGREB, FACULTY OF FORESTRY AND WOOD TECHNOLOGY

Undergraduate Study Forestry

Syllabus
from Acad. Year 2021/22

LIST OF COMPULSORY AND ELECTIVE COURSES WITH CLASS HOURS AND ECTS CREDITS

Year of study: I							
Semester: Winter							
COURSE	COURSE TEACHER	L	E	F	e-learning	ECTS	Compulsory / Elective
Basics of Chemistry	Assoc. Prof. Vibor Roje, Ph.D.	45	15	0		6.0	Compulsory
Mathematics	Asst. Prof. Azra Tafro, Ph.D	45	45	0		7.0	Compulsory
Petrology with Geology	Assoc. Prof. Bojan Matoš, Ph.D Asst. Prof. Duje Smirčić	30	15	0		4.0	Compulsory
Forest Botany – Plant Morphology	Prof. Željko Škvorc, Ph.D, Assoc. Prof. Daniel Krstonošić, Ph.D,	15	30	0		3.0	Compulsory
Zoology in Forestry	Prof. Josip Margaletić, Ph.D Asst. Prof. Marko Vucelja, Ph.D	30	30	8		6.0	Compulsory
Anatomical structure of wood	Prof. Jelena Trajković, Ph.D Asist. Prof. Iva Ištok, Ph.D	30	30	0		3.0	Compulsory
Physical and health education 1	Davor Pavlović, teacher	0	30	0		1.0	Compulsory
In total		**195**	**195**	**8**	**0**	**30**	

Year of study: I							
Semester: Summer							
COURSE	COURSE TEACHER	L	E	F	e-learning	ECTS	Compulsory / elective
Forest Botany – Plant Systematics	Assoc. Prof. Daniel Krstonošić, Ph.D Prof. Željko Škvorc, Ph.D,	30	15	32		5.0	Compulsory
Biometrics	Prof. Anamarija Jazbec, Ph.D Assoc. Prof. Mislav Vedriš, Ph.D	30	30	0		5.0	Compulsory
Soil Science	Prof. Nikola Pernar Ph.D. Prof. Darko Bakšić Ph.D. Asst. Prof. Ivan Perković Ph.D	30	30	24		8.0	Compulsory
Ground surveying with basics of cartography	Prof. Renata Pernar, Ph.D. Asst. Prof. Mario Ančić, Ph.D.	30	45	48		7.0	Compulsory
Psysiology of forest trees	Prof. Željko Škvorc, Ph.D Asst. Prof. Krunoslav Sever. Ph.D	30	15	0		4.0	Compulsory
Physical and health education 2	Davor Pavlović, teacher	0	30	0		1.0	Compulsory
In total		**150**	**165**	**104**	**0**	**30**	

Year of study: II							
Semester: Winter							
COURSE	COURSE TEACHER	L	E	F	e-learning	ECTS	Compulsory / elective
Forest mensuration	Prof. Mario Božić, Ph.D	45	30	16		7.0	Compulsory
Forest phytocenology	Prof. Dario Baričević, Ph.D. Asst. Prof. Irena Šapić, Ph.D.	30	30	24		6.0	Compulsory
Remote sensing and GIS in forestry	Prof. Renata Pernar, Ph.D. Prof. Ante Seletković, Ph.D. Asst. Prof. Jelena Kolić, Ph.D.	30	30	16		5.0	Compulsory
Bases of hunting management	Prof. Marijan Grubešić, Ph.D Prof. Krešimir Krapinec, Ph.D Asst. Prof. Kristijan Tomljanović, Ph.D	30	30	16		6.0	Compulsory
The basic of forest mechanisation	Prof. Marijan Šušnjar, Ph.D Asst. Prof. Zdravko Pandur, Ph.D.	30	30	16		5.0	Compulsory
Physical and health education 3	Davor Pavlović, teacher		30	0		1.0	Compulsory
In total		**165**	**180**	**88**	**0**	**30**	

Year of study: II							
Semester: Summer							
COURSE	COURSE TEACHER	L	E	F	e-learning	ECTS	Compulsory / elective
Establishment of forests	Prof. Milan Oršanić, Ph.D. Assoc. Prof. Damir Drvodelić, Ph.D	45	30	24		6.0	Compulsory
Forest ecology	Prof. Ivica Tikvić, Ph.D Assoc. Prof. Damir Ugarković, Ph.D	30	30	24		6.0	Compulsory
Forest entomology	Prof. Boris Hrašovec, Ph.D	30	30	24		6.0	Compulsory
Dendrology	Prof. Marilena Idžojtić, Ph.D Asst Prof. Igor Poljak, Ph.D	45	30	24		7.0	Compulsory
Forest genetics	Asst. Prof. Ida Katičić Bogdan, Ph.D Prof. Saša Bogdan, Ph.D	30	15	0		4.0	Compulsory
Physical and health education 4	Davor Pavlović, teacher	0	30	0		1.0	Compulsory
In total		**180**	**165**	**96**	**0**	**30**	

Year of study: III							
Semester: Winter							
COURSE	COURSE TEACHER	L	E	F	e-learning	ECTS	Compulsory / elective
Silviculture I	Prof. Igor Anić, Ph.D Assoc. Prof. Stjepan Mikac, Ph.D	45	30	40		7.0	Compulsory
Basic foundation of forest regulation and planning	Prof. Jura Čavlović, Ph.D Asst. Prof. Krunoslav Teslak, Ph.D	45	30	16		6.0	Compulsory
Timber hrvesting operations	Prof. Tomislav Poršinsky, Ph.D Asst. Prof. Andreja Đuka; Ph.D	30	30	32		6.0	Compulsory
Basics of forest economics	Prof. Stjepan Posavec, Ph.D Asst. Prof. Karlo Beljan, Ph.D	30	15	0		4.0	Compulsory
Nature and environmental protection	Prof. Željko Španjol, Ph.D. Assoc. Prof. Damir Barčić, Ph.D.	30	15	0		3.0	Compulsory
Work safety in forestry	Prof. Ivan Martinić, Ph.D Asst. Prof. Matija Landekić, Ph.D	30	15	8		4.0	Compulsory
In total		**210**	**135**	**96**	**0**	**30**	

Year of study: III							
Semester: Summer							
COURSE	COURSE TEACHER	L	E	F	e-learning	ECTS	Compulsory / elective
Forest roads	Prof. Tibor Pentek, Ph.D Asst. Prof. Ivica Papa, Ph.D	30	30	32		5.0	Compulsory
Organization basics in forestry	Prof. Mario Šporčić, Ph.D Asst. Prof. Matija Landekić, Ph.D	30	30	24		5.0	Compulsory
Forest Phytophatology	Prof. Danko Diminić, Ph.D	30	30	16		5.0	Compulsory
Fundamentals of forest protection	Asst. Prof. Marko Vucelja, Ph.D Asst. Prof. Milivoj Franjević, Ph.D Asst. Prof. Kristijan Tomljanović, Ph.D	30	0	0		2.0	Compulsory
Professional practice						2.0	Compulsory
Bachelor thesis						8.0	Compulsory
In total		**120**	**90**	**72**	**0**	**27**	
In total (compulsory)		**1020**	**930**	**464**	**0**	**177**	

Error! Reference source not found.	Sanda Tomičić, teacher	15	0	0		1.0	Elective
Manners of game hunting	Prof. Marijan Grubešić, Ph.D	15	0	0		1.0	Elective
Forest Mushrooms	Prof. Danko Diminić, Ph.D	15	0	0		1.0	Elective
Ornamental Dendrology	Prof. Marilena Idžojtić, Ph.D Asst Prof. Igor Poljak, Ph.D	15	0	0		1.0	Elective
Fires of open space	Prof. Željko Španjol, Ph.D Asst Prof. Roman Rosavec, Ph.D	15	0	0		1.0	Elective
Management of forest genetics resources	Prof. Saša Bogdan, Ph.D Asst. Prof. Ida Katičić Bogdan, Ph.D	15	0	0		1.0	Elective
Animal physiology	Asst. Prof. Kristijan Tomljanović, Ph.D	15	0	0		1.0	Elective
Melliferous herbaceous plants	Prof. Željko Škvorc, Ph.D, Assoc. Prof. Daniel Krstonošić, Ph.D,	15	0	0		1.0	Elective
Basics of digital cartography	Prof. Renata Pernar, Ph.D Asst. Prof. Mario Ančić, Ph.D	15	0	0		1.0	Elective
History of Croatian forestry	Prof. Igor Anić, Ph.D Asst. Prof. Stjepan Mikac, Ph.D	15	0	0		1.0	Elective
In total (elective)		**45**	**0**	**0**		**3.0**	
In total (study programme)		**1065**	**930**	**464**	**0**	**180**	

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Assoc. Prof. Vibor Roje, Ph.D.	1.7. Number of ECTS credits	6
1.2. Course title	Basics of Chemistry	1.8. Number of hours in semester (L+E+F+e-learning)	45+15+0
1.3. Course code	226034	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	After attending of the classes and successfully passing the exam in the subject Basics of Chemistry, the student will have knowledge that will enable him to understand the content of the professional subjects that he will encounter in the further course of study, when he/she will meet some chemical phenomena in the context of forestry.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	After attending the course Basics of Chemistry, the student will be able: 1. to distinguish extensive and intense physical quantities 2. to connect physical quantities for expressing the quantity (mass, quantity, volume, number) of a substance and the composition of mixtures (fractions, concentrations, molality) with SI, some exceptionally permitted and old units of measurement 3. to apply the basic settings of the precision calculus when processing experimental results 4. to distinguish pure substances and mixtures 5. to recognize a substance represented by chemical symbols 6. to connect the basic physical and chemical properties of simple inorganic and organic substances with their chemical composition 7. to apply the relations between physical quantities for calculation based on a chemical reaction equation 8. to distinguish the limiting reactant and the reactant in excess 9. to connect names and chemical formulas with the basic chemical and physical properties of simple inorganic and organic substances 10. to identify natural organic compounds (carbohydrates, amino acids, lipids, nucleic acids, alkaloids) on the basis of a representation of a structure or structure segment and put it in the relation to the basic properties.
2.5. Course content (syllabus)	LECTURES: 1. Physical quantities, units of measurement and basics of precise calculation What is measurement, what is physical quantity? Extensive and intense physical quantities. Units of measurement according to SI, exceptionally permitted units of measurement.

	Decimal units of measurement, prefixes. Conversion of units of measure using prefix values. Relationships between exceptionally permitted or old units for pressure (bar, atm, mmHg) with the official one (Pa). Exceptionally permitted unit of measurement for volume (liter and decimal versions: mL, dL,...). Precise calculation. Rules for determining significant digits. Basic rules of precision calculus for determining the number of significant digits in the calculation result: addition and subtraction, multiplication and division. 2. Basic chemical concepts Periodic table of the elements. Symbols and names of the chemical elements. Atomic radius, electronegativity, ionization energy. Chemical bonding - covalent and ionic bond. Metallic bond. Intermolecular interactions, hydrogen bond. Lewis molecule structures. VSEPR model. 3. Basics of stoichiometry I Relative atomic mass, relative molecular mass, unified atomic mass unit. Mole, number-of-moles, molar mass. Number of entities (abundance), Avogard's constant. Empirical and molecular formula. Calculation of an empirical formula on the basis of the results of chemical analysis. Calculation of the molecular formula from the empirical one, with the using the molar mass of the compound. 4. Basics of stoichiometry II Stoichiometry of chemical reactions. The ratio of the sets of reaction participants. Reach of a reaction. Reaction yield. Limiting reactant and reactant in excess. 5. Chemical thermodynamics What is chemical thermodynamics? Laws of thermodynamics. Internal energy, work, heat. Enthalpy: reaction enthalpy, enthalpy of formation, combustion enthalpy, enthalpy of melting, enthalpy of evaporation, enthalpy of sublimation, enthalpy of chemical bond. Thermochemical equation. Hess's law. Entropy, Gibbs energy. 6. Aggregation states Solid, liquid and gaseous state of aggregation. Differences in basic physical properties of aggregation states (shape, order, compressibility). Crystalline and amorphous structure of solids. Aggregation states changes, boiling point, normal boiling point. Properties of liquids (viscosity / fluidity, capillarity, surface tension). Ideal and real gases. Ideal gas state equation (general gas equation). Phase diagram. 7. Solutions and colloidal systems I Solutions, solvents, solutes. Polar and non-polar solvents, electrolytic and non-electrolytic solutions. Processes in dissolving solid ionic substances in water; enthalpy diagrams. Solubility diagrams. Henry's law of solubility of gases. Quantitative expression of the composition of mixtures. Proportions (mass, volume, plural), concentrations (mass, plural), molarity and appropriate units of measurement. Less commonly used physical quantities to express the composition of mixtures: numerical fraction, numerical concentration, volume concentration; ratios; contents. 8. Solutions and colloidal systems II Colloidal systems. Dispersed phase, dispersion medium. Micelles. Surfactants. Electrical bilayer, coagulation, peptization. 9. Chemical kinetics and chemical equilibrium Chemical kinetics as a branch of physical chemistry. The rate of change in the concentration of reactants or products and the rate of a chemical reaction. Reaction rate law. Order of reaction. Factors affecting the rate of a chemical reaction: concentration, pressure, temperature, catalyst. Dependence of reactant concentration on time. Collision theory. Activation energy and transition state. Chemical equilibrium. Dynamic equilibrium phenomenon. Factors that can affect the system in a state of dynamic equilibrium: concentration, pressure, temperature. Le Chatélier's principle. Equilibrium constant (concentration and pressure). Units of measurement of equilibrium constants. Relationship between concentration and equilibrium pressure constant. 10. Acids, bases, and salts I Acids and bases. The definitions of acids and bases by various authors, according to different criteria. Substances forming acidic aqueous solutions: covalent hydrides and

	similar compounds, oxoacids, oxoacid anhydrides, carboxylic acids. Substances forming basic aqueous solutions: hydroxides, hydroxide anhydrides, covalent hydrides (ammonia and derivatives), organic amines. Acid and base strength. pH, pOH, Kw, Ka, Kb, Ksp, degree of ionization. 11. Acids, bases, and salts II Salts. Salt ionization. Solubility of salts in water. Reactions in which salts are formed. Reactions of metals with acids. Salt hydrolysis, acidity of aqueous salt solutions. Basics of nomenclature of acids, bases and salts. Amphoterism (of some metals, their oxides and hydroxides). Amphoteric acid residues. Buffer solutions, acidic and basic buffers. 12. Oxidation and reduction processes The concept of oxidation number, oxidation and reduction. Rules for determining the oxidation number. Rules for equalization of redox process equations by ion and electron method, in acidic and basic aqueous medium and in aqueous solution without the participation of H+ and OH− ions. Important oxidizing agents and reducing agents (KMnO4, K2Cr2O7, HNO3, H2O2), aqua regia. Complex compounds Complex compounds, central metal atom, ligands. Examples of simple ligands with respect to the charge and with respect to the number of unshared electron pairs. The charge of a co-ordination unit. Geometric shapes of complex units. Nomenclature of complex compounds. Reactivity of complex compounds. Occurence of complex compounds (in nature, analytical chemistry, photography, etc.). Blue vitriol, Hem, chlorophyll. 13. Organic Chemistry I Chemistry of carbon compounds. A tetravalent carbon atom. Functional groups of carbon A tetravalent carbon atom. compounds. Oxidation number of carbon in organic molecules. Representation of molecules of organic compounds: molecular models, perspective formula, wedge-and-dash projections, Newman projection, structural projection formula, condensed structural formula, bond line representation (skeletal drawing). Empirical formula. Hydrocarbons: alkanes, alkenes, alkynes, cycloalkanes, arenes. Nomenclature. Aliphatic and cyclic hydrocarbons. Conformational and constitutional isomerism of hydrocarbons. Geometric isomerism of alkenes: designations cis-, trans- and Z- and E-. Physical and chemical properties of hydrocarbons; substitution and addition reactions. Current concept of aromaticity: Hückel's rule. Organohalogen compounds, the most important representatives of organohalogen compounds. Substitution and elimination reactions. Alcohols and phenols. The most important representatives of the group, nomenclature. Primary, secondary and tertiary alcohols. Divalent, trivalent, multivalent alcohols. Physical and chemical properties; substitution reactions to the O−H and C−O bonds. Ethers. The most prominent representative of the group, the nomenclature. Physical and chemical properties, flammability of ether. Substitution reactions. Aldehydes and ketones. The most important representatives of the group, the nomenclature. Physical and chemical properties. Preparation of aldehydes and ketones from alcohols. Oxidation and reduction reactions on the carbonyl group. Substitution reactions on α-carbon atom. Tollens and Fehling reactions to prove an aldehyde group. Carboxylic acids; the most important representatives, the nomenclature. Carboxylic acid derivatives: esters, acyl halides, carboxylic acid anhydrides, amides. Physical and chemical properties of carboxylic acids and derivatives. Substitution reactions on the carboxyl group. Amine. Primary, secondary and tertiary amines, quaternary ammonium salts. Nomenclature. Physical properties. Alkalinity of amines. Substitution reactions with carboxylic acid derivatives. 14. Organic Chemistry II Heterocyclic compounds, an overview of the simple heterocyclic compounds. Aromatic and non-aromatic heterocyclic compounds. Heterocyclic compounds with condensed rings. Organic compounds with sulfur. Review of groups of compounds with sulfur instead of oxygen atoms. Chirality and optical activity. Chiral carbon atom, enantiomers, diastereoisomers. Rules for determining the absolute configuration of an asymmetrically substituted C-atom (Cahn-

	Ingold-Prelog priority rules). Absolute configuration and direction of rotation of the plane of polarized light. Wedge-and-dash formula, Fischer's projection formula. Racemic, meso-compounds, number of geometric isomers with respect to the number of asymmetric carbon atoms. 15. Natural organic compounds Lipids: triglycerides, phospholipids, lipid waxes; steroids, terpenes, fat-soluble vitamins, icosanoids. Carbohydrates; monosaccharides, oligosaccharides, polysaccharides. Glucose and fructose. Fischer projection formulas and relative configuration. Chain and cyclic structures of monosaccharides. Disaccharides and polysaccharides. Glycosidic bond. Amino sugars, chitin. Amino acids, peptides, proteins. α-amino acids and structures of important natural amino acids, character of side branches. Zwitter-ion, acid-base properties of amino acids. Protein structure: primary, secondary, tertiary and quaternary. α-helix and β-sheet. Simple and conjugated proteins. Nucleic acids. Polynucleotide chain components: heterocyclic bases, pentoses, phosphate ion. Nucleosides and nucleotides. The double helix of a DNA molecule. RNA. Other natural organic compounds; alkaloids. EXERCISES: 1. Conversion of units of measurement: decimal to non-decimal; non-decimal to decimal; derived unnamed units. 2. Representation of structures of simple molecules by Lewis symbols. Correlation of physical properties with chemical bonds and intermolecular interactions. 3. Number-of-moles calculation on the bases of number-of-units or mass data. Calculation of empirical and molecular formula. 4. Calculation of the mass / number-of-moles / volume of the required reaction participant on the basis of data on the reaction participant of a known quantity. Calculation of reaction yield. Determination of the limiting reactant. 5. Calculation of standard reaction enthalpy based on reaction equation and tabulated values for ΔfH°. Calculation of ΔrH° using the values of enthalpy of chemical bonds. Hess's law. Constructing of an enthalpy diagram. Calculation of reaction entropy and Gibbs energy. 6. General gas equation. Stoichiometry of chemical reactions with gas participant (s). 7. Calculation of a quantitative composition of the solution. Calculation of the amounts of ingredients required to prepare a solution of the required concentration, proportion or molarity. 8. Conversion of expression of the composition of a solution from one intensive to another intensive physical quantity. Relationship between mass and molar concentration. Dilution of solutions - calculation of (i) the concentration of the solution prepared by dilution or (ii) the volume of the initial solution. 9. Derivation of the expression for the concentration or pressure equilibrium constant based on the reaction equation, derivation of an appropriate unit of measurement. Calculation of the equilibrium constant value based on the values of the concentrations of the reaction participants. Calculation of equilibrium concentrations of reaction participants based on initial concentrations and equilibrium constant values. 10. Writing acid and base ionization equations. Writing compound formulas on the basis of the names and vice versa. 11. Writing acid-base reactions. Derivation of salt hydrolysis equations. Calculation of pH of aqueous solutions of strong and weak acids and bases. Solubility calculation based on Ksp. 12. Determination of oxidation numbers in various examples of simple inorganic compounds and ions. Balancing redox reaction equations that take place in an acidic or basic medium, with and without the participation of H+ and OH− ions. 13. Derivation of carbon compound names on the basis of the structure. Representation of structures of organic compounds on the basis of the names. Predicting the products of chemical reactions of simple representatives of the above groups of organic compounds and writing the equations.

	14. Determination of the absolute configuration of chiral compounds. Fischer's projection formulas. 15. Demonstration of the structure of simple lipids, carbohydrates and amino acids. Demonstration of acid-base amino acid reactions.

2.6. Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *online in entirety* ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:

2.8. Monitoring student work									
	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work		NO	Report		NO	(other)		
	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam	YES		Practical work		NO	(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	6	

2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.
2.10. Student responsibilities	Attendance and active participation in class, solving homework and partial exams.

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	V. Roje, The lectures	NO	
	of the Basis of Chemistry, ppt-presentations (in Croatian)	NO	
	M. Sikirica, B. Korpar-Čolig, Chemistry with Exercises 1 (in Croatian), Školska knjiga, Zagreb, 1991. and later editions	NO	
	M. Sikirica, B. Korpar-Čolig, Chemistry with Exercises 2 (in Croatian), Školska knjiga, Zagreb, 1991. and later editions	NO	

2.12. Optional literature	1. P.W. Atkins, M.J. Clugston, Basics of Physical Chemistry (translation in Croatian), Školska knjiga, Zagreb, 1992. 2. V. Rapić, Nomenclature of organic compounds (in Croatian), Školska knjiga, Zagreb, 1991. and later editions 3. M. Sikirica, Stoichiometry (in Croatian), Školska knjiga, Zagreb

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Asst. Prof. Azra Tafro, Ph.D	1.7. Number of ECTS credits	7
1.2. Course title	Mathematics	1.8. Number of hours in semester (L+E+F+e-learning)	45+45+0
1.3. Course code	33852	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in	1.10. Level of application of	2

	Forestry	e-learning (level 1, 2, 3)	
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The course objectives are mastering the skills of mathematical modelling, development of abstract and analytical thinking and precision of expression and mathematical inference. Course contents are adapted to students of forestry studies. Overall material relating to functions, differential and integral calculus and basics of linear algebra is preserved in integral form, with a simplified approach.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. Applied approach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyze data and independently draw conclusions based on analyzed data.		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Interpretation of basic notions and facts of sets and functions when solving mathematical problems (graphs of elementary functions, sequence limits, domain of a function, properties of functions, composition of functions, inverse functions, function limits, function continuity). 2. Applications of derivatives (tangents, elementary and compound function derivatives, derivative rules, function growth and decay, extremes of functions, graphs). 3. Interpretation of two variable functions (partial derivatives, extremes). 4. Interpretation of indefinite integrals (concept of primitive function and indefinite integral, integrating, basic properties of indefinite integrals, integration methods). 5. Analysis of definite integrals (basic concepts, Newton-Leibnitz formula, calculating areas of plane figures using definite integrals, calculating the volume of a solid of revolution, centroid coordinates, double integral, first order differential equations). 6. Interpretation of vectors and matrices (vectors in two- and three-dimensional space, operations with vectors, matrices and matrix calculus, determinants).		
2.5. Course content (syllabus)	Lectures and exercises: 1. Number sets. Real numbers. 2. Equations and inequalities 3. Functions. Linear and quadratic function. 4. Elementary functions. 5. Properties of functions. 6. Function domain and inverse. 7. Continuous functions and limits. 8. Derivative. Derivations of elementary functions. Differential calculus. 9. Function analysis. 10. Functions of more than one variable. 11. Integral. Indefinite integral. Some integration methods. 12. Definite integral. Applications of integral calculus (areas, volumes, moments, centroid). 13. Differential equations. 14. Vectors in a two- and three-dimensional space. Vector operations. 15. Matrices and matrix calculus.		
2.6. Format of instruction	☒ lectures	☒ independent	2.7. Comments:

	☐ seminars and workshops ☒ exercises ☐ *online in entirety* ☐ partial e-learning ☐ field work			assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)					
2.8. Monitoring student work	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work		NO	Report		NO	(other)		
	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam	YES		Practical work		NO	(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	7	
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities	Attendance and active participation in class, solving homework and partial exams.								

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Bradić T. et al: Matematika za tehnološke fakultete, Element, Zagreb, 1998.	YES	
	Javor, P.: Matematička analiza 1, Element, Zagreb, 2003.	NO	on-line

2.12. Optional literature	1. Hitrec,V. :Matematika (analiza funkcija), skripta. Šumarski fakultet, Zagreb, 1986 2. Hitrec,V. :Matematika (funkcije od dvije varijable, integriranje i primjena), skripta, Zagreb, 1994. 3. Štambuk Lj.: Matematika, Veleučilište u Rijeci, 2010

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Assoc. Prof. Bojan Matoš, Ph.D Asst. Prof. Duje Smirčić, Ph.D Ivica Pavičić, Ph.D Šime Bilić, Ph.D	1.7. Number of ECTS credits	4
1.2. Course title	Petrology with Geology	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+0
1.3. Course code	229682	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	The program of this course is designed to offer students of Forestry studies basic knowledge in the fields of mineralogy, petrology and geology, providing 1) basic classification of minerals and rocks; 2) understanding the principles of petrogenesis of igneous, sedimentary and metamorphic rocks; 3) understanding processes in rock weathering and erosion on the Earth's surface; 4) understanding of landscape and soil formation processes; 5) usage of basic geological maps; 6) understanding of the hydrogeological properties of surface and ground waters; 7) understanding of the geological role in the environmental protection and sustainable development
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data B3. acquire basic principles of protection of forests from abiotic and biotic factors, especially fires and apply basic procedures and means in protection of forests B7. perform professional field works in the melioration and management of forest areas in the Mediterranean region B8. collaborate in preparation of ecological studies and spatial plans
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain the Earth's architecture and formation of minerals (Earth's interior, endogenic processes in the Earth's interior, Earth's crust and lithosphere, tectonic plate theory, minerals, crystallinity, crystal lattice, crystal systems, chemical composition of minerals, petrogenic minerals, and genesis and physical properties of minerals). 2. Identify and classify igneous, sedimentary and metamorphic rocks (a) magma/lava, classification of igneous rocks according to their place of formation, chemical and mineralogical composition, Bowen's crystallisation series from magma systems, classification of igneous bodies, post magmatic stages of crystallisation; (b) sedimentary rock genesis, basic characteristics and classification of sedimentary rocks; (c) metamorphism, structural and mineralogical changes in metamorphic rocks, metamorphic stages and classification of metamorphic rocks. 3. Differentiate difference between relative and absolute dating methods and explain classification systems and principles in determination of geological time: lithostratigraphic, biostratigraphic, chronostratigraphic and geochronological systems. 4. Apply basic geological principles to identify relative age order of geological events and features. 5. Classify primary and secondary (deformational) geological structures/features in rocks types of the Earth's crust. 6. Address the effect of surface and ground water on mechanical and chemical weathering of minerals and rocks, and landscape formation. 7. Characterize the principles of earthquake occurrences, its manifestation, arrangement, frequency and intensity of earthquakes as well as slope gravitational processes (e.g., landslides, creeping, etc).
	L1 Introduction; Structure of the Earth L2 Minerals, mineral structure and their physical characteristics; E1 Examples of minerals with characteristic physical features L3 Mineral systematics; E2 Mineral examples of characteristic groups and their physical-chemical features, silicate minerals and their crystal structure L4 Igneous rocks – origin and systematics; E3 Classification and examples of igneous rocks, minerals in igneous rocks, igneous rock texture L5 Sedimentary rocks; E4 First partial exam L6 Metamorphic rocks; E5 Classification of sedimentary rocks, clastic sedimentary rocks and sediments, carbonate sedimentary rocks; Metamorphic rocks, classification of metamorphic rocks, characteristic rocks for different metamorphic stage L7 Geological time; E6 Second partial exam

<table>
<tr><td></td><td colspan="9">L8 Geological structures; E7 Concepts of determination of geological time, geological structures, basic geological map
L9 Corrections of first and second partial exam; E8 Understanding of the elements found in the basic geological map, faults, folds, layer position elements
L10 Surface water, Hydrology; E9 Measuring and drawing layer positional elements
L11 Groundwater, Hydrogeology; E10 Construction of the geological profile – drawing the topographic features
L12 Tectonic plate boundaries and earthquakes - seismotectonic features of earthquakes, mechanisms and causes of earthquakes and cogenetic deformations; E11 Construction of the geological profile – drawing of the faults
L13 Gravitational transport of rocks and soils along the slopes; E12 Construction of the geological profile – drawing of the layers and layer elements
L 14 Third partial exam; E13 Construction of the geological profile – determination of the fault character and calculation of the fault heave and throw
L15 Corrections of the third partial exam; E14 Evaluation of the constructed geological profile
E15 Evaluation of the constructed geological profile</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td>YES</td><td></td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>4</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">The student is obligated to attend the exercises of the course. The student is obligated to construct and submit the exercise task for evaluation. The task is done during the semester in the frame of exercise lectures and is referred to the construction of a simple geological profile based on the data from the geological map. During the semester, three partial exams will be organised, enabling the final grade, in case all three are positive. If all three partial exams are not positive, the student is obligated to have at least one partial exam with a positive grade to get the possibility of undertaking the final exam during the exam period.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="3">Title</td><td colspan="3">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td></td><td colspan="3">Pavelić, Davor (2014): Opća geologija. Rudarsko-geološko-naftni fakultet, Zagreb</td><td colspan="3">YES</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3">Vrkljan, Maja (2012): Uvod u mineralogiju i petrologiju</td><td colspan="3">YES</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
</table>

2.12. Optional literature	1. Plummer, C.C., McGeary, D. & Carlson, D.H (1999): Physical geology. 8th Edition, WCB - McGraw-Hill Publishers, Boston – Toronto. 2. Tišljar, Josip (1994): Sedimentne stijene. Školska knjiga, Zagreb, 422 str. 3. Vrkljan, Maja (2001): Mineralogija i petrologija – osnove i primjena. 1-207, Udžbenici Sveučilišta u Zagrebu, izd. RGN fakultet Zagreb		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Željko Škvorc, Ph.D, Assoc. Prof. Daniel Krstonošić, Ph.D,	1.7. Number of ECTS credits	3
1.2. Course title	Forest Botany – Plant Morphology	1.8. Number of hours in semester (L+E+F+e-learning)	15+30+0
1.3. Course code	226035	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Students are introducted to basic botanical terms which are the base for senior-year courses. In addition, they get acquainted with the anatomical and morphological structure and function of plant cells, tissues and organs. All of that develops their understanding of the functioning and role of particular parts in different ecosystems they will work in after their graduation.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. identify tree species based on morphological characteristics, identify parts and tree shapes and apply theoretical and practical knowledge of commercially indigenous and foreign tree species and shrubs		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. To present the plant cell structure and function and plant function and plant histology (cytology, cytoplasm, plastids, mitochondria, cell wall, pits, cell nucleus, chromosomes, DNA, mitosis, meiosis, primary, secondary meristems, phellogen, vascular cambium, permanent or final cells, dermal and vascular tissue). 2. To interpret the anatomy of vegetative plant organs (leaf, stem structure, structure of Gymno- and Angiosperms, bark anatomy, root anatomy, phylogeny of stele). 3. To interpret the morphology of vegetative organs (structure, types, transformations and growth of stems, roots and leaves). 4. Interpret the morphology of reproductive organs (structure and classification of flowers, inflorescences, fruits and seeds) and explain the alternation of generations and plant reproduction.		
2.5. Course content (syllabus)	Lectures 1. Introduction, historical development. Basic organization of the plant body. (1h) 2. Cytology - Protoplast, Cell wall. Cell nucleus - chromatin, chromosomes, DNA. Plant cell division - mitosis, meiosis. (2h) 3. Histology - general characteristics, cell types. Primary meristems. Secondary meristems. Permanent cells. Skin cell. Vascular cell - development of conducting vessels, types and structure of conducting vessels. (2h)		

<table>
<tr><td></td><td colspan="9">4. Morphology of vegetative organs. Primary and secondary growth. Increase in thickness. Root - root structure, root types, root transformations. Shoot - shoot structure, shoot transformations, wood anatomy. (2h)
5. Morphology of vegetative organs. Leaf - structure, shape, polymorphism, leaf duration, leaf transformations. Morphological adaptations to environmental stress conditions. (2h)
6. Morphology of reproductive organs. Alternation of generations. Sporangia and sporophiles, Gametophyte, (2h)
7. Morphology of reproductive organs. Flower. Pollen. Inflorescence. (2h)
8. Pollination and fertilization. Seed. Fruit - anatomical structure, classification. Fruit dispersal. Germination and seedling. (2h)

Exercises
1. Introduction to practicum work. The construction of the microscope. Basics of microscopy. Specimen preparation. Observation of plant cells at low magnification. (2h)
2. Cytoplasmic motion. Living and non-living parts of a plant cell. The apical shoot on the longitudinal section. Tissue classification. Primary meristem, initial cells. (2h)
3. The structure of the tetracytic and gramineous type of stomata. Observation of leaf epidermis. Observation on greater magnification. Opening and closing of stomata. (2h)
4. Parts of a leaf. Leaf shapes. Anatomical structure of dorsiventral and concentric leaf. Assimilation and transpiration parenchyma. Leaves of light and shade. (4h)
5. Shapes and appearance of the shoot. Buds. Stem transformations. (2h)
6. Primary structure of dicot-gymnosperm stem on the cross-section. Stem primary cortex. Stem central cylinder. Types of vessel tissues. Open collateral vessel. (2h)
7. Primary structure of monocot stem. Closed collateral vessel. (2h)
8. Types and root transformations. Primary root structure. The apical root. Root hairs. Radial vessel. (2h)
9. Periderm structure. Bark structure and function. Lenticels. (2h)
10. Wood structure - gymnosperms and angiosperms. Characteristic wood sections. (4h)
11. Flower morphology. Anatomical structure of flower parts. Pollen morphology. (2h)
12. Seed structure - gymnosperms, angiosperms. (2h)
13. Fruit types. Fruit structure. (2h)</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>3</td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures and exercises. Passing preliminary exams, exams.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="3">Title</td><td colspan="3">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
</table>

	Franjić, J., Škvorc, Ž., Trinajstić, I., 2008: Anatomija bilja (interna skripta), 1-62. Zagreb.	NO	YES, MERLIN
	Franjić, J., 1998: Praktikum iz anatomije bilja (interna skripta), 1-22. Zagreb.	NO	YES, MERLIN
	Franjić, J., Ž. Škvorc, 2010: Šumsko drveće i grmlje Hrvatske. Sveučilište u Zagrebu-Šumarski fakultet.	YES	YES, MERLIN
	Franjić, J., Ž. Škvorc, 2014: Šumsko zeljasto bilje Hrvatske. Sveučilište u Zagrebu-Šumarski fakultet.	YES	YES, MERLIN
	Franjić, J., Ž. Škvorc, 2020: Šumsko drveće i grmlje Hrvatske (Novo izdanje). Sveučilište u Zagrebu – Šumarski fakultet, 516 str. Zagreb.	YES	YES, MERLIN
2.12. Optional literature	1. Nikolić, T., 2017: Morfologija biljaka – razvoj, građa i uloga biljnih tkiva i organskih sustava. Alfa d. d. Zagreb. 2. Idžojtić, M., 2013: Dendrologija – Cvijet, češer, plod, sjeme. Šumarski fakultet Sveučilišta u Zagrebu. 672 pp. 3. Glimn-Lacy, J., Kaufman, P. B., 2006: Botany Illustrated. Introduction to Plants, Major Groups, Flowering Plant Families. Springer. 146 p. 4. Moore, R., W. D. CLARK, K. R. STERN, D. VODOPICH, 1995: Botany. WCB Dubuque.		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Josip Margaletić, Ph.D Asst. Prof. Marko Vucelja, Ph.D Linda Bjedov, Ph.D	1.7. Number of ECTS credits	6
1.2. Course title	Zoology in Forestry	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+8
1.3. Course code	226036	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	YES
2. COURSE DESCRIPTION			
2.1. Course objectives	The course is based on the principles of modern forestry science and proceeds from the basis of permanent and ecological management of forest ecosystems in which the zoobiotic component is one of the main components of the complex forest ecosystem. The course is accompanied by modern teaching resources (multimedia, video, slides) and organized laboratory and field exercises.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B2. recognise and determine the most important types of xylophages bacteria, insects and funghi on trees species and detect wood defects incurred due to their activity B3 acquire basic principles of protection of forests from abiotic and biotic factors, especially fires and apply basic procedures and means in protection of forests B8. collaborate in preparation of ecological studies and spatial plans		

2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Interpret animal promorphology (importance and meaning of zoology, differences between plants and animals, the division of zoology, the size and form of animals, the plan of animal bodies (promorphology), the position of animals in space and time (ecological, geographic, geological), trophic chains. 2. Describe the Systematics of the Animalia Kingdom (animal phylogeny, heredity and evolution, animal taxonomy, Kingdom Monera, Kingdom Protoctist, Animalia Animalia, Speciation, Insulation Mechanisms, biological community and ecosystems). 3. Interpret the integumentary, skeletal, muscular and nervous system in animals. 4. Interpret the sensory, digestive and respiratory systems in animals. 5. Interpret the excretory, hormonal, excretory and reproductive system of organs in animals (forms of sexual and non-sexual reproduction, gender determinations, generation changes, heterogenesis). 6. Describe the behavior of animals (osmoregulation of animals on land, bioluminescence, migration, raising of offspring).
2.5. Course content (syllabus)	Students become acquainted with the basic characteristics of the animal kingdom. They become acquainted with the basics of taxonomy and the division of animals into phyla and the morphological, physiological, ecological and etological differences among these. An overview of the lower taxa of the phyla, concentrating in particular on the relevant organisms which inhabit protected areas (national parks, nature parks, horticultural objects), their biology, ecological role and possible harmfulness in forestry and hunting management. The course emphasizes the importance of animals in the processes of cycling matter and energy and the maintenance of stability and diversity of life in various biotopes. Lectures: 1. Zoology as a science. General concepts. Functional and structural characteristics of a living organism. The main differences between plants and animals. Specific branches of zoology. Basic methodological principles in zoological research. Zoology in forestry - history, significance and course objectives. 2. Animal shapes and sizes. Animal body structure (promorphology). Ecological, geographical, geological concepts. 3. Phylogeny of animals. Heredity and evolution. Animal taxonomy. Kingdom Monera. Kingdom Protoctists. Kingdom Animalia. Type of organization Parazoa. Type of organization Ameria - morphology, biology and significance as human and animal parasites. Type of organization Polymeria - morphology, biology and significance as human and animal parasites . Type of organization Oligomeria - morphology, biology and significance as human and animal parasites. Type of organization Chordonia. 4. Conservatism and parallelism in animals. Animal population. Species (typological, morphological and biological concept). Agamospecies. Subspecies. Dem. Monotypic and polytypic species. Speciation. Isolation mechanisms. Biocenozis and ecosystems. 5. Integumentary system in certain animal groups important for forest ecosystems. Skeletal system in animal groups important for forest ecosystems. 6. Muscular system in certain animal groups important for forest ecosystems. Nervous system in individual animal groups important for forest ecosystems. 7. Sensory system in certain animal groups important for forest ecosystems. Mechanoreceptors. Hearing organs. Thermoreceptors. Chemoreceptors. Gustoreceptors. Stiboreceptors. Photoreceptors. 8. Digestive system in certain animal groups important for forest ecosystems. Feeding types. Food intake in animals. Forms of the digestive system. 9. Respiratory system in certain animal groups important for forest ecosystems. Aerobic and anaerobic respiration. Respiratory forms in animals. 10. Circulation system in certain animal groups important for forest ecosystems. Endocrine system in certain animal groups important for forest ecosystems. 11. Excretory system in certain animal groups important for forest ecosystems. 12. Reproductive system in certain animal groups important for forest ecosystems.

<table>
<tr><td></td><td colspan="9">Properties and forms of asexual reproduction. Regeneration. Cloning. Autotomy.
13. General characteristics and forms of sexual reproduction. Plasmogamy. Autogamy. Conjugation. Spermatogenesis. Oogenesis. Parthenogenesis (natural and artificial). Embryogenesis. Gender determination (diplomodification, haplomodification, diplogenetic, gonosomal). Generation change. Heterogonia.
14. Osmoregulation of animals on land. Bioluminescence.
15. Behavior of animal groups

Exercises:

1. Introduction: Microscope, binocular, preparation of microscopy preparations
2. Porifera (morphology, anatomy), Cnidaria: (morphology, anatomy)
3. Parasites: Nematode, Platyhelminthes (morphology, anatomy)
4. Arachnida: Scorpiones, Pseudoscorpiones (morphology, anatomy)
5. Arachnida: Araneae, Acari (morphology, anatomy)
6. Insecta: Hemiptera, Coleoptera (morphology, anatomy)
7. Insecta: Hymenoptera, Diptera (morphology, anatomy)
8. Insecta: Lepidoptera: oral apparatus, structure of tentacles, structure of wings (scales)
9. Annelida: Lumbricus terrestis (morphology, anatomy)
10. Acari: Ixodes ricinus (morphology, anatomy), morphology of the oral apparatus
11. Osteichthyes, Chondrichthyes: shells of different species of both classes
12. Amphibia: larva, tadpole, frog (morphology), salamander skin
13. Aves: the structure of the stomach, the structure of the feathers
14. Mitosis, meiosis
15. Mammalia: Rattus rattus: uterus with embryo

Making drawings of microscopic slides during the exercises. The created drawings are submitted at the end of each unit of exercises and are evaluated. Exercise material is not included in the exam, and the grade of the exercises makes up 25% of the final grade.

Field work:

Introduction to the main groups of animals - field trip to the forest ecosystem. Methods of collecting and catching animals, Preserving for laboratory processing.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
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☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>6</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures and exercises. Passing preliminary exams, exams.</td></tr>
</table>

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Matoničkin, I. 1981. Beskralješnjaci, Biologija viših avertebrata, Školska knjiga, Zagreb.	YES	
	Oštrec, Lj. 1998. Zoologija, štetne i korisne životinje u poljoprivredi. Zrinski d.d., Čakovec, 232 str.	YES	
	Matoničkin, I., Erben R. 2002. Opća zoologija, Školska knjiga, Zagreb. 381 str.	YES	
2.12. Optional literature	1. Young, J. Z., 1995: The life of vertebrates, 3rd edn., Oxford University Press Inc., New York, 645 pp. 2. Randal, D., Burggren, W., French, K., 1998: Eckert animal physiology. Mechanisms and adaptations; W. H. Freeman and Company, New York, 825 pp. 3. Mitchell-Jones, A.J., Amori, G., Bogdanwicz, W., Kryštufek, B., Reijnders, P.J.H., Spitzenberger, F., Stubbe, M., Thissen, J.B.M., Vohralík, V. & Zima, J., 1999: The Atlas of European Mammals, T&A D Poyser fot the Societas Europaea Mammalogica, 484 str. 4. Burnie, D., 2008: Illustrated encyclopedia of Animals. Dorling Kindersley, London, 624 pp 5. Hickman Cleveland P., 2008: Laboratory studies in integrated principles of Zoology, McGraw-Hill, 438 pp. 6. Maljković, Z., 2014: Zagonetna priroda. Leo Paper, Hong Kong, 320 pp 7. HickmanC., Keen, S., Eisenhour, D., Larson, A., I'Anson, H., 2020: Integrated Principles of Zoology, 18 th Edition, McGrow-Hill		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Jelena Trajković, Ph.D Asist. Prof. Iva Ištok, Ph.D Assoc. Prof. Bogoslav Šefc, Ph.D	1.7. Number of ECTS credits	3
1.2. Course title	Anatomical structure of wood	1.8. Number of hours in semester (L+E+F+e-learning)	
1.3. Course code	226037	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	YES
2. COURSE DESCRIPTION			
2.1. Course objectives	One of the aims is to learn to recognize xylem anatomy of woody plants as important prerequisite for understanding basic properties of wood.The second aim is to attain professionalism in identification of selected wood species.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the	B1. identify tree species based on morphological characteristics, identify parts and tree shapes and apply theoretical and practical knowledge of commercially indigenous and		

programme to which the course contributes	foreign tree species and shrubs
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Describe and recognize (sketch) position and role of wood cells, wood tissues and phloem cells and tissues in living tree (botanical conection) 2. Describe and recognize the role of wood anatomy in fundamental wood properties (technical conection) 3. Determine (recognize) domestic commercial types of wood using determination key(s)
2.5. Course content (syllabus)	Lecutres 1. Introduction: The aims of wood anatomy. The origin of wood in plant kingdom. Commercial utilisation. 2. Methods in wood anatomy: Optical microscopy, 3. Macroscopic wood characteristics. Main sections and directions in wood. Texture, grain, growth rings, wood pores, sapwood and hardwood 4. Wood formation in tree, cambium. Structure of vascular plants. Cambium. Ontogenesis of wood tissue. 5. Cells. Cambium formation. Cambium: organisation of cells, dimensions of cells, cell divisions, periods of activity, postcambial growth of cells. Ontogenesis of wood tissue. 6. Secondary phloem and rhytidome. Periderm, structure, origin, position, duration. Bark, inner, outer, rhytidome, cork. 7. Wood cell walls: Layers, submicroscopic structure, pits and other sculptures of the wood cell walls 8. Wood elements. Morphology of wood cells, their dimensions and function. 9. Histology of conifer wood. Pattern and shape of cells and tissues in conifer wood, useful features for conifer wood identification, comparative wood anatomy of comercial conifer wood 10. Histology of hardwood. Pattern and shape of cells and tissues in hardwood, useful features for hardwood identification, comparative wood anatomy of comercial hardwood 11. Wood identification. Dichotomous and polytomous keys for microscopic and macroscopic identification of commercial wood species 12. Variations in wood structure. Wood variations within the tree on different positions: within growth ring, between growth rings, along the radius of transversal section, tree height, between roots, trunk and branch. 13. Causes of wood structure variability within species and within tree. History, position and properties of juvenile and adult wood in trees. Growth ring width: the percentage of late wood in growth ring. 14. Irregularities of wood structure. Reaction wood, compression failures, brittle heart, spiral grain, knots, false and incontinuous rings. 15. Influence of wood structure on technical properties of wood and its use. Wood anatomy and moisture content. Moisture content and technical properties of wood. Wood shrinkage and swelling. Wood anatomy and wood density. Wood density and technical properties of wood. Laboratory exercises 1. Microscopy with a biological school microscope 2. Microscopic structure of coniferous wood cells 3. Microscopic structure of deciduous wood cells 4. Characteristics of coniferous wood structure important for wood identification 5. Characteristics of coniferous wood structure important for wood identification 6. Characteristics of coniferous wood structure important for wood identification 7. Microscopic characteristics of deciduous wood 8. Microscopic characteristics of deciduous wood 9. Microscopic characteristics of deciduous wood 10. Macroscopic characteristics of coniferous wood 11. Macroscopic characteristics of coniferous wood

<table>
<tr><td></td><td colspan="9">12. Macroscopic characteristics of ring-porous deciduous wood
13. Macroscopic characteristics of ring-porous deciduous wood
14. Macroscopic characteristics of diffuse porous deciduous wood
15. Macroscopic characteristics of diffuse porous deciduous wood</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures and exercises. Passing preliminary exams, exams.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="3">Title</td><td colspan="3">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td></td><td colspan="3">Strukturna svojstva drva,: Predavanja iz predmeta strukturna svojstva drva (skripta, autori: Jelena Trajković i Bogoslav Šefc, pdf dokument oko 3 MB) i Atlas slika uz predavanja (Ilustracije uz predavanja, sabrali: Jelena Trajković i Bogoslav Šefc, pdf dokument oko 39 MB</td><td colspan="3">YES</td><td colspan="3">Library of Wood science department</td></tr>
<tr><td></td><td colspan="3">Vrste drva s naslovnica časopisa Drvna industrija (2019), Šumarski fakultet Sveučilišta u Zagrebu, str. 212.</td><td colspan="3">YES</td><td colspan="3">Library of Wood science department</td></tr>
<tr><td></td><td colspan="3">Špoljarić, Z., 1978: Anatomija drva, skripta za slušače Šumarskog odjela Šumarskog fakulteta u Zagrebu, Zagreb, 266 str.</td><td colspan="3">YES</td><td colspan="3">Library of Wood science department</td></tr>
<tr><td></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Panshin, A. J.; Zeew, C. de, 1980: Textbook of wood technology, McGraw-Hill, Inc. 722 p.
2. Schweingruber, F.H., 1990: Anatomy of European woods, Paul Haupt Berne and Stuttgart Publishers, 800 p.
3. Špoljarić, Z.; Petrić, B.; Šćukanec, V., 1969: Višejezični rječnik stručnih izraza u anatomiji drva, Poslovno udruženje šumskoprivrednih organizacija, Zagreb, 85 p.
4. *** Šumarska enciklopedija, HLZ, 1978.</td></tr>
</table>

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Davor Pavlović, teacher	1.7. Number of ECTS credits	1

1.2. Course title	Physical and health education 1	1.8. Number of hours in semester (L+E+F+e-learning)	0+30+0
1.3. Course code	226038	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the course Physical and Health Culture 1. is the acquisition of theoretical and practical kinesiological knowledge in order to train students for independent physical exercise and the adoption of healthy living habits. Through various forms of physical exercise, the goal is to meet the daily needs for movement and improve the motor, functional and cognitive abilities of the student population. Through attending classes, students are educated about the importance of daily physical exercise, or about all the good things that physical activity means for a person and his health. The aim is to simultaneously acquire knowledge about the harmfulness of various forms of addiction to health, especially their impact on intellectual and physical capabilities, the importance of quality nutrition and the most interesting results of previous research on the student population in the segment: physical activity as disease prevention, healthy eating , sports diagnostics, stress management, physical activity as a means of relief.		
2.2. Enrolment requirements and/or entry competences required for the course	health status		
2.3. Learning outcomes at the level of the programme to which the course contributes	To continue training at the graduate university studies of the Faculty of Forestry, Department of Forestry		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Describe the structure of the physical exercise class 2. Explaination of the impact of physical exercise on health. 3. Choose fitness exercises designed to strengthen individual muscle groups. 4. Demonstrate specific exercises with regard to kinesiologic activity 5. Organize constructive free time 6. Assess personal diet and physical exercise habits. 7. Demonstrate general preparatory exercises and stretching exercises. 8. Understanding kinesiology programs and their target orientation 9. Control emotions and strengthen self-control.		
2.5. Course content (syllabus)	1. Athletics Walking - Walking at different paces, Nordic walking, brisk walking, hiking Running - theoretical knowledge and divisions, cyclic movements at different paces, fast running short distances, running down a slope, running along a slope, interval cyclic movements, differences in running long, medium and short distances, running with loads, relay running, running with hurdles of different height 1. Martial arts- Judo, Karate Basic techniques of Judah - falls, hand throws, belt throws, foot throws, choking techniques, levers Basic techniques - karate - kicks, punches, defense 3. Sports games- Basketball - Keeping the ball in place, keeping the ball in motion, basic throwing, pivoting, jumping shot, passing in place and moving Football - passing in place, passing to the first, passing in motion, technique with the ball, cooperation of two and three players, shots on goal from the move, shot on goal after the ball is added, volley kick, headers, stops		

<table>
<tr><td></td><td colspan="9">Volleyball - Passing with two hands above the head, passing with the forearms, service, passing behind the head, receiving service, blocks, technique of attack, technique of defense
Handball - guiding the ball in a straight line and with a change of direction, Passing in place, passing in motion, crossings, passing for a counterattack, cooperation of two and three players, goal kick after the lead, goal shot on the added ball
4. Racket sports
Badminton-forehand punch under the arm, forehand punches above the head, forehand lob above the head, backhand punch under the arm, high serve, backhand serve, short serve, field movements, single play, pair play
5. Shooting-classification of shooting disciplines and shooting equipment, maintenance of weapons, breathing techniques, air rifle 10m
6. Fitness programs - Circuit strength training, functional training, intensive cardio training, Pilates, -
Exercises for warming up and preparing the locomotor system, stretching exercises, muscle strengthening exercises, exercises for reducing subcutaneous fat, exercises for increasing muscle endurance, exercises for increasing muscle mass, stretching exercises
7. Hiking tours - hiking on flat terrain, hiking hiking tours, interval hiking methods
8. Dance structures - English waltz, Viennese waltz, disco fox, jive, salsa</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☐ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☒ (other)</td><td colspan="3">2.7. Comments:
Classes are conducted exclusively in the form of exercises. Students teach only from the content or teaching unit to which they are registered. If necessary, it is possible to conduct classes partially or completely online.</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>1</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td rowspan="5">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="4">D. Pavović (2010): Script for students of the Faculty of Forestry, course Physical and Health Culture</td><td colspan="2"></td><td colspan="3">Faculty of Forestry website, Merlin e-learning system</td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
</table>

2.12. Optional literature	1. Šatalić, Z., M Sorić, M Mišigoj Duraković(2016.) Sports nutrition, Znanje d.o.o, Textbooks of the University of Zagreb 2. Neljak, B. i Caput-Jogunica, R. (2012) Kinesiology Methodology in Higher Education, Faculty of Kinesiology, University of Zagreb 3. Bos, K. (2004.) Walking to health, Mozaik knjiga 4. Sertić, H. (2005.) The Basics of Martial Arts, Faculty of Kinesiology, University of Zagreb 5. Ćurković, S. (2010). Kinesiological Activities and Risk Behavior of Students, Dissertation. Faculty of Kinesiology, University of Zagreb		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Željko Škvorc, Ph.D, Assoc. Prof. Daniel Krstonošić, Ph.D	1.7. Number of ECTS credits	5
1.2. Course title	Forest Botany – Plant Systematics	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+32
1.3. Course code	226039	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Students are introducted to basic botanical terms which are the base for senior-year courses. Furthermore, they are introduced to a great diversity of the world of plants, principles and methods of plant identification as well as to basic characteristics of particular systematic groups. All of that develops their understanding of the functioning and role of particular parts of different ecosystems they will work in after their graduation.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. identify tree species based on morphological characteristics, identify parts and tree shapes and apply theoretical and practical knowledge of commercially indigenous and foreign tree species and shrubs		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. To present the plant systematics and the systemic life division (systemic units (taxa), artificial and phylogenetic systems, plant evolution, speciation, hybridization, plant reproduction, general characteristics and division of Cormophyta). 2. To explain the general characteristics, systematic division, morphology and ontogenetic development of Pteridophyta. 3. To explain the general characteristics, systematic division, morphology and ontogenetic development of Gymnosperms. 4. To explain the general characteristics, systematic division, morphology and ontogenetic development of Angiosperms (vegetative and reroductive plant organs, function, basic forms, plant organs transformations). 5. To apply the principles and methods of plant identification using keys. 6. Show the most important families and genera of the Croatian flora (diversity, taxonomic status, distribution, significance).		
2.5. Course content (syllabus)	Lectures 1. Introduction. Historical development of plant systematics. (1 h).		

<table>
<tr><td></td><td colspan="9">2. Nomenclature and plant identification. Keys. (3h)
3. Sources of taxonomic data and plant classification. Preparation of herbarium collection. (3h)
4. Plant evolution and phylogeny. Speciation. (3h)
5. Plant systematic division. Basic characteristics and phylogenetic relationships of embryophytes. Mosses. (2h)
6. Basic characteristics and division of Lycopodiophyta and Pterydophyta. Basic characteristics and division of Spermatophyta. (2h)
7. Gymnosperms - morphology, ontogenetic development, systematic division, overview of significant genera. (2h)
8. Angiosperms - morphology, ontogenetic development, systematic division. (2h)
9. Magnolianae - overview of significant genera. (1h)
10. Monocotyledons - overview of significant families and genera. (3h)
11. True dicotyledons - overview of significant families and genera. (6h)
12. Plant diversity of Croatia - main characteristics, endemism, endangerment. (2h)

Exercises
1. Collecting and preparing herbarium. (2h)
2. Morphological characteristics of selected gymnosperm families. Plant identification with keys. (3h)
3. Morphological characteristics of selected angiosperm families - dicotyledons. Species identification of these families with keys. (8h)
4. Morphological characteristics of selected angiosperm families - monocotyledons. Species identification of these families with keys. (2h)

Field work
1 In the lowland to the colline area of continental Croatia where students gather herbarium material characteristic for a large number of termophilous and mesophilous forest plant communities. (1 day, 8 h)
2. In the colline to mountain region of Croatia where students gather herbarium material characteristic for large number of forest plant communities. (1 day, 8 h)
3. In the mountain and Mediterranean area of Croatia where students gather herbarium material characteristic for a large number of mountain, sub-Mediterranean and Mediterranean forest plant communities. (2 days, 16 h)</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
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<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>5</td><td></td></tr>
<tr><td></td><td colspan="8"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures and exercises. Preparation of herbarium collection. Passing preliminary exams, exams.</td></tr>
</table>

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Vidaković, M., J. Franjić, 2004: Golosjemenjače. Sveučilište u Zagrebu-Šumarski fakultet. Zagreb.	NO	YES; MERLIN
	Trinajstić, I., 1976: Sistematika bilja (opći dio, bakterije i gljive), (interna skripta), 1-43. Zagreb.	NO	YES; MERLIN
	Trinajstić, I., 1976: Sistematika bilja (Embriobyonta), (interna skripta), 1-117. Zagreb.	YES	
	Franjić, J., Ž. Škvorc, 2010: Šumsko drveće i grmlje Hrvatske. Sveučilište u Zagrebu-Šumarski fakultet.	YES	
	Franjić, J., Ž. Škvorc, 2014: Šumsko zeljasto bilje Hrvatske. Sveučilište u Zagrebu-Šumarski fakultet.	YES	
	Franjić, J., Ž. Škvorc, 2020: Šumsko drveće i grmlje Hrvatske (Novo izdanje). Sveučilište u Zagrebu – Šumarski fakultet, 516 str. Zagreb.	YES	
	Nikolić, T., 2019: Flora Croatica 4 - Vaskularna flora Republike Hrvatske. Alfa d.d.	YES	
2.12. Optional literature	1. Nikolić, T., 2013: Sistematska botanika: raznolikost i evolucija biljnog svijeta, Alfa, Zagreb. 2. Nikolić, T., 2013: Praktikum sistematske botanike - Raznolikost i evolucija biljnog svijeta. Alfa d.d. 3. Nikolić, T., 1996: Herbarijski priručnik, 1-167. Zagreb. 4. Nikolić, T., 2020: FLORA CROATICA Vaskularna flora Hrvatske 5. Alfa d.d. 262 str. 5. Nikolić, T., Kovačić, S., 2008: Flora Medvednice. 250 najčešćih vrsta Zagrebačke gore. Školska knjiga d.d. & Prirodoslovno-matematički fakultet Sveučilišta u Zagrebu, Zagreb, 4-543. 6. Kovačić, S., Nikolić, T., Ruščić, M., Milović, M., Stamenković, V, Mihelj, D., Jasprica, N., Bogdanović, S., Topić, J., 2008: Flora jadranske obale i otoka - 250 najčešćih vrsta. Školska knjiga d.d. & Prirodoslovno-matematički fakultet Sveučilišta u Zagrebu, Zagreb, 4-558. 7. Idžojtić, M., 2013: Dendrologija – Cvijet, češer, plod, sjeme. Šumarski fakultet Sveučilišta u Zagrebu. 672 pp. 8. Šugar I., 1990: Latinsko-hrvatski i hrvatsko-latinski botanički leksikon. JAZU, Zagreb. 9. Simpson, M. G., 2010: Plant Systematics. Academic Press. Elsevier. 10. Glimn-Lacy, J., Kaufman, P. B., 2006: Botany Illustrated. Introduction to Plants, Major Groups, Flowering Plant Families. Springer. 146 p. 11. Moore, R., W. D. CLARK, K. R. STERN, D. VODOPICH, 1995: Botany. WCB Dubuque. 12. Nikolić, T., ur. 2020: Flora Croatica baza podataka. On-Line (http://hirc.botanic.hr/fcd). Botanički zavod, Prirodoslovno-matematički fakultet, Zagreb.		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Anamarija Jazbec, Ph.D Assoc. Prof. Mislav Vedriš, Ph.D Asst. Prof. Ernest Goršić, Ph.D	1.7. Number of ECTS credits	5

1.2. Course title	Biometrics	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+0
1.3. Course code	33857	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	YES
2. COURSE DESCRIPTION			
2.1. Course objectives	Introduce and train students to collect, analyze and graphically display the collected data. Train students to be able to discuss and draw conclusions based on analyzed data.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. 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, stem-and-leaf plot, Box-Whisker plot; relative frequencies, cumulative absolute and cumulative relative frequencies, calculation and analysis 2. 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) 3. Explain measures of variation (data range, interquartile range, standard deviation, variance, coefficient of variation) 4. 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) 5. 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 6. Present hypothesis testing of arithmetic mean and proportion (rules and procedure of testing, type I (α) and type II (β) errors, power of the test (1- β), testing (assumed constant) arithmetic mean and proportion of population 7. 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) 8. Present analysis of observed and expected frequencies for categorical variable using chi-square test		
2.5. Course content (syllabus)	LECTURES: 1. Basic biometric terms (observations, data, population). Types of variables. Graphical tools. 2. Frequency table. Realtive frequencies. Cumulative frequencies 3. Measures of central tendency. Arithmetic mean, geometric mean, harmonic mean 4. Measures of position. Median. Quartiles, percentiles. Mode		

<table>
<tr><td></td><td colspan="9">5. Measures of variation, asymmetry and skewness. Range. Variance, Standard deviation. Coefficient of variation
6. Empirical distribution.
7. Basics of probability. Expected value
8. Continuous random variable. Normal distribution.
9. Discrete random variable. Binomial distribution. Normal approximation to a binomial distribution.
10. Sampling methods. Sampling distribution. Central limit theorem. Estimators. Standard error.
11. Confidence interval. Interval estimation of the mean and proportion. T-distribution.
12. Hypothesis testing and inference. Testing expected value of mean. Testing proportion.
13. Testing two population variances. F distribution. Testing two population means.
14. Testing two population proportions. Paired t-test.
15. 2 distribution. Chi-square test.
EXERCISES:
1. Basic biometric terms (observations, data, population). Types of variables. Graphical tools.
2. Frequency table. Relative frequencies. Cumulative frequencies
3. Measures of central tendency. Arithmetic mean, geometric mean, harmonic mean
4. Measures of position. Median. Quartiles, percentiles. Mode
5. Measures of variation, asymmetry and skewness. Range. Variance, Standard deviation. Coefficient of variation
6. Empirical distribution.
7. Basics of probability. Expected value
8. Continuous random variable. Normal distribution.
9. Discrete random variable. Binomial distribution. Normal approximation to a binomial distribution.
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15. 2 distribution. Chi-square test.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
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☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:
Exercises using computer software</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>5</td><td></td></tr>
</table>

2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.		
2.10. Student responsibilities	Regular attendance of lectures, individual assignments		
2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Jazbec, A (2009) BASIC STATISTICS, 2nd ed. Faculty of Forestry, Zagreb. (University textbook)	DA	
	Teaching materials for the whole subject (script)		YES. All teaching materials in written and video form are on the Merlin platform
2.12. Optional literature	1. Pranjić A. (1986): Šumarska biometrika. ŠF, Zagreb. 204 pp. 2. Kozak A., Kozak R., Staudhammer C., Watts S. (2008): Introductory Probability and Statistics: Applications for Forestry and Natural Sciences. CABI Publishing, Wallingford, UK. 408 pp. 3. Prodan M. (1968): Forest Biometrics. Pergamon press, Oxford. 432 pp. 4. Quinn, G.P., Keough, M.J., (2002): Experimental Design and Data Analysis for Biologists. UP, Cambridge. 537 pp. 5. Sokal RR, Rohlf FJ. (1995) Biometry. Freeman and Company. New York. 899 pp. 6. Zar J.H.(1999) Biostatistical analysis. Prentice Hall. 663 pp.		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Nikola Pernar Ph.D. Prof. Darko Bakšić Ph.D. Asst. Prof. Ivan Perković Ph.D	1.7. Number of ECTS credits	8
1.2. Course title	Soil Science	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+24
1.3. Course code	33858	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the subject is to provide general knowledge of the most important and most complex components of forest ecosystem to students. Furthermore, the aim is to prepare the student for the new knowledge necessary for forest ecosystem management, especially in terms of stability and protection from soil degradation. Therefore, the main goal is for students to learn how soil is formed - what are the factors and processes of soil formation, what are the key processes in soil and what are the physical, chemical, biological and morphological properties of soil.		
2.2. Enrolment			

requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A3. apply skills in solving practical side of buisness, either by control measuring, calculations or testing verification B4. participate in the realization of forest management programs B8. collaborate in preparation of ecological studies and spatial plans D1. continue perfection on university graduate studies on Forestry section on Faculty of Forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Compare the role of soil and pedosphere. Identify the global significance of soil. Interpreted the specificity of forest soil. Group primary soil minerals and compare their properties. Group the most usually rocks and compare their properties that are most important to soil properties. Explain to weathering of minerals and rocks. Explain the properties of rocks and minerals. Enumerate and classify the most important soil organisms. Describe the accumulation of organic residues - quantity and quality. Describe the method of degradation of organic residues and the formation of humus. Describe composition and properties of humus. Analyze a soil humus acidity and character of humus Describe biological circulating of matter and role of soil. Identify specific cycles of some biogenic elements. Explain the principles of soil sorption. Explain the composition and role of the colloidal complex of soil. Analyze the sorption characteristics of soil. Explain the solid soil phase composition. Enumerate and distinguish the properties of mechanical particles of soil. Particle size distribution and soil structure Enumerate and distinguish the properties of shapes and elements of the soil structure. Soil porosity and soil densities. Enumerate and explain the soil consistency indicators. Natural dynamic water in soil. Describe water forms in soil. Analyze the soil water constants. Explain quantity and quality of soil air. Analyze soil air capacity. Explain thermal properties of soil. Explain chemical properties of soil solution. Analyze and interpret soil reaction. Explain the significance and nature of the redox potential of the soil. Describe the dynamics of biogenic elements in the soil solution. Soil-forming factors. Identify the nature of some soil-forming factors in Croatia. Enumerate and explain some soil-forming processes. Identify the role of sol-forming factors and processes on a specific soil profile. Soil horizons. Explain the properties of some soil horizons. Soil classification system. Enumerate the sections, classes and types of soil. Explain the basic characteristics of the most important soils at the class level and type of soil. Classify soil according to taxonomic affiliation. Plan, ways and purpose of soil sampling. Representative soil samples. Describe the types of soil samples. Describe sampling and mark of soil samples.

	Enumerate and describe field observations of soil parameters.
2.5. Course content (syllabus)	Lectures: 1. Introduction - definition, roles, soil specificity and the importance of soil in forestry and environmental protection 2. Sources, composition and dynamics of the mineral component of the soil: Minerals and rocks 3. Sources, composition and dynamics of the mineral component of the soil: Weathering of minerals and rocks 4. Soil organisms and soil organic matter: Soil biology 5. Soil organisms and soil organic matter: Soil organic matter – sources, changes and properties 6. Soil organisms and soil organic matter: Forest biogeochemistry 7. Physical properties of soil: The solid phase of soil 8. Physical properties of soil: Soil liquid phase – water and soil water regime 9. Physical properties of soil: The gaseous phase – soil air and thermal properties of soil 10. Sorption properties of soil 11. Soil solution chemistry and chemical elements in soil: concentration and osmotic pressure of soil solution; important elements in soil solution and their dynamics in soil and ecological properties 12. Soil solution chemistry and chemical elements in soil: reaction of the soil solution - acidity, basicity and buffering of the soil solution 13. Soil genesis and soil evolution 14. Soil morphology 15. Soil classification and properties of soil Laboratory exercises: 1. Field and laboratory survey of soil: Soil sampling plan; types of soil sampling; sampling depth of soil; number and layout of soil samples, types of soil samples 2. Field and laboratory survey of soil: soil sampling and soil sample marking; transport and storage of soil samples; field observations of soil parameters; soil sampling report 3. Pretreatment of samples for physical-chemical analysis (according to ISO 11464, 1994) 4. Determination of stability of soil macro-aggregates 5. Determination of dry matter and water content on a mass basis — Gravimetric method (according to ISO 11465, 1993) 6. Determination of the particle size distribution by International B method 7. Determination of soil reaction (according to ISO 10390,1994) 8. Determination of carbonate content – volumetric method (according to ISO 10693, 1995) 9. Determination of acidity (character) of humus 10. Determination of humus (organic carbon) by Tjurin 11. Determination of water content as volume fraction using coring sleeves – gravimetric method (according to ISO 11461, 2001), Determination of water-retention characteristic 12. Determination of dry bulk density (according to 11272, 1998) 13. Determination of particle size density (according to 11508, 1998) 14. Determination of soil porosity 15. Determination of air capacity of soil 16. Determination of organic and total carbon (according to ISO 10694, 1995) and total nitrogen (according to ISO 13878, 1998) by dry combustion - demonstration exercise 17. Determination of effective cation exchange capacity and base saturation level using barium chloride solution (according to ISO 11260) - demonstration exercise 18. Determination of the particle size distribution in mineral soil material (according

<table>
<tr><td></td><td colspan="9">to ISO 11277) - demonstration exercise
19. Determination of water-retention characteristic – Laboratory methods (according to ISO 11274, 1998) - demonstration exercise
20. Determination of the water permeability - demonstration exercise

Field courses:
1. Presentation of soil sampling (composite and individual samples) and explanation of soil morphological characteristics and soil classification on the open soil profile (1 day)
2. Explanation of soil-forming factors on different examples and the specifics of the soil in terms of the soil functions (2 days)</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>8</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance of lectures, laboratory exercises</td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="4">Pernar, N., 2017: Tlo; nastanak, značajke, gospodarenje. Šumarski fakultet, Zagreb, XVIII + 799 p</td><td colspan="2">YES</td><td colspan="3"></td></tr>
<tr><td colspan="4">Pernar, N., D. Bakšić, I. Perković, 2013: Terenska i laboratorijska istraživanja tla. Šumarski fakultet, Zagreb, 192 p.</td><td colspan="2">YES</td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Blume, H. P., G. W. Brümmer, H. Fleige, R. Horn, E. Kandeler, I. Kögel-Knabner, R. Kretzschmar, K. Stahr & B.-M. Wilke, 2016: Scheffer/Schachtschabel Soil Science.Springer, 629 p.</td></tr>
</table>

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Renata Pernar, Ph.D. Asst. Prof. Mario Ančić, Ph.D.	1.7. Number of ECTS credits	7

	Asst. Prof. Jelena Kolić, Ph.D.		
1.2. Course title	Ground surveying with basics of cartography	1.8. Number of hours in semester (L+E+F+e-learning)	30+45+45
1.3. Course code	226040	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Make a students acquainted with the need for ground surveying and cartography in forestry. Apart from that, students must be acquainted with the fundamentals of cartography and ground surveying, so as to prepare them for studying and practical use of mapping and terrain surveying methods during their further studies and in practice.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data B5. perform works on inventorying forests B8. collaborate in preparation of ecological studies and spatial plans D1. continue perfection on university graduate studies on Forestry section on Faculty of Forestry		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain cartography and its tasks, Extract objects of display and object names (toponyms) on different cartographic views (TK 50000, 25000, 5000). 2. Describe and explain the difference between topographical and thematic maps. Specify a measurement definition, used measuring units, specify standards, and explain measurement errors., Explain the difference between direct and indirect measurements. Determine scale. Construct linear and transverse scale. 3. Calculate allowed deviations and measurements Adopt the basics of orthogonal and quoted projections, Explain the quoted projection of the topographic plane and its application. Calculate the largest slope line and constant slope line. 4. Explain and make a cross section of the topographic plane with the vertical plane and direction. Create a terrain profile, Explain and share map projections. 5. Explain the coordinate systems. Specify the types of coordinates. Calculate coordinates on different topographic maps ((TK 50000, 25000, 5000). Measure the size on topographic maps 1: 50.000 and 1: 5.000 (angle, length, altitude difference, gradient, ..) ,Describe cadastre and its organization 6. Describe the land registry and its organization, State and explain the difference between the old and the new cadastre, Explain and describe the indirect method of determining the surface on cadastral maps., Calculate area with the different methods (dot grid, grid squares grid and analytical calculation of area). 7. Explain triangulation, polygonometry, Calculate the direct and indirect geodetic task, Describe the methods of direct and indirect length measurements. 8. Determine azimuths, distances, height differences, and inclinations between the points, Mapping certain points in the default scale., Collect data, calculate and explain measurements with the compass. 9. Describe and perform the recording of the details by a polar and orthogonal method. Calculate the altitude difference, explain and enumerate type of leveling. 10. Describe the global positioning system and its parts, Indicate GPS application in forestry, Explain GPS measurement errors, Apply GPS to determine spot positioning in terrain.		

2.5. Course content (syllabus)	Lectures: 1. Cartography - definition and division, showing terrain, objects and phenomena on maps, types of maps - topographic and thematic maps 2. Measurement, scales, measuring units, norms, the errors and corrections of measurement, measurment methods 3. Presentation of the topographic surface by projection. Types of projections. Fundamentals of orthogonal and quoted projection, application of the quoted projection, plane and line crossings 4. Earth shape and size, ellipsoids, coordinate types 5. Map projections, Gauss – Krüger projection, HTRS96/TM projection, geodetic datums 6. Cadastre, scales, old cadastre, new cadastre, land register 7. Cadastral plans, direct and indirect measuring of surface, types of indirect measurements 8. Elements of terrain measurement. Methods measurement of points, lengths, angles, surfaces, altitude difference. Geodetic points, triangulation, polygonometry, theodolites 9. Lengths measurements, reduction an lengths on the horizon, indirect length measurements, instruments for measuring distances (distometers) - optical, electronic 10. Angle types, polygon angle, directional angle, azimuth, declination, orientation, convergence of meridian, elevation angle, depressive angle, zenith distance 11. Measurement of altitude differences, types of leveling (general and detailed, linear and surface, geometric and trigonometric leveling) 12. Recording of detail - polar and orthogonal method. Orthogonal method – pentagonal prism, rectangular coordinates (abscissa and ordinate). Polar method – tacheometry, polar coordinates (horizontal and vertical angle, inclined length) 13. Types of compass. Measuring and mapping with the compass. 14. Global navigation satellite system (GNSS) – satellite positioning (GPS, GLONASS, GALLILEO), system organization 15. Global positioning system (GPS), measurement methods, accuracy and application in forestry Exercises: 1. Types of letters on maps. Cartographic signs and symbols. Paper formats, line types, bending paper 2. Scale types – numerical, graphical, determining the scale, calculating the distance between objects depending on the scale of the map / plan 3. Construction of graphical scale – linear and transversal scale, calculating of allowed deviations and corrections of measurement 4. Cross section of a topographic surface with a vertical plane, cross section of a topographic surface with a direction, observations. Create a terrain profile. 5. Determining the slope of the terrain. Calculating the largest slope of the line, construction of a constant slope line. Determination of altitudes of points. 6. Ways of displaying individual objects and occurrences on maps. Reading and interpretation of maps. Extracting objects of display and object names (toponyms) on topographic maps of different scales. 7. Determination of coordinates on topographic maps of scale 1: 5000 and 1: 50000. Measurement the sizes (angle, length, altitude difference, slope, ..) on topographic maps. 8. Use of cadastral plans. Measurement of shrinkage old cadastral plans. Determination of allowed deviations and corrections of measurements when calculating areas of parcels. 9. Indirect methods of determining the area of parcels with dot grid and square grid (statistical methods) 10. Indirect methods of determining the area of parcels with coordinates (analytical

<table>
<tr><td></td><td colspan="9">method)
11. Geodetic calculations. Direct and indirect geodetic task. Determining the coordinates of points based on angle and length. Determining angle and length based on coordinates
12. Measuring azimuth on the map. Map orientation. Point mapping based on azimuth and length.
13. Orthogonal method - recording and mapping details. Compass - measurement and mapping. Creation of stakes on the maps. Staking out points and lines. Repairs staking.
14. Measurement of height differences. Calculation of height differences from trigonometric and geometric levelling. Creating terrain profiles based on measurement of height differences.
15. Using a GPS receiver, Determining the position of points by GPS, Point mapping based on GPS measurements

Field work:

1. Setting up and measuring polygons. Compass - measurement and mapping.
2. Lengths measurements on flat and sloping terrain, determining the slope of the terrain. Reduction an lengths on the horizon.
3. Setting and measuring detailed leveling, line and surface leveling, measurement and calculation.
4. Staking out length with tracer and compass.Staking out of broken lines with compass. Repairs staking.
5. Orientation on the terrain, finding objects by using maps, finding objects using a compass, finding objects using GPS.
6. Measurement coordinates of points by using GPS. Mapping points measured by GPS</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>7</td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">In the course with regular attendance of lectures, exercises and field work student will produce 10 individual programs (tasks), and 3 projects tasks on field work. Exam through two midterm exam or written and oral exams.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td></td><td colspan="4">Benčić, D., Solarić, N. (2008): Mjerni instrumenti i sustavi u geodeziji i geoinformatici, Školska knjiga, Zagreb</td><td colspan="2"></td><td colspan="2">YES</td></tr>
</table>

	Pernar, R. (2019): Prezentacije s predavanja		YES
	Niče, V.: Deskriptivna geometrija (odabrana poglavlja), Školska knjiga Zagreb (bilo koje izdanje)	YES	
	Lovrić, P. (1988): Opća kartografija, SNL Zagreb, 291 str.	YES	
	Pribičević, B. i D. Medak (2003): Geodezija u građevinarstvu (odabrana poglavlja), V.B.Z., Zagreb, 223 str.		YES
	Neidhardt, N. i Tomašegović, Z.: Geodezija u šumarstvu, Zagreb, 266 str.	YES	
2.12. Optional literature	1. Brinker and Minnick, R. (1995): The surveying handbook (second edition), New York, 840 str. 2. Möser, M.; Müller, G.; Schlemmer, H.; Werner, H. [2000]: Handbuch der Ingenieurgeodäsie - Grundlagen. 3. Neubearbeitete Auflage, Wichmann, Heidelberg 3. Mulahusić, A., Topoljak., J, Tuno, N. (2017): Geodezija za građevinske inžinjere. Politehnički fakultet, 295 str. 4. Macarol, S.: Praktična geodezija, (bilo koje izdanje) Zagreb 5. Šumarska enciklopedija: Geodezija, Geodetski instrumenti, Zagreb		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Željko Škvorc, Ph.D Asst. Prof. Krunoslav Sever. Ph.D	1.7. Number of ECTS credits	4
1.2. Course title	Psysiology of forest trees	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+0
1.3. Course code	33864	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Development of basic knowledge necessary for evaluation of research on plant physiology and its integration into the models of plant functioning. Development of abilities of critical insight into plant physiology, as well as development and improvement of skills in experiment design and statistical analysis.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. identify tree species based on morphological characteristics, identify parts and tree shapes and apply theoretical and practical knowledge of commercially indigenous and foreign tree species and shrubs B6. perform professional field works on establishing, caring for, and renewing forest stands B7. perform professional field works in the melioration and management of forest areas in the Mediterranean region D1. continue perfection on university graduate studies on Forestry section on Faculty of Forestry		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning	To explain the relationship between water and plants (water potential, plant water uptake and conductivity, root pressure, water loss, transpiration, embolism, plant water status). To explain plant metabolism and mineral nutrition (the structure and activity of enzymes in plant cells, the physiological role of mineral nutrients in the plant, the assimilation,		

outcomes)	mycorrhiza). To interpret photosynthesis and respiration (chemoautotrophy, photoautotrophy, the structure of photosynthetic apparatus, photosynthetic reactions, photorespiration, photosynthesis types, influence of environmental factors, aerobic and anaerobic cellular respiration, whole-plant respiration, the regulation of cellular metabolism). To present physiological processes of plant growth and differentiation in relation to key environmental factors (plant hormones, auxins, gibberellins, cytokinins, abscisic acid, bud, seed and embryo dormancy, phytochromes, photomorphogenesis). To analyze the physiological processes involved in the fructification of forest trees (the control of flowering, development of male and female gametophytes, fertilization). To interpret the physiology of stress (resistance of woody plants to low and high temperatures, droughts, water, soil and air pollution, diseases). To explain the physiology of movements.		
2.5. Course content (syllabus)	Lectures 1. Introduction. Cell metabolism. Chemical composition of a plant body. Enzymes. 2. Water and plant cells. Absorption, movement and loss of water in the plant. 3. Mineral nutrition - absorption and availability of nutrients, mycorrhiza. Assimilation. 4. Chemoautotrophy, photoautotrophy, structure of the photosynthesis apparatus. 5. Photosynthetic reactions, impact of environment on photosynthesis, heterothropic nutrition. 6. Cell respiration - aerobic, anaerobic. Respiration of a whole plant. Regulation of metabolism within the cell. 7. Growth, differentiation. Plant senescence. Abscission. 8. Plant hormones, auxins, gibberelins, cytokinins, abscisins and other physiologically active substances. 9. Temperature impact on growth and development of plants, dormancy. 10. Impact of light upon growth and development of plants, phytochromes, photomorphogenesis, flowering control. 11. Fertilization and germination. 12. Stress physiology, temperature stress. 13. Drought physiology, extreme pH values of the soil. 14. Lack of oxygen in the soil, pollution of water, soil and air, resistance of plants to diseases. 15. Physiology of plant movement. Excersises 1. Staining of plant cells. Permeability of cell membranes. 2. Plasmolysis and deplasmolysis of plant cells. 3. Relative content of free, hygroscopic and total water in plant tissue. 4. Determining the water status of plants using a potometer. 5. Determination of transpiration intensity by weighing using a potometer. 6. Stomata number and size. 7. Physiological and morphological characteristics of leaves (dry matter content, specific leaf area). 8. Germination of pollen and the energy of its germination. 9. Monitoring the development of plant organs based on phenological changes (phenophases). 10. Application of a portable pressure chamber for measuring water potential in leaves. 11. Application of a portable device for measuring the exchange of gases between the plant and the atmosphere. 12. Measurement of chlorophyll fluorescence with interpretation of the obtained results. 13. Calibration of an optical chlorofilmeter with the aim of non-destructive assessment of the content of photosynthetic pigments in leaves.		
2.6. Format of instruction	☒ lectures	☐ independent	2.7. Comments:

	☐ seminars and workshops ☒ exercises ☐ *online in entirety* ☒ partial e-learning ☐ field work			assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)					
2.8. Monitoring student work	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work	YES		Report		NO	(other)		
	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam	YES		Practical work	YES		(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	4	
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities	Regular attendance and active participation in lectures and exercises. Taking colloquia, exams.								
2.11. Required literature (available in the library and/or via other media)	Title			Availability in the library			Availability via other media		
	Škvorc, Ž., Sever, K., Franjić, J., 2013: Fiziologija šumskoga drveća (interna skripta), Šumarski fakultet. Zagreb			NO			Yes, Merlin		
2.12. Optional literature	1. Larcher, W., 2003: Physiological Plant Ecology. 3rd ed. Springer. Berlin. 2. Pevalek-Kozlina, B. 2002: Fiziologija bilja. Profil international. Zagreb								

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Davor Pavlović, teacher	1.7. Number of ECTS credits	1
1.2. Course title	Physical and health education 2	1.8. Number of hours in semester (L+E+F+e-learning)	0+30+0
1.3. Course code	226042	1.9. Expected enrolment in the course	80
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the course Physical and Health Culture 2. is the acquisition of theoretical and practical kinesiological knowledge in order to train students for independent physical		

	exercise and the adoption of healthy living habits. Through various forms of physical exercise, the goal is to meet the daily needs for movement and improve the motor, functional and cognitive abilities of the student population. Through attending classes, students are educated about the importance of daily physical exercise, or about all the good things that physical activity means for a person and his health. The aim is to simultaneously acquire knowledge about the harmfulness of various forms of addiction to health, especially their impact on intellectual and physical capabilities, the importance of quality nutrition and the most interesting results of previous research on the student population in the segment: physical activity as disease prevention, healthy eating , sports diagnostics, stress management, physical activity as a means of relief.
2.2. Enrolment requirements and/or entry competences required for the course	health status
2.3. Learning outcomes at the level of the programme to which the course contributes	To continue training at the graduate university studies of the Faculty of Forestry, Department of Forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Describe the structure of the physical exercise class 2. Explaination of the impact of physical exercise on health. 3. Choose fitness exercises designed to strengthen individual muscle groups. 4. Demonstrate specific exercises with regard to kinesiologic activity 5. Organize constructive free time 6. Assess personal diet and physical exercise habits. 7. Demonstrate general preparatory exercises and stretching exercises. 8. Understanding kinesiology programs and their target orientation 9. Control emotions and strengthen self-control.
2.5. Course content (syllabus)	1. Athletics Walking - Walking at different paces, Nordic walking, brisk walking, hiking Running - theoretical knowledge and divisions, cyclic movements at different paces, fast running short distances, running down a slope, running along a slope, interval cyclic movements, differences in running long, medium and short distances, running with loads, relay running, running with hurdles of different height 2. Martial arts- Judo, Karate Basic techniques of Judah - falls, hand throws, belt throws, foot throws, choking techniques, levers Basic techniques - karate - kicks, punches, defense 3. Sports games- Basketball - Keeping the ball in place, keeping the ball in motion, basic throwing, pivoting, jumping shot, passing in place and moving Football - passing in place, passing to the first, passing in motion, technique with the ball, cooperation of two and three players, shots on goal from the move, shot on goal after the ball is added, volley kick, headers, stops Volleyball - Passing with two hands above the head, passing with the forearms, service, passing behind the head, receiving service, blocks, technique of attack, technique of defense Handball - guiding the ball in a straight line and with a change of direction, Passing in place, passing in motion, crossings, passing for a counterattack, cooperation of two and three players, goal kick after the lead, goal shot on the added ball 4. Racket sports Badminton-forehand punch under the arm, forehand punches above the head, forehand lob above the head, backhand punch under the arm, high serve, backhand serve, short serve, field movements, single play, pair play 5. Shooting-classification of shooting disciplines and shooting equipment, maintenance of weapons, breathing techniques, air rifle 10m 6. Fitness programs - Circuit strength training, functional training, intensive cardio training,

<table>
<tr><td></td><td colspan="9">Pilates, -
Exercises for warming up and preparing the locomotor system, stretching exercises, muscle strengthening exercises, exercises for reducing subcutaneous fat, exercises for increasing muscle endurance, exercises for increasing muscle mass, stretching exercises
7. Hiking tours - hiking on flat terrain, hiking hiking tours, interval hiking methods
8. Dance structures - English waltz, Viennese waltz, disco fox, jive, salsa</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☐ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☒ (other)</td><td colspan="3">2.7. Comments:
Classes are conducted exclusively in the form of exercises. Students teach only from the content or teaching unit to which they are registered. If necessary, it is possible to conduct classes partially or completely online.</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>1</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="4">D. Pavović (2010): Script for students of the Faculty of Forestry, course Physical and Health Culture</td><td colspan="2"></td><td colspan="3">Faculty of Forestry website, Merlin e-learning system</td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Šatalić, Z., M Sorić, M Mišigoj Duraković(2016.) Sports nutrition, Znanje d.o.o, Textbooks of the University of Zagreb
2. Neljak, B. i Caput-Jogunica, R. (2012) Kinesiology Methodology in Higher Education, Faculty of Kinesiology, University of Zagreb
3. Bos, K. (2004.) Walking to health, Mozaik knjiga
4. Sertić, H. (2005.) The Basics of Martial Arts, Faculty of Kinesiology, University of Zagreb
5. Ćurković, S. (2010). Kinesiological Activities and Risk Behavior of Students, Dissertation. Faculty of Kinesiology, University of Zagreb</td></tr>
</table>

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Mario Božić, Ph.D Asst. Prof. Ernest Goršić, Ph.D Assoc. Prof. Mislav Vedriš, Ph.D	1.7. Number of ECTS credits	7
1.2. Course title	Forest mensuration	1.8. Number of hours in semester (L+E+F+e-learning)	45+30+16
1.3. Course code	33861	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	Acquiring knowledge and skills related to measurements and assesment of quantitative and qualitative variables on tree and stand level. During the course students will learn how to measure log and tree diameters, tree heights and calculate tree volume. Students will learn how to project and set up sample plots and based on their measurement data calculate stand structure (number of trees, surface area per hectare for certain diameter class, height curve and tariff construction, calculation of stand volume) and variability.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. apply aproach to experimental observing and mathematical modelling, mathematically solvingresearch and practical problems, statistically process, present and analyse data and concludeindividually based on analysed data B5. perform works on inventorying forests C1. plan and organise time study, work rationalisation, conduct works of organization of productionin forestry D1. continue perfection on university graduate studies on Forestry section on Faculty of Forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 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.
2.5. Course content (syllabus)	CLASSES 1. Introduction. Measures and measurement systems. Measurement errors. Presentation of measured data. Measurement planing. 2. Measurement of tree diameter and circumference: procedure, instruments, errors. 3. Height measurement.Working principle of hypsometer.. Errors in tree height measurement. Height measurement with hypsometers working on geometrical principle. 4. Height measurement with Blume-Leiss and Vertex hypsometers. 5. Height measurement with standard and CP scale Bitterlich relascope.

	Measurement of unattainable diameters with Bitterlich relascope. 6. The volume of trees and its parts. 7. Double-entry volume tables. 8. Forest inventory. Stand quality. 9. Sample. Sample size. 10. Sample plots: Types and form; setup and measurement. 11. Diameter distribution of even and uneven aged stands. 12. Height curves – even aged stands: sample, construction, height curve shift. Height curves – uneven aged stands: sample, construction. 13. Single-entry volume tables – tariffs: construction, implementation. 14. Growth and yield tables. 15. Former surveys. Sample for definition of tree increment. PRACTICE (field work, computer) 1. Introduction. Familiarising with instruments for diameter and circumference measurement. Caliper rectification. 2. Tree diameter and circumference measurement procedures. 3. Familiarising with hypsometer Haga, Blume-Leiss, Vertex, Christen-Eić. 4. Familiarising with Bitterlich relascope hypsometer with standard and CP scale. 5. Measurement of tree diameter: with caliper, relascope and measuring tape (circumference). 6. Analysis of differences in diameters measured with different instruments. 7. Calculation of tree volume with sectioning method. 8. Measurement of tree diameter and height for volume calculation with double-entry volume tables. 9. Calculation of tree volume with double-entry volume tables. 10. Familiarising with different types of measurement plots (circle, square, line, nested circle). 11. Preparation for field practice, drawing dot grid on the map and azimuth definition. 12. Calculation of field practice data: Distribution of trees per diameter classes and construction of height curves. 13. Calculation of field practice data: Construction of volume tariff and volume calculation. 14. Calculation of field practice data: Variabilitiy of measured data, filling the forms. 15. Student presentation of field practice results. Field practice Calculation of particular stand volume is the main goal of field practice in subject Forest mensuration. For that pourpose students will in class (within class practice) set up a grid of sample plots on the map which will be used in the filed for measurement. The measurement itself will be carried out for each group of students during two days on Faculty research facility - Management unit Doršćina. 1. DAY Upon arrival un the Faculty research facility students will be instructed to find their stands for measurement using the map and known points in the field. On the first day students measure stand variability based on breast height basal area variability which will be measured with Bitterlich relascope. The measurement will be preformed on 10-15 standpoints. After that they will measure heights and dedicated diameters of 50-100 trees of dominant species in the stand. On the basis of the heights measured the students will (within class practice) construct stand height curve. 2. DAY On the sample of 10-15 plots (depending on the size of certain stand) in the same stands as on previous day measurement of number of trees per diameter class will be performed. The measurement will be carried out on circular plots with radius defined in advence. Before the measurement itself, students will be warned about most common mistakes made during the measurement process so they could avoid them.

2.6. Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *online in entirety* ☒ partial e-learning ☒ field work			☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)			2.7. Comments:		
2.8. Monitoring student work	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work		NO	Report	YES		(other)		
	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam	YES		Practical work	YES		(other)		
	Project	YES		Written exam	YES		ECTS credits (total)	7	
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities	In the course with regular attendance of lectures, exercises and field work student will produce 8 individual programs (tasks), and 2 projects tasks on field work. Exam through two midterm exam or written and oral exams.								

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Pranjić, A., Lukić, N., 1997: Izmjera šuma. Šumarski fakultet Sveučilišta u Zagrebu, 410 pp., Zagreb	YES	NO
	Čavlović, J., Božić, M., 2008: Nacionalna inventura šuma u Hrvatskoj – Metode terenskog prikupljanja podataka. Šumarski fakultet Sveučilišta u Zagrebu.146 pp. Zagreb	YES	NO
	Božić, M., Goršić, E., Vedriš, M.: Presentations from classes and practice.	NO	YES; MERLIN
2.12. Optional literature	1. Van Laar, A., Akça, A., 2007: Forest Mensuration. Springer, 383 pp.		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Dario Baričević, Ph.D. Asst. Prof. Irena Šapić, Ph.D.	1.7. Number of ECTS credits	6
1.2. Course title	Forest phytocenology	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+24
1.3. Course code	33868	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	The objectives of the course are to introduce students with the methods and techniques of collecting and processing phytocenological data, which they will later be able to apply in practice. Based on knowledge and skills, they will be able to determine the crucial abiotic and biotic factors important for the functioning and arrival of various forms of forest vegetation, determine its condition and changes, and make recommendations for further management. The principles of naturalness, sustainability, ecological balance and biodiversity shall be applied.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data B1. identify tree species based on morphological characteristics, identify parts and tree shapes and apply theoretical and practical knowledge of commercially indigenous and foreign tree species and shrubs B4. participate in the realization of forest management programs B8. collaborate in preparation of ecological studies and spatial plans D1. continue perfection on university graduate studies on Forestry section on Faculty of Forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Explain forest phytocenology and ecosystems (role and tasks, division and historical development of phytocenology, phytochenological directions and schools, biocenosis and natural and anthropogenic ecosystems). Forest vegetation synmorfology and synecology (qantitative and qualitative indicators, data collection, analytical processing and synthetic development, synmorphology (structure and composition) of plant communities, classification of synecological factors, relation of plant species and plant communities to the synecological factors of their adherence - soil, climatic, geomorphological and biotic factors) Syndynamics of forest vegetation (vegetation succession, syndynamics units, initial, transitional, permanent and climatic communities, practical importance). Present the synhorology of forest vgetation (definition and types of area of distribution of plant communities, floral geoelements and area, spatial distribution and zoning of vegetation, altitude and horizontal distribution, disorders and disturbance of vegetation). Explain systematics of forest vegetation (historical development, nomenclature rules, associations, higher and lower systematic units). Present the forms of forest vegetation, their development and their distribution in Croatia (forest vegetation, the most important forest communities).
2.5. Course content (syllabus)	Lectures: 1. Definition and task of phytocenology. Division of phytocenology. Historical development. Phytochenological directions and schools. 2. Biocenosis and ecosystem. Natural stands. Quantitative and qualitative indicators. 3. Analytical processing. Data collection. Synthetic elaboration. Meaning of species in synthesis. 4. Sinecology. Classification of factors. Distribution of forest vegetation in relation to climate factors (light, heat, water, wind) 5. Forest species and forest communities in relation to soil properties. Relationship of soil types and forest communities. 6. Geomorphologic factors - altitude, exposure, slope, relief and their impact on the distribution of forest vegetation. 7. Influence of biotic factors (phytogenic, zoogenic) on the distribution of forest vegetation. Human impact on the development of forest vegetation in the past and today. 8. Succession of forest vegetation - definition, types, methods of research and display. Sindynamics units, initial, transitional, permanent and climatic communities, 9. Examples of succession of forest vegetation. Practical importance of sindynamics in forestry.

	10. Sinchronology. Plant fossils. Pollen analysis. The development of vegetation in the ancient times. Europe in the Ice Age. 11. The development of forest vegetation after the Ice Age. Development of the vegetation of the Panonian area. Development of late glacial and postglacial vegetation in Central Europe. Development of Mediterranean forests. 12. Definition and types of area of distribution of plant communities. Floral geoelements - types, distribution, spectrum. Floristic regions on Earth. 13. Spatial distribution and zoning of forest communities. Altitude and horizontal distribution disorders and disturbance of vegetation. The floristic-geographical division of Europe. 14. Forest communities systematics. Nomenclature rules. Systematic units. Systematization of forest communities in Croatia. 15. Phytogeographical stratification of forest vegetation in the Republic of Croatia. Mediterranean vegetation region. Eurasian-North American vegetation region. The most important forest communities in the Republic of Croatia. Exercises: 1. Introduction to exercise. Sinmorfology. Phytocenological indicators. Entering general data. Floristic composition. Braun-Blanquet's scale. 2. Field research methodology. Choice and size of phytochenological releves, phytocoenological recording and data entry into the forms. 3. Phytosociological recording of forest vegetation in the field. 4. Examples of phytocoenological releves and their synthetic elaboration, the meaning of species in synthetic elaboration. 5. Using new methods of phytochenological releves synthesizing. Entering phytocoenological releves to the database Turboveg. 6. Numerical multivariate analysis of phytochenological data. Using the software package Syntax 2000. Cluster analysis - method with examples. 7. Multidimensional scaling - method with examples. 8. Applying eco-indicator scales according to Ellenberg. Processing of environmental data using a computer program Juice 7.0. 9. The appearance of the most important hydrophilic, of hygrophilic and mesophilic species and their eco-indicator values. Forest communities in relation to humidity. Analysis of indicator values of humidity in computer programs. 10. The appearance of the most important neutrophil, basophil and acidophilic plant species and their eco-indicator values. Forest communities in relation to soil acidity. An analysis of indicator values of soil acidity in computer programs. 11. Examples of the biological spectrum and spectrum of floristic geo-elements. 12. Changes in the floral composition of the most important types of succession. 13. Methodology of classical mapping of forest vegetation. Field work. Work in the office. Examples. 14. New methods of vegetation research and mapping. Remote sensing of vegetation. Aero-photos and their application. Satellite imaging (sensors for vegetation research) and their application in the mapping of forest vegetation. GIS - technology, practical application, examples. 15. Digitization of vegetation maps - process, examples and advantages in relation to classical vegetation maps. The exercises are held in the computer room by using computer programs. Fieldwork (three days): 1. Introduction to the most important forest communities in the planar and coline vegetation belt, their synecology, syndynamics, synchrology, plant species and systematics. 2. Introduction to the most important forest communities in the montane, altimontane and pre-Alps vegetation belt, their synecology, syndynamics, synchrology, plant species and systematics. 3. Introduction to the most important forest communities in the Mediterranean vegetation region, their synecology, syndynamics, synchrology, plant species and systematics.

2.6. Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *online in entirety* ☒ partial e-learning ☒ field work			☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☒ computer classroom			2.7. Comments:		
2.8. Monitoring student work	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work		NO	Report		NO	(other)		
	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam	YES		Practical work		NO	(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	6	
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities	Regular attendance and active participation in lectures, exercises and field teaching. Passing the preliminary exams, final exams.								
2.11. Required literature (available in the library and/or via other media)	Title				Availability in the library		Availability via other media		
	Vukelić, J., Đ. Rauš, 1998: Šumarska fitocenologija i šumske zajednice u Hrvatskoj. Šumarski fakultet Sveučilišta u Zagrebu, 310 pp.				YES				
2.12. Optional literature	1. van der Maarel, E., J. Franklin (eds.), 2013: Vegetation Ecology – Second Edition. Wiley-Blackwell, Chichester, UK, 557 pp. 2. Glavač, V., 1996: Vegetationsökologie - Grundfragen, Aufgaben, Methoden. Gustav Fischer, Jena, Stuttgart, 385 pp. 3. Vukelić, J., Mikac, S., Baričević, D., Bakšić, D., R. Rosavec, 2008: Šumska staništa i šumske zajednice u Hrvatskoj Nacionalna ekološka mreža. Državni zavod za zaštitu prirode, 263 pp.								

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Renata Pernar, Ph.D. Prof. Ante Seletković, Ph.D. Asst. Prof. Jelena Kolić, Ph.D. Asst. Prof. Mario Ančić, Ph.D.	1.7. Number of ECTS credits	5
1.2. Course title	Remote sensing and GIS in forestry	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+16

1.3. Course code	33862	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Students will acquire knowledge on latest achievements in the field of application of remote sensing in our country and in the world, theoretical fundamentals of remote sensing, types of systems photographing and methods of photographing, as well as possibilities for the application of aerial and satellite images in forestry. They will also get to know fundamental assumptions and methods for establishment of geographic information systems in forestry, as the aid for data saving, processing and analysis, as well as their maintenance and integration with other disciplines.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A3 apply skills in solving practical side of buisness, either by control measuring, calculations or testing verification B5. perform works on inventorying forests B8. collaborate in preparation of ecological studies and spatial plans D1. continue perfection on university graduate studies on Forestry section on Faculty of Forestry		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Pronounce the definition of remote sensing Describe the historical development of remote sensing. Compare digital and analog photography. Explain ways of stereoscopic observation. Identify the basic principles of remote sensing and their physical and technological basics. Explain and describe parts of the electromagnetic spectrum. List reflection and emission properties of natural objects. Describe the spectral characteristics of objects on Earth surface. Indicate and explain the recording systems within remote sensing. List the types and characteristics of photography Describe procedures of aerial survey. Explain what type of errors occur in aerial surveying. Describe and demonstrate the preparation of images for measuring and orientation procedure of the aerial photographs. Perform visual, measurement and digital photo interpretation on aerial photographs. Specify the application of aerial photographs for forestry purposes. Specify the types of satellites and their classification according to purpose and orbit. Explain ways of interpretation of satellite images. Carry out a visual interpretation of satellite imagery. Show and explain the procedure of digital interpretation of satellite image (supervised and unsupervised classification). Specify the application of satellite images in forestry. Pronounce the definition of the geographic information system (GIS). Specify a historical overview of GIS development. Explain the GIS organization. Show the establishment of a database in GIS. Apply different forms of data for displaying objects. Carry out linking of the attribute database with geometric data. Explain the difference and the basic features of raster and vector GIS. Compare and describe the analysis of vector and raster data. Create thematic maps based on the interpretation of the images. Explain the application of RS and GIS in forestry.		

2.5. Course content (syllabus)	Lectures: 1. Introduction to Remote sensing. Classification of RS. Historical development (photography, aviation, photogrammetry, satellite technology) 2. Physical and technological basics of remote sensing. Electromagnetic radiation. Global radiation. Remission and Reflection 3. Spectral characteristics of objects on Earth's surface (vegetation, soil, water). A distribution form of directions of reflection 4. Photographic Systems. Recording systems. Photographic images, types and characteristics. Quality and error of images 5. Aerial photographs (ground preparation, flight plan, recording time, scale). Unmanned aerial vehicles (drones), photograph types, law regulations 6. Methods of interpretation in remote sensing (visual, measurement, digital). Application of aerial images in forestry 7. Non-photographic systems. Active and passive processes in remote sensing. LIDAR - historical development, methods of work, application in forestry. Satellite classification according to orbit and purpose 8. Satellite image resolutions, color composite, methods of interpretation and characteristics of satellite imagery, application of satellite imagery in forestry 9. Introduction to geographic information system (GIS). Definitions of terms. Historical development 10. Types of geographic information systems. Methods and terms of system design. Types and characteristics of computer technology and software support GIS 11. Format of records for different databases. Creating and maintaining databases 12. Data Formats in GIS (geometric, attributive, graphic). Data sources in GIS (primary and secondary) 13. Vector and Raster GIS. Advantages and disadvantages Operations on raster and vector thematic layers 14. Thematic mapping. Data analysis in GIS for forestry purposes (silviculture, forest management, forest protection forests, wildlife management, ...) 15. Connection between RS and GIS products, digital relief model, digital orthophoto, forestry applications Exercises: 1. Stereoscopic observation, stereoscopic observation tests 2. Recognition way of recorded objects to different images, photointerpretation keys 3. Preparation of images for measuring, orientation of aerial images, map scale assessment 4. Stereoscopic measurement (analog and digital images), parallaxes, flight high, altitude, slope, exposition, etc. 5. Photointerpretation by measuring, (area, number of trees, width canopy of tree, assembly, tree height, volume, etc.) 6. Visual photointerpretation (damage of tree, vegetation types, …) 7. Visual interpretation of satellite image (land use, stand damage of stand, etc.) 8. Digital processing of satellite images (unsupervised classification) 9. Digital processing of satellite images (supervised classification) 10. Introduction and work with GIS programs (ArcGIS, QGIS, etc.) 11. Creating a GIS database, data processing and analysis 12. Displaying objects with different data types (point, line, polygon) and shapes (geometric, attribute, graphic) 13. Connection a database to geometric data 14. Creating thematic maps for the needs of forestry (silviculture,forest management, protection of forests, wildlife management, ...) 15. Connection between RS and GIS products (vector and raster data models)

<table>
<tr><td></td><td colspan="9">Field work:

1. Collecting field data (GPS) and making a GIS database. Creating thematic layers.
2. Verification of the results photo interpretation images on the terrain</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td>5</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Within the course, with the regular attendance of lectures, exercises and field work, students create individual assignments and two project tasks from field work during the semester.
Taking an exam is through the 2 midterm exam and oral exam. Regular attendance and active participation on lectures and exercises, preparation of seminar work.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="3">Title</td><td colspan="3">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td></td><td colspan="3">Weng, Q. (2009): Remote sensing and GIS integration, theories, methods and applications. McGraw-Hill Education. 416 str.</td><td colspan="3"></td><td colspan="3">YES</td></tr>
<tr><td></td><td colspan="3">Lillesand T.M., Kiefer R.W. and j. W. Chipman (2004): Remote sensing and image interpretation, Wiley & Sons, 763 str.</td><td colspan="3"></td><td colspan="3">YES</td></tr>
<tr><td></td><td colspan="3">Pernar R. (2019): Prezentacije s predavanja</td><td colspan="3"></td><td colspan="3">YES</td></tr>
<tr><td></td><td colspan="3">Oštir, K. Mulahusić, A. (2014): Daljinska istraživanja. Građevinski fakultet, Univerzitet u Sarajevu, 343 str.</td><td colspan="3"></td><td colspan="3">YES</td></tr>
<tr><td></td><td colspan="3">Oluić, M. (2001): Snimanje i istraživanje Zemlje iz svemira, HAZU, Zagreb, 580 str.</td><td colspan="3">YES</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3">Konecny, G. (2002): Geoinformation: Remote Sensing, Photogrammetry and Geographic Information Systems. CRC Press. 280 str.</td><td colspan="3"></td><td colspan="3">YES</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Prasad S. T., Lyon, J. G., Huete, A. (2012): Hyperspectral Remote Sensing of Vegetation. CRC Press. 782 str.
2. Campbell J. B. (1996): Introduction to Remote Sensing , 2nd ed., Guilford, 622 str.
3. Gőpfert, W. (1991):Raumbezogene Informationssysteme: Grundlagen der integrierten Verarbeitung von Punkt-, Vektor-und Rasterdaten; Anwendungen in</td></tr>
</table>

	Kartographie, Fernerkundung und Umweltplanung. H. Wichmann Verlag GmbH, Karlsruhe, 318 str. 4. Pernar R., 1996: Primjena rezultata interpretacije aerosnimaka i GIS-a za planiranje u šumarstvu, Disertacija, Zagreb,156 str. 5. Steede-Terry, K. (2000): Integrating GIS and the Global Positioning System. ESRI Press, USA. 150 str.

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Marijan Grubešić, Ph.D Prof. Krešimir Krapinec, Ph.D Asst. Prof. Kristijan Tomljanović, Ph.D	1.7. Number of ECTS credits	6
1.2. Course title	Bases of hunting management	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+16
1.3. Course code	33863	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	YES
2. COURSE DESCRIPTION			
2.1. Course objectives	Students will get to know hunting as a complex area, comprising biological, technical and economic part. Through teaching, exercises and teaching in the field students will be prepared for the duties, which will be implemented in practice in terms of game breeding, protection and hunting.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data C4. conduct professional works on implementation of wildlife management programs and perform organisation od hunting areas D1. continue perfection on university graduate studies on Forestry section on Faculty of Forestry		
2.4. Expected learning outcomes at the level of the course (3 to 10 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).		
2.5. Course content (syllabus)	Lectures: 1. Introduction. Content. Historical overview of hunting development 2. Hunting management as a sports, recreational and economic activity 3. Game zoology. Game classification (scientific, hunting and legal)		

<table>
<tr><td></td><td colspan="9">4. Morphology, biology and ecology of large furry game
5. Morphology, biology and ecology of small hairy game
6. Morphology, biology and ecology of game birds (Part I)
7. Morphology, biology and ecology of game birds (Part II)
8. Diseases and protection of wildlife
9. Hunting ground, division of hunting grounds, types of hunting grounds, acquisition of hunting rights
10. Management of open hunting grounds
11. Game breeding and protection. Damage to and from wildlife
12. Ways of hunting game
13. Hunting weapons and ammunition
14. Hunting cynology
15. Legislation in the field of hunting (Regulations)

Exercises:
1. Systematics and classification of game
2. Determining age and sex - large game
3. Determining age and sex - small game
4. Errors of horns, antlers and tusks - I
5. Errors of horns, antlers and tusks - II
6. Beginning of breeding shooting
7. Preparation and processing of hunting trophies - horns and antlers
8. Preparation and processing of hunting trophies - fur and skulls
9. Game counting - large and small game
10. Counting other animal species
11. Hunting management basis - forms
12. Implementation of the hunting management basis
13. Basics of cynology
14. Weapons and Ballistics - I
15. Weapons and ballistics - II</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>6</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
</table>

	Andrašić, D., 1984: Zoologija divljači i lovna tehnologija. Skripta, Sveučilište u Zagrebu Šumarski fakultet, Zagreb, 294 str.	YES	
	Mustapić, Z., i suradnici., 2004: LOVSTVO priručnik. Hrvatski lovački savez Zagreb, 597 str.	YES	
	Tucak, Z., Florijančić, T., Grubešić, M., Topić, J., Brna, J., Dragičević, P., Tušek, T., Vukušić, K., 2002: Lovstvo. Drugo prošireno izdanje. Uđbenik, Sveučilište Josipa Jurja Strossmayera u Osijeku, Poljoprivredni fakultet Osijek, 405 str	YES	
2.12. Optional literature	1. Grupa autora: 1967: Lovački priručnik, Lovačka knjiga Zagreb, 704 str.		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Marijan Šušnjar, Ph.D Asst. Prof. Zdravko Pandur, Ph.D.	1.7. Number of ECTS credits	5
1.2. Course title	The basic of forest mechanisation	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+16
1.3. Course code	33875	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The objectives of the course are the acquisition of basic knowledge about physical quantities and materials for the construction of forest machines, methods of measuring physical values and processing the results. Further goals are to get acquainted with the basics and development of the most important forest machines used for mechanization of works in forestry.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A3 apply skills in solving practical side of buisness, either by control measuring, calculations or testing verification B9. apply knowledge about the forest machines, techniques and standard technologies used in forestry and above all in timber harvesting from natural forests, forest cultures and plantations		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Describe metering systems, basic metric sizes Interpret materials in the construction of forest machines (material types, properties - choice of materials, strength and hardness of materials). Interpret the energy in forestry (energy balance of forestry, energy consumption, environmental suitability, toxicity and ecology of liquid fuels and lubricants). Interpret the use of forest vehicles and devices (chainsaws, skidders, forwarders, adapted farming tractors forest trucks)		
2.5. Course content (syllabus)	Lectures 1. Introductory lecture: principles of mechanization of forest works.		

<table>
<tr><td></td><td colspan="3">2. Unit systems: internationally standardized system of units. Basic measurement units, size and numerical equations; units of measurement, decimal units, some illegal units.

3. Derived measured quantities: for speed and acceleration, force and moment of force, work and energy (law of conservation of energy), for force, pressure and stress.
4. Materials in the construction of forest machinery - Types of materials, properties - choice of materials.
5. Internal combustion engines.
6. Chainsaws - historical development, technical features, parts, working principle, cutting tools,, development guidelines.
7. Harmfulness of chainsaws - dangers to workers' health and environmental pollution by using chainsaws.
8. Harvesters - historical development, technical features, parts, working principle, harvester head.
9. Pump - definitions, classification, basic technical characteristics, pump parts, operation modes, application, pump efficiency determination.
10. Hydraulic systems - basic concepts, parts, operation modes. Hydraulic cranes.
11. Tractors - basic technical features, three-joint tractor drawbar, PTO shaft.
12. Skidders; types, method of use, parts, forest winches.
13. Forwarders; types, method of use, parts.
14. Forest trucks; types, methods of use, legal restrictions for transport by public roads.
15. Energy balance of forestry - energy consumption of characteristic processes.

Exercises
1. Computational exercises with tasks from measurement physical quantities and the formation of units of measurement; mass and weight.
2. Computational exercises with tasks related to the carrying capacity of vehicles, power during rotation.
3. Computational exercises with tasks related to material stress.
4. Calculation exercises with tasks from hydraulics, calculation of pump hydraulic power.
5. Preparation for measurement exercise: "Measurement of pump characteristics".
6. Measurement exercise: "Measurement of pump characteristics".
7. Measurement exercise data processing: "Measurement of pump characteristics".
8. Preparation for measurement exercise: "Determination of fan efficiency".
9. Measurement exercise: "Determination of fan efficiency".
10. Measurement excercise dana processing: "Determination of fan efficiency".
11. Computational exercises: Engine speed feature.
12. Measurement exercise: "Harmfulness of chainsaws".
13. Measurement exercise: "Vehicle stability".
14. Computational exercises: Timber winching.
15. Computational exercises: Skidder wood extraction

Field Work
• Timber harvesting in hilly / mountainous areas - chainsaw, skidder, truck set with semi-trailer.
• Timber harvesting in the lowland area - forwarder, tractor assembly and truck assembly with semitrailer.</td></tr>
<tr><td>2.6. Format of instruction</td><td>☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td>☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
</table>

<table>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>5</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td rowspan="8">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td>Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="5">Šušnjar, M., Pandur, Z., - Prezentacije predavanja i vježbi iz predmeta Osnove mehanizacija šumarstva</td><td>NO</td><td colspan="3">YES; MERLIN</td></tr>
<tr><td colspan="5">Halilović, V., 2017: Karakteristike i upotreba motornih pila u šumarstvu. Šumarski fakultet Univerzitet u Sarajevu. 1-154.</td><td>NO</td><td colspan="3">YES; MERLIN</td></tr>
<tr><td colspan="5">Best Practice Guidelines for Ground-based Logging, FITEC, New Zealand 2000, poglavlja: a) Types of extraction machines, s. 2-7., b) Personal protective equipment, s. 30., c) Wire rope, strops, and other accessories, s. 31-35., d) Forwarder extraction, s. 43.</td><td>NO</td><td colspan="3">YES; MERLIN</td></tr>
<tr><td colspan="5">Korbar, R., 2007: Pneumatika i hidraulika. Skripta. Veleučilište u Karlovcu. 1-134. (odabrana poglavlja)</td><td>NO</td><td colspan="3">YES; MERLIN</td></tr>
<tr><td colspan="5">Pandur, Z., Zorić, M., Šušnjar, M., 2012: Rad s motornom pilom i održavanje. Gospodarski list 22, 33-43.</td><td>NO</td><td colspan="3">YES; MERLIN</td></tr>
<tr><td colspan="5"></td><td></td><td colspan="3"></td></tr>
<tr><td colspan="9"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Šušnjar, M., Pandur, Z.; Bačić, M.; Zorić, 2016: Raspodjela mase tovara i osovinskog opterećenja šumskih kamionskih skupova pri prijevozu jelova celuloznog drva. Nova mehanizacija šumarstva. 37; 47-58.
2. Šušnjar, M., Bačić, M., Horvat, T., Pandur, Z., 2019: Analiza radnih obilježja šumskih kamionskih skupova za prijevoz drva. Nova mehanizacija šumarstva. 40 (2019), 1; 11-19. https://doi.org/10.5552/nms.2019.2
3. Pandur, Z., Šušnjar, M., Bačić, M., Đuka, A., Lepoglavec, K., Nevečerel, H., 2019: Fuel consumption comparison of two forwarders in lowland forests of pedunculate oak. iForest 12: 125-131. https://doi: 10.3832/ifor2872-011
4. Marenče, J., Šušnjar, M., 2019: Granične sile i mase tovara pri privitlavanju drva. Šumarski list 143 (11/12), 515-521.
5. Marenče, J., Šušnjar, M., 2017: Wheel slip during wood extraction. : Radovi Šumarskog Fakulteta Univerziteta u Sarajevu 2017 Vol.47 No.2 pp.36-48.
6. Horvat, D., Zečić, Ž., Šušnjar, M., 2007: Morfološke i proizvodne značajke traktora Ecotrac 120 V (Morphological characteristics and productivity of skidder ECOTRAC 120 V). Nova mehanizacija šumarstva 28. Posebno izdanje 1. 81-92.
7. Šušnjar, M., Bosner, A., Poršinsky, T., 2010: Vučne značajke skidera pri</td></tr>
</table>

privlačenju drva niz nagib (Skidder Traction Performance in Downhill Timber Extraction). Nova mehanizacija šumarstva 31: 3–14.
8. Šušnjar, M.; Horvat, D.; Pandur, Z.; Zorić, M., 2011: Axle load determination of truck and truck with semitrailer for wood transportation (Određivanje osovinskih opterećenja kamionskoga i tegljačkoga skupa za prijevoz drva). Croatian journal of forest engineering. 32, 1; 379-388.
9. Tomašić, Ž., Horvat, D., Šušnjar, M., 2007: Raspodjela opterećenja kotača skidera pri privlačenju drva (Wheel load distribution of skidders in timber extraction). Nova mehanizacija šumarstva 28 (1): 27-36.
10. Castro G.P., Malinovski J.R., Nutto L., Malinovski R.A. (2016) Machinery and Equipment in Harvesting. In: Pancel L., Köhl M. (eds) Tropical Forestry Handbook. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-54601-3_183.
11. Wong, J.Y., Theory of ground vehicles. Fourth edition, John Wiley and sons, Inc. 2008, poglavlje: Performance characteristics of off-road vehicles, s. 319-362.
12. Harvesting Systems and Equipment in British Columbia, FERIC, s. 49-89

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Davor Pavlović, teacher	1.7. Number of ECTS credits	1
1.2. Course title	Physical and health education 3	1.8. Number of hours in semester (L+E+F+e-learning)	0+30+0
1.3. Course code	226043	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the course Physical and Health Culture 3. is the acquisition of theoretical and practical kinesiological knowledge in order to train students for independent physical exercise and the adoption of healthy living habits. Through various forms of physical exercise, the goal is to meet the daily needs for movement and improve the motor, functional and cognitive abilities of the student population. Through attending classes, students are educated about the importance of daily physical exercise, or about all the good things that physical activity means for a person and his health. The aim is to simultaneously acquire knowledge about the harmfulness of various forms of addiction to health, especially their impact on intellectual and physical capabilities, the importance of quality nutrition and the most interesting results of previous research on the student population in the segment: physical activity as disease prevention, healthy eating , sports diagnostics, stress management, physical activity as a means of relief.		
2.2. Enrolment requirements and/or entry competences required for the course	health status		
2.3. Learning outcomes at the level of the programme to which the course contributes	To continue training at the graduate university studies of the Faculty of Forestry, Department of Forestry		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Describe the structure of the physical exercise class 2. Explaination of the impact of physical exercise on health. 3. Choose fitness exercises designed to strengthen individual muscle groups. 4. Demonstrate specific exercises with regard to kinesiologic activity 5. Organize constructive free time 6. Assess personal diet and physical exercise habits.		

<table>
<tr><td></td><td colspan="9">7. Demonstrate general preparatory exercises and stretching exercises.
8. Understanding kinesiology programs and their target orientation
9. Control emotions and strengthen self-control.</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">1. Athletics
Walking - Walking at different paces, Nordic walking, brisk walking, hiking
Running - theoretical knowledge and divisions, cyclic movements at different paces, fast running short distances, running down a slope, running along a slope, interval cyclic movements, differences in running long, medium and short distances, running with loads, relay running, running with hurdles of different height
2. Martial arts- Judo, Karate
Basic techniques of Judah - falls, hand throws, belt throws, foot throws, choking techniques, levers
Basic techniques - karate - kicks, punches, defense
3. Sports games-
Basketball - Keeping the ball in place, keeping the ball in motion, basic throwing, pivoting, jumping shot, passing in place and moving
Football - passing in place, passing to the first, passing in motion, technique with the ball, cooperation of two and three players, shots on goal from the move, shot on goal after the ball is added, volley kick, headers, stops
Volleyball - Passing with two hands above the head, passing with the forearms, service, passing behind the head, receiving service, blocks, technique of attack, technique of defense
Handball - guiding the ball in a straight line and with a change of direction, Passing in place, passing in motion, crossings, passing for a counterattack, cooperation of two and three players, goal kick after the lead, goal shot on the added ball
4. Racket sports
Badminton-forehand punch under the arm, forehand punches above the head, forehand lob above the head, backhand punch under the arm, high serve, backhand serve, short serve, field movements, single play, pair play
5. Shooting-classification of shooting disciplines and shooting equipment, maintenance of weapons, breathing techniques, air rifle 10m
6. Fitness programs - Circuit strength training, functional training, intensive cardio training, Pilates, -
Exercises for warming up and preparing the locomotor system, stretching exercises, muscle strengthening exercises, exercises for reducing subcutaneous fat, exercises for increasing muscle endurance, exercises for increasing muscle mass, stretching exercises
7. Hiking tours - hiking on flat terrain, hiking hiking tours, interval hiking methods
8. Dance structures - English waltz, Viennese waltz, disco fox, jive, salsa</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☐ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☒ (other)</td><td colspan="3">2.7. Comments:
Classes are conducted exclusively in the form of exercises. Students teach only from the content or teaching unit to which they are registered. If necessary, it is possible to conduct classes partially or completely online.</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written</td><td>YES</td><td></td><td>ECTS</td><td>1</td><td></td></tr>
</table>

				exam			credits (total)		
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities									
2.11. Required literature (available in the library and/or via other media)	Title				Availability in the library		Availability via other media		
	D. Pavović (2010): Script for students of the Faculty of Forestry, course Physical and Health Culture						Faculty of Forestry website, Merlin e-learning system		
2.12. Optional literature	1. Šatalić, Z., M Sorić, M Mišigoj Duraković(2016.) Sports nutrition, Znanje d.o.o, Textbooks of the University of Zagreb 2. Neljak, B. i Caput-Jogunica, R. (2012) Kinesiology Methodology in Higher Education, Faculty of Kinesiology, University of Zagreb 3. Bos, K. (2004.) Walking to health, Mozaik knjiga 4. Sertić, H. (2005.) The Basics of Martial Arts, Faculty of Kinesiology, University of Zagreb 5. Ćurković, S. (2010). Kinesiological Activities and Risk Behavior of Students, Dissertation. Faculty of Kinesiology, University of Zagreb								

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Milan Oršanić, Ph.D. Assoc. Prof. Damir Drvodelić, Ph.D Asst. Prof. Vinko Paulić, Ph.D	1.7. Number of ECTS credits	6
1.2. Course title	Establishment of forests	1.8. Number of hours in semester (L+E+F+e-learning)	45+30+24
1.3. Course code	33867	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the subject is to familiarize students with methods of forest establishment. Due to the complexity of the subject matter, students learn about the basics of seed production, nursery production, and growing of forest cultures and plantations. By taking this course student's become able to organize and conduct harvesting of forest seed, its cleaning, testing, grading and transportation. Students learn to organize, conduct and control nursery production of forest seedling of tree and shrub species, and transportation of seedlings. Students design a project for establishing new forest plantations with artificial regeneration method (choice of tree species, afforestation method and time, number of seedlings, care for young plantation). Also they design a project for special purpose plantations such as tree shelterbelts, short rotation plantations, quarry sanitations, forest		

	cultures for phytoremediation and other.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data B1. identify tree species based on morphological characteristics, identify parts and tree shapes and apply theoretical and practical knowledge of commercially indigenous and foreign tree species and shrubs B6. perform professional field works on establishing, caring for, and renewing forest stands B7. perform professional field works in the melioration and management of forest areas in the Mediterranean region B9. apply knowledge about the forest machines, techniques and standard technologies used in forestry and above all in timber harvesting from natural forests, forest cultures and plantations D1. continue perfection on university graduate studies on Forestry section on Faculty of Forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain forestry seeds (forest seeds and species, maturation and collection, cleansing and sorting, dormancy, forest seed quality elements). 2. Applied forest nursery and breeding methods in nurseries (division of nurseries, choice of habitats for the establishment of forest nurseries, generative and vegetative propagation of plants). 3. Describe soil treatment (division, basic and additional soil treatment, depth and volume of soil treatment, basis of equipment and tools used in soil treatment). 4. Presenting Container Planting (Container Sharing, Planted Container Problems, Root System Deformation, Substrate, Breeding Time, Plant Care in Containers). 5. Analyze the production technology of the main crops of forest seedlings (Quercus, Fagus, Fraxinus, Alnus, Betula, Populus, Salix, Abies, Pinus, Picea). 6. Appropriate afforestation of the main species of forest trees (raising and cultivation of forest cultures of autochthonous species of shreddersand conifers).
2.5. Course content (syllabus)	By taking this course student get familiar with basic tasks in forest seed production, forest seedling production and new forest cultures and plantations of trees and shrubs afforestation. List of lectures: 1. Forest seed anatomical structure. What is establishment of forest and what does it cover. Seed of forest tree and shrub species. Evolution adaptation of seed, broadleaves and conifer seed anatomical structure. Embryo and seed structure, type of seeds, chemical composition of seed, fruiting and periodicity. 2. Maturation and harvesting of seeds and fruits. Stands for forest seed production. Assessment of forest seed maturation. Criteria for forest seed and fruit maturation assessment, collecting forest seed and fruits (timing, methods), collecting not completely ripe and when the seed are ripe, handling of collected seeds, predrying of forest seed, temporary storage and transport of forest seed. 3. Cleaning and processing of forest seed. Extraction of seeds from cone, seed processing facility for cones processing (example Croatian Forestry Institute seed processing facility), extraction of stones, maceration, extraction of seeds from pods, processing of forest seed (methods and reasons). 4. Drying and storage of seeds. Classification of seeds in relation to moisture content, drying temperature, storage treatment, factors that influence seed storage (moisture content, temperature, aeration, pathological problems, timing, species), natural viability of seeds. 5. Dormancy of forest seed. Term and definition of dormancy, dormancy classifications, dormancy treatments, pretreatment with stratification (type and duration of stratification, stratification medium), stratification methods and equipment.

	6. Estimation of seed quality. Seed sampling, seed purity, moisture content in seed, weight of thousand seeds, germination, viability (mechanical, biochemical, radiographic methods, etc.), calculation on number of produced seeds on basis of germination tests. 7. General about forest nursery production. History of forest nursery production, areas and size of forest nurseries in Croatia, forest nursery classification, site for forestry nursery. 8. Soil tillage. What is soil tillage, soil tillage classification, primary and secondary soil tillage, depth and zone of soil tillage, basic tools and methods for soil tillage. 9. Sowing forest seed and transplanting seedlings. Presowing treatment (non dormant and dormant seed), germination beds, sowing timing, depth and density, sowing methods, preparation of germination beds, sowing on field germination beds, sowing in germination frames, sowing in containers, mediums for sowing covering, germination of seeds, protection of seeds, transplanting seedlings, timing of seedling transplanting, transplantation density, hand and mechanical transplanting of seedlings, technology for growth of transplanted seedlings in nurseries. 10. Seedling fertilization basics: Fertilization classification, mineral and organic fertilizers, organic-mineral fertilizers, microfertilizers, green manure, fertilization application, symptoms of fertilizer deficiency on forest seedlings. 11. Container production of seedlings. History of container production, container classification, materials for container production, seedling production in containers, root deformation in containers, size and shape of containers, substrate for filling containers, growing time in containers, greenhouse and container production of seedlings, care of container plants. 12. Global trends in afforestation. Definition of forest cultures according to FAO, history of afforestation in world, statistics about species and areas for afforestation in world. Suitable land for afforestation in Croatia. Global trends in afforestation according to species and production aim (plantations for production of highly valuable timber, plantations for biomass and wood fiber production), negative perspective on afforestation. 13. Afforestation of new forest plantations. What are forest cultures, intensive forest cultures and forest plantations, available area for afforestation in Croatia, structure of newly established forest plantations. Preparatory works by afforestation (selection of suitable areas, selection of tree species, selection of afforestation methods, afforestation season, soil preparation for afforestation, number of plants and planting schedule. 14. Tending and management of newly established forest plantations. Success of afforestation, seedling quality and afforestation success, weeds reduction, additional planting, cleaning, thinning, branch pruning, crown formation, fertilization, irrigation, afforestation rotation. 15. Technology of main tree species afforestation. Establishment and tending of forest cultures and plantation of soft broadleaved species (poplars and willows), establishment and tending of hard broadleaved species forest cultures (birch, honey locust, black alder, ash, black walnut etc.), establishment and tending of autochthonous and allochthones conifers. List of exercises: 1. Germination testing of forest seed. Laboratory exercises. Students investigate germination of forest seed by themselves in modern, open and closed, germination cabinets. At the end of exercise, germination time, germination percentage, germination energy, number of germinated seeds and number of seedlings from 1 kilo of seed is determined. During this exercises students get acquainted with seed quality elements, types of germination cabinets and germination substrates according to ISTA rules. WinSEEDLE software for morphological analysis of seed and seedlings and plant diseases in presented to students. With introduction, germination testing of forest seed is conducted during three weeks, for which in total this exercise is done in four weeks. 2. Determination of forest seed viability with special reference to indigo carmine and tetrazolium methods. Laboratory exercises. Students get detail acquainted with basic methods for forest seed viability testing, and special attention is given to indigo carmine and tetrazolium methods. Students carry viability testing of forest seed with tetrazolium

	chloride method by themselves. Total viability testing with introduction is conducted in six hours in total. 3. General about forest nurseries. Students get acquainted with history of nursery production in Croatia, nursery classification and definitions, choice of suitable site for nursery establishment (climate, soil, topography). Technical preconditions for nursery establishment is discussed (buildings, mechanization, fencing, irrigation). 4. Calculating capacity of nursery for poplar production. Practical exercise. Students get acquainted with floodplain forests in Croatia, nurseries for production of soft broadleaves species, types of poplar plantations, establishment and tending of poplar stem and roots cuttings production, extraction of poplar seedlings, planting of poplar seedlings in field, use of mechanization for establishment of poplar plantations. Second part of exercises is related to problem solving where students need to calculate capacity of nursery for afforestation of certain area with poplar or willow seedlings. During exercises students are presented with poplar stem and root cuttings production, and poplar seedling production (2/3) where students would be able to produce poplar stem cuttings by themselves. 5. Calculating capacity of nursery for conifer production. Practical exercise. Students get detail acquaintance with parts of nursery for conifer production, number of seedling in sowing beds and after transplanting in nursery, also with number of seedlings and amount of seed for successful afforestation. Second part of exercise is related to problem solving where student calculate number of seedling necessary for successful afforestation with certain conifer species. 6. Transplanting seedling in nursery. Practical exercise. In Faculty of Forestry Zagreb nursery students get acquainted with theoretical background for transplanting seedlings in nursery (definition of seedling material, seedling marking, soil preparation before transplanting, timing of transplanting, distance from one seedling to another, transplanting methods, care after transplanting seedlings, etc.). In second part of exercises students make practical work in transplanting seedlings of certain conifer species in nursery. 7. Planting seedlings in field. Practical exercise. In Faculty of Forestry Zagreb nursery students get acquainted with theoretical background for transplanting seedling in field (definitions, afforestation methods, seedlings types, container types, spatial arrangement during planting in field, basic planting methods, etc.). In second part of exercise basic methods for planting seedling in field are displayed. 8. Propagation of trees and shrubs in nursery. Practical exercise. Students get acquainted with basic methods for vegetative propagation of plants. Special attention is given to propagation by cuttings (reasons for propagation by cuttings, factors that influence cuttings propagation success, types of cuttings by plant parts, advantages and disadvantages of cuttings propagation, etc.). Grafting is also explained with overview of grafting methods, factors that influence grafting success, practical examples are displayed. In second part of exercises demonstration of some propagation methods is given. Students have opportunity to see tools for propagation, hormones used, substrate for cuttings rooting and other. 9. Seed sowing in nursery. Practical exercise. In Faculty of Forestry Zagreb nursery students get acquainted with theoretical and practical background of forest seed sowing in nursery (sowing depth, quantity, time etc.). In second part of exercise students have practical work where they do hand sowing of certain conifer species. 10. Care of plants in nursery. Practical exercise. Students get information about care of plants, types of used fertilizers, compost production, green manure, works in seed beds before and after germination, works in seed beds in first and second year, seedling quality parameters, seedling storage, seedling handling. Students are also acquainted with examples of certain seedling that have symptoms of nutrients deficiency. Equipment for determination physiological and morphological quality of seedlings is also displayed and introduced to students. List of field work: 1. Production of hard broadleaves seedlings (pedenculate and sessile oak, beech, ash). Field work would be conducted in nursery Zdenacki gaj, Forest office Grubisno polje

<table>
<tr><td></td><td colspan="9">or at some other nursery that has similar production. Field works is complex with participation of colleagues from Basis of mechanization in forestry.
2. Production of soft broadleaves seedlings, establishment and tending of poplar cultures or plantations. Field works would be conducted in nursery Višnjevac, Forest office Osijek. After detail introduction of nursery production of poplar seedlings students would visit newly established poplar plantation or culture in close proximity of Forest office Osijek or Valpovo. Production of hard broadleaves seedlings, production of ornamental trees and shrubs and production of seedlings for clonal reproduction plantations. Field work would be conducted in nursery Hajderovac, Forest administration Požega. Field works is complex with participation of colleagues from Basis of mechanization in forestry.
3. Forest seed production and seedling nursery production. Field works would be conducted in Croatian Forestry Institute. Nursery production of bare root and container seedlings. Seed processing facility, Cold storage. Laboratory for seed testing. Seed storage. Thermotherapy of seed (pedenculate oak, chesnut, beech). In vitro propagation. Propagation in glasshouse. Field works is complex with participation of colleagues from Basis of mechanization in forestry.
4. Establishment and tending of conifer cultures. Field works would be conducted in Forest office Duga Resa in part of experimental plots that are monitored by Croatian Forestry Institute (comparative experiment of different conifer species).</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:
Exercises are partially taken in Laboratory for forest seed and nursery production and practice work in Faculty of Forestry nurseries. Complex field work.</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>6</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation of students at the lectures, exercises and field work. The student can be absent with a maximum of 20% of lectures and 10% of the exercises. Students need to make report from field works. Taking partial exams and final exam.</td></tr>
<tr><td rowspan="4">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="4">Oršanić, M., Anić, I., Drvodelić, D., 2005: Šumsko sjemenarstvo i rasadničarstvo (Interna skripta). Zagreb. 228 str.</td><td colspan="2">No</td><td colspan="3">Yes, Merlin e-portfolio system</td></tr>
<tr><td colspan="4">Oršanić, M., Anić, I., Drvodelić, D., 2005: Priručnik za razmnožavanje drveća i grmlja (Interna skripta). Zagreb. 125 str.</td><td colspan="2">No</td><td colspan="3">Yes, Merlin e-portfolio system</td></tr>
<tr><td colspan="4">Matić, S., B. Prpić, 1983: Pošumljavanje. Savez inžinjera i tehničara</td><td colspan="2">No</td><td colspan="3">Yes, Merlin e-portfolio system</td></tr>
</table>

2.12. Optional literature	1. Savill, P. E., J. Auclair, D. J. Falck. Plantation Silviculture in Europe. Oxford University Press. 1997. 2. Šmelkova, L. Lesne školky. Zvolen. 2001 3. Krüssmann, G. Die Baumschule. Paul Parey Verlag. 1997. 4. Davidson, H., Mecklenburg, R. Nursery Management. Prentice Hall. 2000. 5. Chapman, G. A. & R. D. Wray. Christmas Trees for Pleasure and Profit. Rutgers University Press. Third Edition. 1987		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Ivica Tikvić, Ph.D Assoc. Prof. Damir Ugarković, Ph.D	1.7. Number of ECTS credits	6
1.2. Course title	Forest ecology	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+24
1.3. Course code	33869	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Acquiring knowledge about the functioning of forests in the temperate zone of Europe, about the functioning of forest habitats and habitat factors in the main forests in Croatia, about the relationship between the main species of forest trees and ecological factors. Development of skills for monitoring the state of ecological factors in forests, monitoring the state of forests and the state of forest trees, defining the main ecological problems in forests, determining their causes and consequences and proposing solutions to ecological problems. Acquisition of skills for assessing the vitality and damage of forest trees, as well as for assessing the financial value of non-market forest functions		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. identify tree species based on morphological characteristics, identify parts and tree shapes and apply theoretical and practical knowledge of commercially indigenous and foreign tree species and shrubs B3 acquire basic principles of protection of forests from abiotic and biotic factors, especially fires and apply basic procedures and means in protection of forests B4. participate in the realization of forest management programs B5. perform works on inventorying forests B6. perform professional field works on establishing, caring for, and renewing forest stands B8. collaborate in preparation of ecological studies and spatial plans		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Identify tree species on the basis of morphological features, identify tree parts and shapes, and apply theoretical and practical knowledge of economically important indigenous and alohton species of trees and shrubs. 2. Adopt the fundamental principles of protecting the forests of abiotic and biotic factors, especially from the fires, and apply the basic procedures and means to protect the forests. 3. Participate in the implementation of the forest management program. 4. Carry out works on forest inventory. 5. Perform professional field work on the establishment, care and restoration of forest		

<table>
<tr><td></td><td colspan="9">stands.
6. Collaborate on the development of ecological studies and spatial plans.</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">Lectures
1. Introduction to forest ecology. Functioning of forests and forest habitats.
2. Relationships of forest trees and light in forests. Relationships of forest trees and heat in forests.
3. Relationships of forest trees and water in forests. Relationships of forest trees and air in forests.
4. Relationships of forest trees and chemical factors in forests. Relationships of forest trees and mechanical factors in forests.
5. Relationships of forest trees and climate in forests. Relationships of forest trees and relief in forests.
6. Relationships of forest trees and forest soil in forests. Relationships between forest trees and geological substrates in forests.
7. Relationships of forest trees and other plants in forests.
8. Relationships of forest trees and animals in forests.
9. Relationships of forest trees and microorganisms in forests.
10. Influence of ecological factors on biomass production in forest ecosystems.
11. Influence of ecological factors on rooting of forest trees.
12. Influence of ecological factors on the phenological development of forest trees.
13. Assessment of vitality, damage and mortality of forest trees.
14. Monitoring the state of environmental factors. Forest condition monitoring.
15. Assessment and financial evaluation of non-market forest functions.

Exercises
1. Review of professional and scientific environmental topics
2. Habitat characteristics and description of forest ecosystems
3. Ecological equipment and its practical application in forestry
4. Analysis of phenological observations of forest trees and methods for determining tree biomass
5. Climate analysis and making climate diagrams
6. Assessment of non-market forest functions
7. Assessment of vitality, damage and mortality of trees

Field work
1. Ecological problems of lowland forests
2. Ecological problems of mountain forests
3. Ecological problems of Mediterranean and sub-Mediterranean forests</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>6</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.9. Assessment methods</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the</td></tr>
</table>

and criteria	current academic year.		
2.10. Student responsibilities			
2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Šume hrvatskog sredozemlja, Akademija šumarskih znanosti, 2011. (odabrana poglavlja - vezana uz ekologiju šuma).	YES	
	Hrast lužnjak u Hrvatskoj, HAZU Centar za znanstvni rad Vinkovci, «Hrvatske šume» Zagreb, 1996., (odabrana poglavlja - vezana uz ekologiju šuma).	YES	
	Obična jela u Hrvatskoj, Akademija šumarskih znanosti, Hrvatske šume d.o.o. Zagreb, 2001., (odabrana poglavlja vezana uz ekologiju šuma).	YES	
	Obična bukva u Hrvatskoj, Akademija šumarskih znanosti, Hrvatske šume d.o.o. Zagreb, Grad Zagreb, Gradski ured za poljoprivredu i šumarstvo 2003., (odabrana poglavlja vezana uz ekologiju šuma).	YES	
	Oršanić, M., S. Mikac, D. Ugarković, D. Drvodelić, D. Diminić, J. Kranjec Orlović, M. Milotić, B. Hrašovec, M. Franjević, M. Vucelja, L. Bjedov, J. Margaletić, 2020., Ekologija, obnova i zaštita poplavnih šuma Posavine. Sveučilište u Zagrebu, Šumarski fakultet, str. 368 (odabrana poglavlja vezana uz ekologiju šuma).	YES	
	I. Tikvić i sur., 2018. Branimir Prpić – Ekologija šuma i šumarstvo	YES	Merlin, Web page Croatian Forestry Society
2.12. Optional literature	1. Mihovl Gračanin, Ljudevit Ilijanić, 1977., Uvod u ekologiju bilja, Školska knjiga, Zagreb. 2. Penzar, I., B. Penzar, 2000., Agrometeorologija. Školska knjiga, Zagreb, str. 222 3. Poplavne šume u Hrvatskoj, 2005., Akademija šumarskih znanosti. 4. INTENSIVE MONITORING OF FOPREST ECOSYSTEMS IN EUROPE, FIMCI; Intensive Monitoring of Forest Ecosystems in Europe, FIMCI, Tehnical Report 2003, http://www.icp-forests.org/Manual.htm 5. Stephen H. Spurr, Burton V. Barnes, Forest Ecology, John Wiley and Sons, New York. 6. Kimmins J.P. 2004.: Forest Ecology, Prentice Hall, New Jesey, str. 611. 7. Waring, R., S. W. Running, 2007: Forest Ecosystems. Elsevier Academic Press, str. 420		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Boris Hrašovec, Ph.D Asst. Prof. Milivoj Franjević, Ph.D	1.7. Number of ECTS credits	6
1.2. Course title	Forest entomology	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+24

1.3. Course code	33870	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Students get basic knowledge of important forest pests, their taxonomic identification, collecting and knowledge of their "weak points" usable for suppression tactics.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B2. recognise and determine the most important types of xylophages bacteria, insects and funghi on trees species and detect wood defects incurred due to their activity		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. To interprete taxonomy, morphology, physiology and nutrition of forest insects, and the importance of insects in the forest ecosystem and urban areas 2. To interprete growth and ontogenetic development in insects (developmental stage, types of larvae, pupae, physiology of metamorphosis , apolysis,eclosis, ecdosis, hormone system, endocrine glands). 3. Describe the insect sense and communication with the environment in function survival in forest habitat and urban space (sensations of tastes, sight, hearing, smell and taste, intrinsic and interpersonal communication, sexual and aggregate attractants, insect attack symptoms). 4. Define the foundations of the insect ecology of the populations, endangered and rare insect species (fluctuations, oscillations, outbreaks, outbreak types, antagonistic relations and symbiosis, predation and parasitism, endangered and rare insect species, the concept of species preservation through conservation of habitats). 5. Decsribe and interprete the most significant pests of urban timber from the group of sucking insects species from the order of Orthoptera, Thysanoptera and Hemiptera (bionomy, ecology and significance). 6. Decsribe and interprete the most significant pests of urban timber from the group of sucking insects species from the order of Hymenoptera (bionomy, ecology and significance, parasitoid species, their reductive role on forest pests). 7. Decsribe and interprete the most significant pests of urban timber from the group of sucking insects species from the order of Coleoptera (bionomy, ecology and significance). 8. Decsribe and interprete the role and biological features of bark beetles, their population ecology, physiology, phloeophages and ambrosia beetles, physiological pests and technical pests, xylophagy and mycetophagy, their role in forest succession. 9. Decsribe and interprete the most significant pests of urban timber from the group of sucking insects species from the order of Lepidoptera and Diptera (bionomy, ecology and significance).		
2.5. Course content (syllabus)	LECTURES 1. The history of forest entomology in Croatia, importance of forest insect outbreaks and disturbances they cause, connections with the courses on higher levels of education (2 hr.) 2. Insect taxonomy with an overview of insect orders and their main morphological features. Main body parts, exoskeleton, competitive advantages and constrains emerging from the body structure (2 hr.). 3. Anatomy of an insect, physiology (haemolymph, breathing, food intake, excretion), feeding types, supplementary feeding, importance and repercussions in the insect population control, sexual and parthenogenetic reproduction, polygamy, sexual		

	indices and ecological meaning of protandry or protoginy (2 hr.) 4. Growth and development (onthogenesis), developmental stages (egg, larva, pupa, adult), larval and pula types, physiology of metamorphosis, eclosion, ecdysis, endocrinal regulation of moulting (2 hr.) 5. Senses in insects (palpation, sight, hearing, smell, taste) communication via semiochemicals, inter- and intra specific communication (pheromones, alomones, kairomones etc.), case examples (2 hr.). 6. Main environmental adaptations of insects to their habitats, the impact of temperature, sunlight, moisture on insect development Fundamental adaptations of insects to the environmental conditions, temperature, moisture and diurnal impacts on development, circadial rhythm, diapause, heterotypic relations between the insects, predation, parasitism, examples (2 hr.) 7. Fundamentals of population ecology in insects, quantitative indices and population distribution patterns, fluctuations, oscillations, outbreaks, outbreak types with examples (2 hr.) 8. Representatives of the forest insect pests from the taxons Orthoptera, Thysanoptera and Hemiptera. Bionomy. Bionomy, ecology and importance of selected species (2 hr.) 9. Representatives of the forest insect pests from the taxons Cicindelidae, Carabidae, Anobiidae, Buprestidae and Cerambycidae. Bionomy, ecology and importance of selected species and their impact on the forest ecosystem (2 hr.) 10. Representatives of the forest insect pests within the Chrysomelidae, Coccinelidae, Elateridae, Staphylinidae, Scarabaeidae i Curculionidae. Bionomy, ecology and importance of selected species and their impact on the forest ecosystem (2 hr.) 11. Representatives of the forest insect pests within the Scolytinae. “Primary” and “secondary” pests in forest entomology and forestry, general biological traits of nark beetles and timber beetles, physiological pest and technical pests. Bionomy, ecology and importance of selected species and their impact on the forest ecosystem (2 hr.) 12. Representatives of the forest insects pests within the Siricidae, Diprionidae, Tenthredinidae and parasitic wasps within Apocrita. Bionomy, ecology and importance of selected species and their impact on the forest ecosystem. Special adaptations of parasitoid wasps and their role in reduction of pest populations (2 hr.) 13. Representatives of the forest pest Lepidoptera within the Tischeridae, Lithocolletidae, Yponomeutidae, Argyresthiidae. Ksilofagni Lepidoptera; Cossidae i Sessidae. Porodice Lymantridae, Tortricidae, Pyralidae. Bionomy, ecology and importance of selected species and their impact on the forest ecosystem (2 hr.) 14. Representatives of the forest pest Lepidoptera within the Geometridae, Lasiocampidae, Thaumetopoeidae, Notodontidae, Noctuidae. Bionomy, ecology and importance of selected species and their impact on the forest ecosystem (2 hr.) 15. Representatives of the forest pest Lepidoptera within the Diptera. Porodice Tipulidae, Cecidomyidae, Asilidae, Syrphidae, Tachinidae. Fundamental principles and characteristics of parasitic Diptera Bionomy, ecology and importance of selected species and their impact on the forest ecosystem (2 hr.). LAB 1. Introduction with an overview of the field and laboratory methods in forest entomology. General aspects of the insect morphology. Simple dissection of the cockchafer (Melolontha melolontha), drawing of the main body parts (head, thorax, abdomen) (2 hr.) 2. Locomotive organs in insects, legs and wings. Dissection of legs, and wings and drawing of their segments. Differentiations within specific leg types and wings (elytra, semielytra and halterae) (2 hr.) 3. Mouth apparatus and main types within insects. Dissection of the chewing apparatus on Saltatoria and Sawyer beetle. Even and non-even segments of mouth apparatus and segmentation. Line drawing of all dissected parts. (2 hr.) 4. Sensory organs within insects. Tympanum in Acridoidea, faceted eye in Libelloidea, stridulatory organ in Acridoidea, multiple antennae types (moniliform, pectinate, setaceous, lamellate, clavate, geniculate). Drawing of antennal segments represented by a Cerambycid, Rhagium inquisitor (2 hr.)

<table>
<tr><td></td><td colspan="9">5. Dissection of insect: gut, nerves, reproductive organs, Line drawing of main gut parts. Microscopic slides of diseased insects: bacteria, microsporidians, gregarine, nematodes (2 hr.)
6. Introduction to the mounting and preserving of insects. Mounting of beetles (Chrysomela populi), and butterflies and moths (Lymantria dispar), Actual mounting and documenting various procedures (2 hr.)
7. Moiunting of smaller beetles (bark beetles) glued on cardboard (Ips typographus, Pytiogenes chalcographus). Mounting of hymanopterans (Vespa ssp.). Actual mounting, scetching, and documenting various procedures (2 hr.)
8. ETOH preserved larval stages of main larval types and pupae. Alive larvae of caterpillars (Lepidoptera) and false caterpillars Hymenooptera, Tenthredinidae). Sketch drawings of main larval and pupal samples with morphological structures (2 hr.)
9. Predators and parasitoids. Line drawing of typical representative (carabid beetle, tiger beetle), parasitoit wasp (Torymus spp.) and parasitoid Diptera (cocoon, pupa, adult). Egg clusters with normally ecloded larvae and those that evaded by egg parasitoids (pine processionary moth egg cluster) (2 hr.)
10. Representatives from Heteroptera, Homoptera and Thysanoptera: line drawing of dried specimens of Pyrhocoris apterus and ETOH conserved Rhynchaenus fagi and Dendrothrips ornatus. Galls of the Adelges viridis and Prociphilus bumeliae (2 hr.)
11. Representatives from the order Hymenoptera. Line drawing of seasonably available species, like Urocerus gigas, Neodiprion sertifer, Apethymus abdominalis, Camponotus herculeanus and Vespa crabro (2 hr.)
12. Representatives from the order Lepidoptera. Line drawing of seasonably available species, like male and female of: Lymantria dispar, Operophtera brumata, Euproctis chrysorrhoea and a cocoon of Argyresthia fundella (2 hr.)
13. Representatives from the order Coleoptera. Line drawing of seasonably available alive leaf beetle larva, a coccinelid and cerambycid larva. Line drawing of Cerambyx cerdo, Monochamus galloprovincialis and Thanasimus formicarius. Galleries of Agrilus bigutattus and Coraebus florentinus (2 hr.)
14. Bark beetles. Line drawings of the main types of their gallery systems (uniramial, biramial, multiramial, mainly in transverse or longitudinal orientation). Differentiation of maternal and larval galleries, mating chamber and pupal chamber (2 hr.)
15. Representatives from the order Diptera. Line drawing of Bibio sp., available species of Syrphidae, Cecidomyiidae and Mikiola fagi (2 hr.)
FIELD EXCURSION
During a three-day field excursion students are familiarized with the most common and important forest pests and beneficials in their natural environment, their impact on trees and forest as a whole. Field excursion encompasses three most important forest ecosystems: lowland oak forests, mountainous silver fir and beech forests and Mediterranean.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits</td><td>6</td><td></td></tr>
</table>

							(total)			
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.									
2.10. Student responsibilities										

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Hrašovec-Franjević, 2020: Šumarska entomologija -posebni dio - pregled najznačajnijih vrsta šumskih kukaca i njihova osnovna biološka obilježja	YES	Faculty web pages
	Hrašovec, B. 2004: Kukci – važni pokazatelji bioraznolikosti ali i povremeni uzročnici kalamiteta u šumskom ekosustavu. Hrvatsko šumarsko društvo, Zagreb, 76 str.	YES	Faculty web pages
	Hrašovec, Franjević, 2020: Šumarska entomologija - opća entomologija – unutarnja i vanjska građa kukaca, fiziologija, opća ekologija i biologija	YES	Faculty web pages

2.12. Optional literature	1. Tomiczek, C., D. Diminić, T. Cech, B. Hrašovec, H. Krehan, M. Pernek, B. Perny, 2008: Bolesti i štetnici urbanog drveća. Udžbenici Sveučilišta u Zagrebu, Šumarski institut, Jastrebarsko – Šumarski fakultet Sveučilišta u Zagrebu, Zagreb, 382 str. 2. Zúbrik, M., Kunca, A., Csóka, G., Forster, B., Hâruţa, O., Hoch, G., Hrašovec, B., Koltay, A., Kulfan, J., Leontovyč, R., Nageleisen, L.M., Nakládal, O., Novotný, J., Roques, A., Peña, G.S., Šrůtka, P., Stergulc, F., Sukovata, L., Tomiczek, Ch., Turčáni, M., Vakula, J., Wermelinger, B., 2013: Insects and diseases damaging trees and shrubs of Europe. N.A.P. Editions, ISBN 978-2-913688-18-6, 535 p. 3. Chapman, R.F., 1998: The Insects – Structure &

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Marilena Idžojtić, Ph.D Asst Prof. Igor Poljak, Ph.D Antonio Vidaković, mag. ing. silv.	1.7. Number of ECTS credits	7
1.2. Course title	Dendrology	1.8. Number of hours in semester (L+E+F+e-learning)	45+30+24
1.3. Course code	226044	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Students acquire theoretical and practical knowledge about autochthonous and allochthonous tree and shrub species. Theoretical knowledge encompasses biological features, morphological characteristics, intra-species variability, distribution, special characteristics, and the economical and ecological importance of species. Students acquire		

	practical skills to recognize woody species on the basis of different morphological characteristics: habit, bark, leaves and twigs of deciduous species in winter, flowers, cones, fruits and seeds. They also gain knowledge on the practical use of trees and shrubs in forestry and urban forestry.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. identify tree species based on morphological characteristics, identify parts and tree shapes and apply theoretical and practical knowledge of commercially indigenous and foreign tree species and shrubs
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. To define and explain biological features and morphological characteristics of the genera of autochthonous gymnosperms (6 genera), allochthonous gymnosperms (18 genera), autochthonous angiosperms (trees - 28 genera, shrubs - 45 genera), allochthonous angiosperms (trees and shrubs - 27 genera), autochthonous and allochthonous angiosperms - vines (10 genera), 2. To identify and describe the autochthonous and allochthonous gymnosperms according to: habit (21 species), bark (12 species), twigs and buds in winter (5 deciduous species), leaves (49 species), cones and/or seeds (41 species); 3. To identify and describe the autochthonous and allochthonous angiosperms according to: habit (41 species), bark (27 species), twigs and buds in winter (72 deciduous species), leaves (196 species), flowers (61 species), fruits and/or seeds (123 species); 4. To use determination keys for autochthonous and allochthonous gymnosperms and angiosperms; 5. To group autochthonous and allochthonous gymnosperms and angiosperms (trees, shrubs and vines) according to biological features, morphological characteristics, distribution, economic, horticultural and ecological importance; 6. To choose autochthonous and allochthonous gymnosperms and angiosperms (trees, shrubs and vines) for various purpose in forestry and urban forestry;
2.5. Course content (syllabus)	Lectures: 1. Biological features, morphological characteristics, number of species and distribution of genera in the families Ginkgoaceae, Araucariaceae, Pinaceae (part one). Biological features, morphological characteristics, distribution and importance of species within these genera. 2. Biological features, morphological characteristics, number of species and distribution of genera in the family Pinaceae (part two). Biological features, morphological characteristics, distribution and importance of species within these genera. 3. Biological features, morphological characteristics, number of species and distribution of genera in the families Taxodiaceae, Cupressaceae. Biological features, morphological characteristics, distribution and importance of species within these genera. 4. Biological features, morphological characteristics, number of species and distribution of genera in the families Taxaceae, Cycadaceae, Ephedraceae, Magnoliaceae, Lauraceae. Biological features, morphological characteristics, distribution and importance of species within these genera. 5. Biological features, morphological characteristics, number of species and distribution of genera in the families Ranunculaceae, Berberidaceae, Platanaceae, Hamamelidaceae, Ulmaceae, Moraceae. Biological features, morphological characteristics, distribution and importance of species within these genera. 6. Biological features, morphological characteristics, number of species and distribution of genera in the families Juglandaceae, Fagaceae. Biological features, morphological characteristics, distribution and importance of species within these genera. 7. Biological features, morphological characteristics, number of species and distribution of genera in the families Betulaceae, Tiliaceae. Biological features, morphological characteristics, distribution and importance of species within these genera.

	8. Biological features, morphological characteristics, number of species and distribution of genera in the families Cistaceae, Tamaricaceae, Salicaceae. Biological features, morphological characteristics, distribution and importance of species within these genera. 9. Biological features, morphological characteristics, number of species and distribution of genera in the families Capparaceae, Ericaceae, Ebenaceae, Pittosporaceae, Hydrangeaceae, Grossulariaceae, Rosaceae (part one). Biological features, morphological characteristics, distribution and importance of species within these genera. 10. Biological features, morphological characteristics, number of species and distribution of genera in the family Rosaceae (part two). Biological features, morphological characteristics, distribution and importance of species within these genera. 11. Biological features, morphological characteristics, number of species and distribution of genera in the families Mimosaceae, Caesalpiniaceae, Fabaceae, Elaeagnaceae. Biological features, morphological characteristics, distribution and importance of species within these genera. 12. Biological features, morphological characteristics, number of species and distribution of genera in the families Myrtaceae, Punicaceae, Cornaceae, Loranthaceae, Viscaceae, Santalaceae, Celastraceae, Aquifoliaceae, Buxaceae, Euphorbiaceae, Rhamnaceae. Biological features, morphological characteristics, distribution and importance of species within these genera. 13. Biological features, morphological characteristics, number of species and distribution of genera in the families Vitaceae, Staphyleaceae, Hippocastanaceae, Aceraceae, Anacardiaceae, Simaroubaceae. Biological features, morphological characteristics, distribution and importance of species within these genera. 14. Biological features, morphological characteristics, number of species and distribution of genera in the families Meliaceae, Araliaceae, Apocynaceae, Solanaceae, Verbenaceae, Lamiaceae, Oleaceae (part one). Biological features, morphological characteristics, distribution and importance of species within these genera. 15. Biological features, morphological characteristics, number of species and distribution of genera in the families Oleaceae (part two), Scrophulariaceae, Bignoniaceae, Caprifoliaceae, Asteraceae, Liliaceae, Smilacaceae, Ruscaceae, Agavaceae. Biological features, morphological characteristics, distribution and importance of species within these genera. Exercises: 1. Determination of leaves, fruits and seeds - exercises using plant material and determination keys - genera and species of Pinaceae. 2. Determination of leaves, fruits and seeds - exercises using plant material and determination keys - genera and species of Taxodiaceae. 3. Determination of leaves, fruits and seeds - exercises using plant material and determination keys - genera and species of Cupressaceae. 4. Determination of twigs and buds in winter - exercises using plant material and determination keys - deciduous gymnosperms. Drawings of gymnosperms: 1-11 (Hempel-Wilchelm). 5. Trees and shrubs of the Arboretum of the Faculty of Forestry and Maksimir - field exercises - gymnosperms. 6. Determination of twigs and buds in winter - exercises using plant material and determination keys - genera and species of Ulmaceae, Fagaceae, Betulaceae. 7. Determination of twigs and buds in winter - exercises using plant material and determination keys - genera and species of Tiliaceae, Salicaceae. 8. Determination of twigs and buds in winter - exercises using plant material and determination keys - genera and species of Aceraceae, Oleaceae. 9. Determination of leaves - exercises using plant material and determination keys - genera and species of Ulmaceae, Fagaceae. 10. Determination of leaves - exercises using plant material and determination keys - genera and species of Tiliaceae, Salicaceae. 11. Determination of leaves - exercises using plant material and determination keys - genera and species of Aceraceae, Oleaceae. 12. Determination of fruits - exercises using plant material and determination keys - genera

<table>
<tr><td></td><td colspan="9">and species of Ulmaceae, Fagaceae, Tiliaceae.
13. Determination of fruits - exercises using plant material and determination keys - genera and species of Aceraceae, Oleaceae.
14. Trees and shrubs of the Arboretum of the Faculty of Forestry and Maksimir - field exercises - angiosperms.
15. Drawings of angiosperms: 12-60 (Hempel-Wilchelm).

Field work is held for three days in the lowland, mountain and Mediterranean regions of Croatia. During field work students collect herbarium specimens.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☒ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>Homework</td><td>YES</td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>7</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance at lectures, exercises and field work. Writing exercise and field work reports. Doing and submitting homework. Collecting herbarium specimens and passing herbarium exam. Passing partial and final exam.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td>Availability via other media</td></tr>
<tr><td></td><td colspan="5">Idžojtić, M., 2005: Listopadno drveće i grmlje u zimskom razdoblju. Šumarski fakultet Sveučilišta u Zagrebu. 256 pp.</td><td colspan="2">YES</td><td></td></tr>
<tr><td></td><td colspan="5">Idžojtić, M., 2009: Dendrologija – List. Šumarski fakultet Sveučilišta u Zagrebu. 904 pp.</td><td colspan="2">YES</td><td></td></tr>
<tr><td></td><td colspan="5">Idžojtić, M., 2013: Dendrologija – Cvijet, češer, plod, sjeme. Šumarski fakultet Sveučilišta u Zagrebu. 672 pp.</td><td colspan="2">YES</td><td></td></tr>
<tr><td></td><td colspan="5">Šumarska enciklopedija Vol. I-III, 1980-1987. JLZ Miroslav Krleža, Zagreb.</td><td colspan="2">YES</td><td></td></tr>
<tr><td></td><td colspan="5"></td><td colspan="2"></td><td></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Anić, M., 1946: Dendrologija. Šumarski priručnik I, Zagreb. 475-582 pp.
2. Bean, W.J., 1989: Trees and shrubs hardy in the British Isles. John Murray Publ., Ltd., London.
3. Fitschen, J., 2007: Gehölzflora. Quelle und Meyer Verlag, Wiebelsheim. 915 pp.
4. Herman, J., 1971: Šumarska dendrologija. Stanbiro, Zagreb. 470 pp.
5. Hillier, J., Coombes, A. (Eds.), 2007: The Hillier manual of trees and shrubs. A David and Charles Books, Cincinnati.
6. Idžojtić, 2019: Dendrology: Cones, Flowers, Fruits and Seeds. Elsevier – Academic Press,</td></tr>
</table>

	London, San Diego, Cambridge, Oxford. 800 pp. 7. Roloff, A., A. Bärtels, 2008: Flora der Gehölze. Bestimmung, Eigenschaften und Verwendung. Eugen Ulmer KG, Stuttgart. 853 pp. 8. Roloff, A., Weisgerber, H., Lang, U.M., Stimm, B. (Eds.), 1994–weiter: Enzyklopädie der Holzgewächse: Handbuch und Atlas der Dendrologie. Wiley-VCH. 9. Šilić, Č., 1973: Atlas drveća i grmlja. Zavod za izdavanje udžbenika, Sarajevo. 218 pp. 10. Vidaković, M., 1993: Četinjače – morfologija i varijabilnost. GZH i Hrvatske šume, Zagreb. 744 pp.

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Asst. Prof. Ida Katičić Bogdan, Ph.D Prof. Saša Bogdan, Ph.D	1.7. Number of ECTS credits	4
1.2. Course title	Forest genetics	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+0
1.3. Course code	33865	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Interpretation of the theoretical basics of genetics of forest tree species (basics of inheritance, functioning of genes, interaction of genes, control of gene expression, influence of genes on phenotype). Basics of work in molecular biology laboratory (DNA extraction, PCR, electrophoresis). Characterization and monitoring of genetic constitution and genetic structure of forest tree species (concepts and definitions, genetic characterization of a population, population genetic constitution, Hardy-Weinberg equilibrium and effective population size, inbreeding, evolutionary-adaptation factors, racial differentiation). Interpretation of the polygenic inheritance basics and application of quantitative genetics (set up and analysis of a genetic test).		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B8 – to carry out professional tasks of nurseries and seedings B9 – to collaborate on environmental and spatial plans C1 – to plan and organize integrated environmental management C2 – to plan and organize professional tasks of implementing economic programs of protected facilities Nature C3 – to apply the current legal regulations in the management of protected objects of nature C4 – to conduct environmental monitoring C5 – to calculate basic business performance indicators, draw up basic financial statements, identify types of costs, define and analyze costs		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1.To discuss the interaction of genes and the impact of the environment on phenotypic traits. 2.To carry out basic field and laboratory procedures in the context of DNA analysis (collection of plant material, extraction of DNA from plant tissue, PCR method, production of agarose gel, electrophoresis). 3.To discuss the usefulness and procedures of using different types of genetic markers for genetic characterization of a population and calculate the relevant parameters; To calculate relevant parameters and assess the basic genetic condition of a population.		

<table>
<tr><td></td><td colspan="9">4.To explain the importance of genetic diversity, methods of its determination and the impact of evolutionary factors on genetic diversity; To calculate different parameters describing: the level of genetic diversity of a population, the level of genetic differentiation among populations and the effective size of a population; To analyze genetic diversity of a population based on calculated parameters.
5.To design genetic test for analysis of quantitative phenotypic traits and describe the process of collecting data from a genetic test; To calculate basic parameters of quantitative genetic diversity based on data from a genetic test.</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">Lectures:
1. Fundamental laws of inheritance.
2. Deviations from Mendel's laws (multiple allelism, letal alleles, gene interactions).
3. Structure of DNA molecules and chromosome. Repetitive DNA. The replication of DNA molecules.
4. DNA function. Genes, genetic code, transcription, translation.
5. Regulation of gene expression.
6. Cell division (mitosis, meiosis) – the perspective of genetics.
7. Introduction to population genetics. Population genetic constitution and genetic structure.
8. Hardy-Weinberg's equilibrium, Crossing-over, Inbreeding.
9. Evolutionary-adaptation factors.
10. Effective population size. Genetic markers.
11. Genetic diversity of forest trees - introduction.
12. Introduction to quantitative genetics. Definitions, settings.
13. Genetic testing (provenance test, progeny test).
14. Determination of quantitative genetic parameters.
15. Genotype by environment interaction.
Exercises:
1. Introduction to molecular biology laboratory (laboratory).
2. Extracting DNA from plant tissue (laboratory).
3. Functioning of genes; creating a mental map (practicum).
4. Cell division (practicum).
5. The use of DNA markers (PCR method, electrophoresis) - laboratory.
6. Determination of genetic constitution of a population (practicum).
7. Calculation of the inbreeding coefficient and the inbreeding depression (practicum).
8. Calculation of the effects of evolution/adaptation factors on the genetic composition of a population (practicum).
9. Calculate the effective size of the population (practicum).
10. Calculation of parameters of genetic diversity (practicum).
11. Analysis of quantitative traits. Calculation of genotypic and additive values of individuals (practicum).
12. Designing a genetic test (practicum).
13. Genetic testing (data collection, statistical analysis, calculation of quantitative genetic parameters) - practicum.
14. Genetic testing (determination of racial variability) - practicum.
15. Selection of forest reproductive material based on genetic testing (practicum).</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="2">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
</table>

	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam	YES		Practical work		NO	(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	4	

2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.		
2.10. Student responsibilities			
2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Bogdan, S. and I. Katičić Bogdan, 2016. Genetics and breeding of trees and shrubs. Internal peer-reviewed script. 224. p. (selected chapters)	NO	YES; MERLIN
2.12. Optional literature	1. Ballian Dalibor, Kajba Davorin: ŠUMARSKA GENETIKA, 2007. Šumarski fakultet Univerziteta u Sarajevu, Šumarski fakultet Sveučilišta u Zagrebu 2. White, T. L., W. T. Adams, D. B. Neale, 2007: Forest Genetics. Wallingford, UK, Cambridge, CAB International. p682.		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Davor Pavlović, teacher	1.7. Number of ECTS credits	1
1.2. Course title	Physical and health education 4	1.8. Number of hours in semester (L+E+F+e-learning)	0+30+0
1.3. Course code	226045	1.9. Expected enrolment in the course	70
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the course Physical and Health Culture 4. is the acquisition of theoretical and practical kinesiological knowledge in order to train students for independent physical exercise and the adoption of healthy living habits. Through various forms of physical exercise, the goal is to meet the daily needs for movement and improve the motor, functional and cognitive abilities of the student population. Through attending classes, students are educated about the importance of daily physical exercise, or about all the good things that physical activity means for a person and his health. The aim is to simultaneously acquire knowledge about the harmfulness of various forms of addiction to health, especially their impact on intellectual and physical capabilities, the importance of quality nutrition and the most interesting results of previous research on the student population in the segment: physical activity as disease prevention, healthy eating , sports diagnostics, stress management, physical activity as a means of relief.		

<table>
<tr><td>2.2. Enrolment requirements and/or entry competences required for the course</td><td colspan="3">health status</td></tr>
<tr><td>2.3. Learning outcomes at the level of the programme
to which the course contributes</td><td colspan="3">To continue training at the graduate university studies of the Faculty of Forestry, Department of Forestry</td></tr>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning
outcomes)</td><td colspan="3">1. Describe the structure of the physical exercise class
2. Explaination of the impact of physical exercise on health.
3. Choose fitness exercises designed to strengthen individual muscle groups.
4. Demonstrate specific exercises with regard to kinesiologic activity
5. Organize constructive free time
6. Assess personal diet and physical exercise habits.
7. Demonstrate general preparatory exercises and stretching exercises.
8. Understanding kinesiology programs and their target orientation
9. Control emotions and strengthen self-control.</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="3">1. Athletics
Walking - Walking at different paces, Nordic walking, brisk walking, hiking
Running - theoretical knowledge and divisions, cyclic movements at different paces, fast running short distances, running down a slope, running along a slope, interval cyclic movements, differences in running long, medium and short distances, running with loads, relay running, running with hurdles of different height
2. Martial arts- Judo, Karate
Basic techniques of Judah - falls, hand throws, belt throws, foot throws, choking techniques, levers
Basic techniques - karate - kicks, punches, defense
3. Sports games-
Basketball - Keeping the ball in place, keeping the ball in motion, basic throwing, pivoting, jumping shot, passing in place and moving
Football - passing in place, passing to the first, passing in motion, technique with the ball, cooperation of two and three players, shots on goal from the move, shot on goal after the ball is added, volley kick, headers, stops
Volleyball - Passing with two hands above the head, passing with the forearms, service, passing behind the head, receiving service, blocks, technique of attack, technique of defense
Handball - guiding the ball in a straight line and with a change of direction, Passing in place, passing in motion, crossings, passing for a counterattack, cooperation of two and three players, goal kick after the lead, goal shot on the added ball
4. Racket sports
Badminton-forehand punch under the arm, forehand punches above the head, forehand lob above the head, backhand punch under the arm, high serve, backhand serve, short serve, field movements, single play, pair play
5. Shooting-classification of shooting disciplines and shooting equipment, maintenance of weapons, breathing techniques, air rifle 10m
6. Fitness programs - Circuit strength training, functional training, intensive cardio training, Pilates, -
Exercises for warming up and preparing the locomotor system, stretching exercises, muscle strengthening exercises, exercises for reducing subcutaneous fat, exercises for increasing muscle endurance, exercises for increasing muscle mass, stretching exercises
7. Hiking tours - hiking on flat terrain, hiking hiking tours, interval hiking methods
8. Dance structures - English waltz, Viennese waltz, disco fox, jive, salsa</td></tr>
<tr><td>2.6. Format of instruction</td><td>☐ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety</td><td>☐ independent assignments
☐ multimedia and the internet</td><td>2.7. Comments:
Classes are conducted exclusively in the form of exercises. Students teach</td></tr>
</table>

	☐ partial e-learning ☐ field work			☐ laboratory ☐ work with mentor ☒ (other)			only from the content or teaching unit to which they are registered. If necessary, it is possible to conduct classes partially or completely online.		
2.8. Monitoring student work	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work		NO	Report		NO	(other)		
	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam		NO	Practical work		NO	(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	1	
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities									

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	D. Pavović (2010): Script for students of the Faculty of Forestry, course Physical and Health Culture		Faculty of Forestry website, Merlin e-learning system

2.12. Optional literature	1. Šatalić, Z., M Sorić, M Mišigoj Duraković(2016.) Sports nutrition, Znanje d.o.o, Textbooks of the University of Zagreb 2. Neljak, B. i Caput-Jogunica, R. (2012) Kinesiology Methodology in Higher Education, Faculty of Kinesiology, University of Zagreb 3. Bos, K. (2004.) Walking to health, Mozaik knjiga 4. Sertić, H. (2005.) The Basics of Martial Arts, Faculty of Kinesiology, University of Zagreb 5. Ćurković, S. (2010). Kinesiological Activities and Risk Behavior of Students, Dissertation. Faculty of Kinesiology, University of Zagreb

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Igor Anić, Ph.D Assoc. Prof. Stjepan Mikac, Ph.D	1.7. Number of ECTS credits	7
1.2. Course title	Silviculture I	1.8. Number of hours in semester (L+E+F+e-learning)	45+30+40
1.3. Course code	33872	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2

1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the course is to introduce the student to the basics of silviculture – a scientific and specialist discipline for studying the processes and methods aimed at raising and forming a forest stand in the shortest possible time, at least costs, by sustaining the production ability of the soil, in order to gain optimal and permanent economic and non-commercial services. By taking this course, a student gets acquainted with the following: the genesis, morphology and structure of the forest; the structure and types of forest stands, and the silvicultural procedures in them; the analyses of the characteristics of pure and mixed forest stands, even-aged and selection stands, coppices and coppices with standards, and the features of the other basic silvicultural systems. A student is trained in practical activity in a forest stand, particularly for the implementation and control of the silvicultural procedures in forest tending and the silvicultural procedures of forest regeneration.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B6. perform professional field works on establishing, caring for, and renewing forest stands		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Present morphology, forest dynamics and the structure of the forest stands (morphology of the forest edge and the upper and lower boundaries of the forest, silvidinamic, structure of the forest stands, stand form, dynamics of the stand structure, development stage of the stand). Apply the forest tending from the appearance of the young growth to the cleaning (inter-species and the inter-population competition, silvicultural selection, tending under the crowns of old trees, tending of young growth after the final felling, supplementing the insufficiently regenerated areas). Explain the tending of forest stand by thinning (goal, intensity, volume, method and interval, influence and effects). Present forest regeneration using clearcutting system and edge system (biology and ecology, using of methods, advantages and disadvantages). Present forest regeneration using selection system (selection structure, ecological factors in selection forest stand, tree species, functions of tree marking, advantages and disadvantages). Present high forest, coppice forest, coppice with standards forest.		
2.5. Course content (syllabus)	Lectures (45 hours): 1. Definition, origin and general characteristics of silviculture: Concept and scope. The man-forest relationship through history. Origin and development of forestry and silviculture. Zagreb School of Silviculture. Silviculture in the future. Types of silvicultural procedures. 2. Forest morphology: Definition of forest. The importance of the forest. Purpose of the forest. Forest edge. Forest border. Elements of the forest. Forest tree species and their function. Forest land. 3. Silviculture and forest ecosystem: Forest structure. Forest production. Forest dynamics. Influence of ecological factors on morphogenesis and morphodynamics of trees and forest stands. Forest geography: Occurrence forms and distribution of forests in the world, Europe and Croatia. Emerging forms of forests and forest habitats in Croatia by vegetation belts and zones. Influence of silviculture on forest forms in Croatia. 4. Forest stand morphology: The concept and size of a forest stand. Stand mixture. Pure forest stand. Mixed forest stand. Silvicultural forms of stands. Developmental stages. Age of stand. Canopy density. Stand density and stand density index. Social relations between		

	trees in a stand. Habitat quality. Morphology and health status of trees in the stand. 5. Introduction to silvicultural analysis: Criteria for forest stand analyse. Elements of the structure of a even-aged forest stand. Elements of the structure of a selective forest stand. Forest stand analyse process. 6. Introduction to forest regeneration: Starting points and types of regeneration. Systematics of regeneration methods. Types of regeneration felling. Regeneration area. The beginning of regeneration. Silvicultural and management preconditions for regeneration. The duration of regeneration and rate of regeneration. Habitat preparation for regeneration. 7. Regeneration on a bare site: The concept of regeneration by clear felling. Historical development. Basic features. Ecological features. Forms of clear felling. Evaluation of the method. Application in practice. 8. Regeneration under the shelter of old stand: The concept of regeneration by shelterwood fellings. Historical development. Basic features. Types and forms of fellings. Ecological features. Evaluation of the method. Application in practice. Regeneration at the edge of an old stand: The concept of regeneration by edge felling. Historical development. Basic features. Types and forms of fellings. Ecological features. Evaluation of the method. Application in practice. 9. Regeneration under the canopy of mature trees: Selection forest. Selection stand. Selection forest management. Selective and selection felling. Historical development. Silvicultural characteristics of selection forest and selection stand. Tree species for selection management. Ecological characteristics. Features of selection management. Volume and intensity of selection felling. Tree marking implementation. Evaluation of the method. Application in practice. 10. Introduction to forest tending: Silvicultural, ecological, biological and economic concept of forest tending. Purpose, goals, and principles of forest tending. Tending at young development stages of stand: Soil treatment. Protection of a young stands from biotic and abiotic factors. Tending after final felling. Replanting. 11. Cleaning of stands: Morphology and analysis of the stand before cleaning. Goals of cleaning. Selection and marking of trees in stand care by clearing. 12. Thinning of stands: Thinning goals. Stand analysis before thinning and classification of trees in the stand. Features of thinning: volume, intensity, method, turn, first thinning, last thinning. Selection and marking of trees. 13. Application of forest tending: Application of forest tending in the stands of main tree species. Tending of selection stand. Forest tending planning and implementation. Overlapping regeneration and tending. 14. High forest system: The concept of high forest. Types of high forests. An overview of high forest silvicultural systems. 15. Coppice and coppice with standards: The concept of coppice. Types of coppice stands. Suitable tree species. Regeneration. Tending. Distribution and silvicultural significance. Silvicultural approach to coppice in Croatia. Coppice with standards: The concept, characteristics, and types. Suitable tree species. Regeneration. Tending. Distribution and silvicultural significance. Exercises (30 hours): 1. Historical development of forestry and silviculture in Croatia 2. Types and distribution of forest stands in Croatia 3. Morphology of trees in the stand 4. Influence of ecological factors on morphogenesis and morphodynamics of trees and forest stands 5. Analysis of the forest stand 6. Analysis of even-aged and selection forest stands 7. Tree marking in shelterwood method 8. Analysis of young growth during regeneration by shelterwood method 9. Tree marking in selection management 10. Analysis of young growth in selection stand 11. Tending of young growth

<table>
<tr><td></td><td colspan="9">12. Cleaning of oak stands and beech stands
13. Thinning, first part (classification of trees in stands)
14. Thinning, second part (calculation and analysis of stand structure before thinning, calculation of thinning elements)
15. Thinning, third part (tree marking, calculation and analysis of stand structure after thinning)

Field trip (40 hours):

1. Silvicultural characteristics of selected stands of Mediterranean forests
2. Silvicultural characteristics of selected stands of lowland forests 3. Silvicultural characteristics of selected stands of mountain forests
4. Silvicultural characteristics of selected stands of selection forests</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>7</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in all forms of teaching. Preparation of reports from exercises and fieldwork. Taking partial exam. Taking exam.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td></td><td colspan="5">Anić, I., 2020: Uzgajanje šuma I (predavanja). Interna skripta, Šumarski fakultet Sveučilišta u Zagrebu.</td><td colspan="2">No</td><td colspan="2">Yes, Merlin</td></tr>
<tr><td></td><td colspan="5">Anić, I., S. Mikac, 2020: Uzgajanje šuma I (vježbe i terenska nastava). Interna skripta, Šumarski fakultet Sveučilišta u Zagrebu.</td><td colspan="2">NO</td><td colspan="2">Yes, Merlin</td></tr>
<tr><td></td><td colspan="5"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td></td><td colspan="5"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td></td><td colspan="5"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Burschel. P., J. Huss, 1997: Grundriss des Waldbauss. Parey Buchverlag, Berlin, 487 p.
2. Matić, S., 1996: Uzgojni radovi na obnovi i njezi sastojina hrasta lužnjaka. U: D. Klepac (ur.), Hrast lužnjak (Quercus robur L.) u Hrvatskoj, HAZU i Hrvatske šume p.o. Zagreb, Zagreb – Vinkovci, str. 167 – 212.
3. Matić, S., I. Anić, M. Oršanić, 2001: Uzgojni postupci u prebornim šumama. U: B. Prpić (ur.), Obična jela (Abies alba Mill.) u Hrvatskoj, Akademija šumarskih znanosti, Zagreb, str.</td></tr>
</table>

	407 – 460. 4. Matić, S., I. Anić, M. Oršanić, 2003: Uzgojni postupci u bukovim šumama. U: S. Matić (ur.), Obična bukva (Fagus sylvatica L.) u Hrvatskoj, Akademija šumarskih znanosti, Zagreb, str. 340 – 369. 5. Matthews, J., 1989: Silvicultural systems. Clarendon press, Oxford, 284 p.

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Jura Čavlović, Ph.D Asst. Prof. Krunoslav Teslak, Ph.D	1.7. Number of ECTS credits	6
1.2. Course title	Basic foundation of forest regulation and planning	1.8. Number of hours in semester (L+E+F+e-learning)	45+30+16
1.3. Course code	226046	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Basic goal of this subject is to introduce students (baccalauraeates) to the basic foundations, which - based on the synthesis of other forestry disciplines (dendrology, ecology, phytocenology, cultivation, utilization, surveying) - represents the basis for forest regulation and planning by space and time. During this course of lectures, knowledge and skills in the synthesis of basic forestry disciplines regarding forest management, as well as the skills for using concrete forest management plans, are acquired. The course of lectures represents the basic foundation for acquiring the skills of elaboration of forest management plans in the next stage.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B4. participate in the realization of forest management programs B5. perform works on inventorying forests D1. continue perfection on university graduate studies on Forestry section on Faculty of Forestry		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. To recognize, to distinguish, to explain and to analyse meanings, content and elements of forest regulations and planning (content and type of plans, forest management systems, elements and dynamics of even-aged and uneven-aged stand structures, structure of volume and volume increment) 2. To explain and to discuss principle of sustainability (monitoring system of sustainable forest management, forest certification, prerequisites and constrains of sustainable forest management) 3. To explain, to derive and to calculate models of theoretical forest (forest normality, theoretical growing stock of even-aged forest, theoretical growing stock of selection/uneven-aged forest) 4. To explain, to calculate and to apply time as component of forest regulation and planning (types of maturity, absolute and economic maturity, rotation lenght, diameter and age of maturity) 5. To explain and to apply space as component of forest regulation and planning and procedures of forest division (basic units of spatial forest dividing, functions of forest management unit dividing, procedures and criteria of forest dividing on compartments/subcompartments) 6. To explain and to calculate possible (theoretical) cut in regulated forest (felling		

	(regeneration) cut, thinning cut, cut in selection/multi-aged forest)
2.5. Course content (syllabus)	Lectures 1. Introduction, content and literature. Defining of importance and role of forests and forest regulation. 2. Necessity of forest regulation. Forest management plans: type of plans, defining of management aims, structure and contents of operational management plans. 3. Historic review of development of forest regulations in Europe and Croatia by periods. 4. Elements of forest managing. Systems of forest management. Advantages/disadvantages of several management system. Selection of appropriate management system. 5. Type of management. Definition of forest stand. Structure of forest stand - general. 6. Elements of site and stand description, definitions, categories and methods of assessment. 7. Characteristics of even-aged stand development and of structure changes of selection/uneven-aged stand. Structure of growing volume and volume increment. 8. Principle of sustainable management. Monitoring system of sustainable management. Prerequisites and limitations of sustainable forest management. 9. Defining of normality – in general, by area, growing volume and tree density. Theoretical growing volume in selection forests. 10. Methods of defining of theoretical model of even-aged forest: average increment in mature age, Pressler s equation, method of age classes, method of growth model. 11. Methods of defining of theoretical model of selection/uneven-aged forest: method of arithmetic progression of selection/uneven-aged stands, method of geometric progression of selection/uneven-aged stands. 12. Time as planning element in forestry. Maturity and types of maturity. Defining of rotation length. Defining of target diameter and age of cut. 13. Spatial regulation of forests. Categories of forest divisions. Forest division on management units. 14. Division of management unit: compartment, sub-compartment management class. Prescribing of cut – in general. 15. Prescribing of cut in theoretical forests. Prescribed cut in even-aged forest. Prescribed cut in selection/uneven-aged forest Exercises 1. Even-aged stand growth – tree density and mean stand dbh. 2. Even-aged stand growth – growing volume. 3. Theoretical growing volume of even-aged forest. 4. Age-class distribution (according to area and growing volume) for even-aged forest. 5. Age-class distribution (according to area and growing volume) for even-aged forest. 6. Examples of prescribing of cut in even-aged stand - felling and thinning. 7. Examples of cut prescribing for theoretical and actual even-aged forests – felling cut and intermediate cut. 8. Changes of structure elements of selection/uneven-aged stands 9. Theoretical growing volume of selection stand. 10. Examples of cut prescribing in selection stand 11. Examples of cut prescribing in selection forest 12. Theoretical growing volume and prescribed cut in even-aged forest 13. Forest management plans – types and levels 14. Forest management plan - plan proceeding and stand level data 15. Forest management plan - forest level data

<table>
<tr><td></td><td colspan="9">Field work
1. Introduction in management unit, use of management plan, site and structure elements of even-aged stand, prescribing of management measures, basic units of forest management unit dividing and marking of unit borders (region of even-aged forests)
2. Specifics of selection management system, division of management unit, management plan and its use, comparison of current stand structure according to desired, prescribed and realized activities of forest management.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>7</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td></td><td colspan="4">Čavlović, J., 2013: Osnove uređivanja šuma. Šumarski fakultet Sveučilišta u Zagrebu, Zagreb, 322 str.</td><td colspan="2">YES</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td></td><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td></td><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td></td><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">Klepac, D., 1965: Uređivanje šuma, Znanje, Zagreb.
Knuchel, H., 1953: Planning and control in the managed forest. T. and A. Constable LTD., Edinburgh, p. 360.
Davis, L.S. & Johnson, K.N., 1987: Forest management. McGraw-Hill Book Company, New York.</td></tr>
</table>

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Tomislav Poršinsky, Ph.D Asst. Prof. Andreja Đuka; Ph.D Asst. Prof. Dinko Vusić, Ph.D	1.7. Number of ECTS credits	6

1.2. Course title	Timber hrvesting operations	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+32
1.3. Course code	226047	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The focus of the subject is on practical knowledge necessary for the educational profile of the bachelor to fulfil the requirements of less complex tasks in forestry.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B9. apply knowledge about the forest machines, techniques and standard technologies used in forestry and above all in timber harvesting from natural forests, forest cultures and plantations		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain the limiting and influential factors of timber harvesting (terrain characteristics, terrain trafficability and vehicle mobility, forest infrastructure networks and forest accessibility, climatic conditions, impact of stand features). 2. Define the harvesting plan (motor-manual tree felling and timer processing, mechanised tree felling and timber processing, volume quality estimation of standing trees, utilisation of timber volume during feeling and processing). 3. Present the timber transport (long distance timber transport, determination of optimum distance between forest roads, type of landing sites, timber truck transport, performance analysis and costs of timber truck transport). 4. Analyse timber extraction (primary timber transport by: adapted agricultural tractor, tractor-trailer system, skidder, forwarder, forest skyline and helicopter). 5. Present timber harvesting systems (production of forest biomass, timber harvesting in an environmentally sound manner).		
2.5. Course content (syllabus)	Lectures 1. Introduction to logging. Scope and goal. 2. Limiting factors in logging (social, terrain, stand, customer position, 5E criteria) 3. Felling (cutting) of trees with a chain saw 4. Processing of timber with a chain saw 5. Mechanised felling and processing 6. Introduction to timber transport and forest accessibility indicators 7. Manual, animal and mechanised timber bunching 8. Timber extraction with forestry vehicles 9. Aerial timber extraction with forest skyline and helicopters 10. Long distance timber transport by trucks 11. Long distance timber transport by railway and waterway 12. Obtaining forest biomass for energy 13. Causes and consequences of stand and habitat damage due to harvesting operations 14. Measures to reduce stand and habitat damage due to harvesting operations 15. Harvesting systems Practical lessons – excercises 1. Timber measurement 2. Wood defects I (irregularities of round wood, irregularities in anatomy)		

<table>
<tr><td></td><td colspan="9">3. Wood defects II (irregularities due to physical-mechanical factors, change in colour and consistency of timber, defects due to insects).
4. Classification of deciduous and coniferous wood by purpose (JUS)
5. Classification of deciduous and coniferous wood by quality (EN)
6. Evaluation of the standing tree.
7. Calculation of the Logging Plan
8. Components of the Harvesting Plan (cut-block)
9. Determining the optimal distance between forest roads
10. Costs and productivity of skidding timber
11. Costs and productivity of timber forwarding
12. Analysis of the performance and costs of long distance timber transport by trucks
13. Preparation for fieldwork measurements “Utilisation of timber in felling and processing of pedunculate oak".
14. Processing of data from fieldwork measurements.
15. Analysis of results obtained in the fieldwork measurements

Students acquire practical skills through one-day field trips and two-day fieldwork measurements "Utilisation of timber in felling and processing of pedunculate oak."</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>6</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures and exercises. Taking colloquia, exams.</td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="4">Poršinsky, T., Đuka, A.: Presentations of lectures, practical lessons – excercises and preparation materials for fieldwork measurements from the course Logging I.</td><td colspan="2">NO</td><td colspan="2">YES; MERLIN</td></tr>
<tr><td colspan="4">Zečić, Ž., Vusić, D., 2020: Katalog drvnih šumskih proizvoda. Šumarski fakultet Zagreb, 1–182.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="2"></td></tr>
</table>

2.12. Optional literature	1. MacDonald, AJ., 1999: Harvesting Systems and Equipment in British Columbia. FERIC, Handbook No., HB-12: 1–197. 2. Sessions, J., 2007: Harvesting operations in the tropics. Springer-Verlag, Berlin, Heidelberg, 1–170. 3. Längin, D., Ackerman, P., Krieg, B., Immelmann, A., Potgieter, C., van Rooyen, J., Upfold, S., 2010: South African Ground Based Harvesting Handbook. Forest Engineering Southern Africa and Institute for Commercial Forestry Research, Scottsville, South Africa, 1–182. 4. Krpan, A.P.B., Poršinsky, T., 2002: Productivity of Timberjack 1070 Harvester in Scotch Pine Thinning. Šum. list 126(11-12): 551–561. 5. Poršinsky, T., Stankić, I., 2005: A Contribution to Understanding Timber Yarding by Forest Skylines. Nova meh. šumar. 26: 39–54. 6. Sabo, A., Poršinsky, T., 2005: Skidding of fir roundwood by Timberjack 240C from selective forests of Gorski Kotar. Croat. j. for. eng. 26(1): 13–27. 7. Prka, M., Poršinsky, T., 2009: Structure Comparison of Technical Roundwood in Even-Aged Beech Cutblocks by Assortment Tables with Application of Standards HRN (1995) and HRN EN 1316-1:1999. Šum. list 133(1–2): 15–25. 8. Poršinsky, T., Stankić, I., Bosner, A., 2011: Ecoefficient Timber Forwarding Based on Nominal Ground Pressure Analysis. Croat. j. for. eng. 31(1): 345–356. 9. Stankić, I., Poršinsky, T., Tomašić, Ž., Tonković, I., Frntić, M., 2012: Productivity Models for Operational Planning of Timber Forwarding in Croatia. Croat. j. for. eng. 33(1): 61–78. 10. Đuka, A., Grigolato, S., Papa, I., Pentek, T., Poršinsky, T., 2017: Assessment of timber extraction distance and skid road network in steep karst terrain. iForest – Biogeosciences and Forestry 10: 886–894. 11. Poršinsky, T., Đuka, A., Papa, I., Bumber, Z., Janeš, D., Tomašić, Ž., Pentek, T., 2017: Criteria for Determining Primary Forest Traffic Infrastructure Network Density – Examples of The Most Common Cases. Šum. list 141(11–12): 593–608. 12. Poršinsky, T., Petreković, V., Đuka., A., 2020: Bark Thickness of Wild Cherry in Timber Scaling. Šum. list 144(1–2): 7–14.

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Stjepan Posavec, Ph.D Asst. Prof. Karlo Beljan, Ph.D	1.7. Number of ECTS credits	4
1.2. Course title	Basics of forest economics	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+0
1.3. Course code	33866	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	YES
2. COURSE DESCRIPTION			
2.1. Course objectives	Issues in the forest management and forest resources as part of the economics of renewable natural resources. The concept of sustainability management. Ideas, concepts and methods of forest valuation used by forest economists.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course	A1. apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data A2. use relevance in maintaining, area and possibilities of basic technical components		

<table>
<tr><td>contributes</td><td colspan="8">A3 apply skills in solving practical side of buisness, either by control measuring, calculations or testing verification
C5 plan and calculate production, calculate basic indicators of successful buisness, compose basic financial reports, recognise and analyse types of costs</td></tr>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="8">1. To explain economics of natural resources and sustainable development (specificity of production in forestry, biological-technical characteristics and economic characteristics).
2. Interpret forest rent and forest tax.
3. Interpret the determination of forests value (methods of evaluation in forestry, problems of total economic value of natural resources)
4. To explain the meaning of forest as capital (fixed assets and capital in forestry, categories of capital goods in forestry).
5. To analyze marketing in forestry (market laws, formation of forest resource prices, supply and demand laws).
6. Present economic analysis and planning in forestry (business indicators, forestry production, outline investment plan and business plan).</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="8">Exercises:
1. Introduction to the economics of natural resources
2. Definition and subject of forestry economics
3. Historical development of the economy
4. Basics of natural resource economics
5. Basics of environmental economics
6. Sustainable development and renewable energy sources
7. The concept and definition of forest rent and forest tax
8. Determining forest values
9. The meaning of the forest as capital
10. Depreciation
11. Economic role and importance of forestry
12. Basics of marketing in forestry
13. Basics of economic analysis
14. Planning in forestry
15. The role of forestry in the bioeconomy

Lectures:
1. Simple and compount interest rate calculation
2. Interest rate and discounting in forestry
3. Economic characteristics of the development of even-age stands
4. Determining the value of a even-age stand
5. Economic characteristics of uneven-age stand development
6. Determining the value of the uneven-age stand
7. Present cutting value method, forest tax
8. Modern methods of determining the value of forests
9. Land rent in forestry
10. Calculation of depreciation of assets in forestry
11. Examples of supply and demand in forestry
12. Elasticity of supply and demand
13. Cost-effectiveness and profitability in forestry
14. Basics of cost planning in forestry
15. Basics of investing in forestry</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Monitoring student</td><td>Class</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
</table>

work	attendance								
	Experimental work		NO	Report		NO	(other)		
	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam	YES		Practical work		NO	(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	4	
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities									

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Figurić, M.: UVOD U EKONOMIKU ŠUMSKIH RESURSA, Šumarski fakultet, Zagreb, 1998	YES	
	SABADI, R.: EKONOMIKA ŠUMARSTVA, Školska knjiga Zagreb, 1992	YES	
	Posavec, S.: Jurjević, P., Prpić, B., Vuletić, D., Jakovac, H., Posavec, S., 2011.: Procjena vrijednosti općekorisnih funkcija sredozemnih šuma primjenom šumarskih ekoloških i klasičnih ekonomskih načela, Šume hrvatskoga Sredozemlja, Matić, S. (ur.), Zagreb, Akademija šumarskih znanosti, 2011. Str. 516-523. ISBN 978-953-985715-6	NO	YES
	Posavec, Stjepan; Pezdevšek Malovrh, Špela, 2020: Market Value and Timber Assortment Sale Models - Comparative Study, Management Aspects in Forest Based Industries / Jelačić, Denis (ur.). Zagreb: WoodEMA i.a., 2020. str. 17-37, ISBN:978-953-57822-7-8	NO	YES
	Posavec, S., Beljan, K. 2013. Forest products production and sale trends in Croatia, Markets for wood and wooden products, ur. Jelačić, D., Zagreb, 2013., str 95-105, ISBN978-953-57822-0-9	NO	YES
2.12. Optional literature	KLEMPERER, W.D.: FOREST RESOURCE ECONOMICS AND FINANCE, McGraw-Hill Book Comp. New York, 1996		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Željko Španjol, Ph.D. Assoc. Prof. Damir Barčić, Ph.D. Assoc. Prof. Roman Rosavec, Ph.D.	1.7. Number of ECTS credits	3
1.2. Course title	Nature and environmental protection	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+0
1.3. Course code	226048	1.9. Expected enrolment in the course	60

1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	A survey of forms and ways of managing institutions in protected areas, a method of establishing protection institutions, a method of placing plant species on the list of endangered plant species or the list of protected plant species.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B8. collaborate in preparation of ecological studies and spatial plans D1. continue perfection on university graduate studies on Forestry section on Faculty of Forestry		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Analyze the protection of flora and fauna and the protection of forest ecosystems (rare and endangered species, endemic species of biological diversity, forest management on the basis of endurance, forest in protected areas). 2. Explain the protection of air, water, soil and biological and landscape diversity of Croatia (protection measures and wastewater treatment, ecological value of soil, factors affecting air pollution and contamination). 3. Improve waste management, sustainable sustainable development and renewable energy sources (waste management, soil, water and air impact, anthropogenic greenhouse effect).		
2.5. Course content (syllabus)	Lectures 1. Historical overview of nature protection and environmental protection in Croatia and the world. 2. Legal issues of nature and environmental protection in Croatia, international conventions and regulations in the field of nature protection and environmental protection. 3. Problems of forest ecosystem protection in Croatia and Europe. Experiences in conservation, protection measures and the impact of pollutants on forests. Protected forest areas. 4. Flora protection. Legally protected species, rare and endangered species. Protection of target species of flora in Croatia. 5. Fauna protection. Diversity of Croatia in the faunal sense, endangerment of taxa. 6. Protected areas in Croatia. Valuation methods and management methods. 7. Biological and landscape diversity of Croatia, protection measures with regard to economic development. 8. National Habitat Classification and European Ecological Network Natura 2000 9. Air protection - factors that affect air pollution and pollution. 10. Soil protection - technologies for remediation and remediation of contaminated soils. 11. Water protection - environmental, economic and health issues. Special attention is paid to wastewater. 12. Causes of global changes in the world - urbanization, energy consumption, world population growth, economic and social policy. Global climate change related to human impact on the global climate - anthropogenic greenhouse effect and stratospheric ozone degradation. 13. Natural resources and their use; waste management issues in Croatia and the world. 14. Sustainable development - issues related to forestry and environmentally friendly technologies. 15. International and domestic institutions dealing with nature protection, promotion and popularization of nature protection, and adoption of principles in development strategies.		

<table>
<tr><td></td><td colspan="9">Exercises
1. Practicum - classroom exercises. Projects in nature and environmental protection.
2. Practicum - classroom exercises. Problems of drying and forest degradation. Causes and consequences on forests, forest ecosystems and biodiversity.
3. Practicum - classroom exercises. Air pollution and pollution, impact in urban areas and natural ecosystems.
4. Practicum - classroom exercises. Pollution and pollution of water and sea, impact on aquifers, legally protected areas.
5. Practicum - classroom exercises. Soil pollution and pollution, main causes and possibilities of remediation, the role of soil as the main factor of plant production.
6. Practicum - classroom exercises. Waste management, problems of unregulated landfills, impact on soil, water and air.
7. Practicum - classroom exercises. Waste management, issues of regulated landfills, remediation, construction and closure of landfills.
8. Practicum - classroom exercises. Biodiversity in national parks.
9. Practicum - classroom exercises. Biodiversity in nature parks.
10. Practicum - classroom exercises. Manner of determining, natural values, division and declaring special reserves as categories according to the Nature Protection Act.
11. Practicum - classroom exercises. Endangered plant and animal species, assessment methods and endangered status in the Republic of Croatia.
12. Practicum - classroom exercises. Karst area as a geomorphological, hydrological, floristic and faunal value.
13. Practicum - classroom exercises. Overview of Croatian biodiversity.
14. Practicum - classroom exercises. An overview of the landscape diversity of Croatia.
15. Practicum - classroom exercises. Overview of protected natural values, their role and evaluation, issues of protection and preservation.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>3</td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td></td><td colspan="4">Španjol, Ž., Barčić, D., 2020: Zaštita prirode i okoliša (interna skripta), Faculty of Forestry, Zagreb.</td><td colspan="2">NO</td><td colspan="3">YES; MERLIN</td></tr>
</table>

	RAUŠ, Đ. 1991: Zaštita prirode i čovjekova okoliša. Šumarski fakultet, Sveučilište u Zagrebu, Zagreb.	YES	
2.12. Optional literature	1. CARTER, N. 2004: Strategije zaštite okoliša, Barbat, Zagreb. 2. GLAVAČ, V. 1999: Uvod u globalnu ekologiju, Državna uprava za zaštitu prirode i okoliša i Hrvatske šume d.o.o. Zagreb. 3. MARTINOVIĆ, J. 1997: Tloznanstvo u zaštiti okoliša, Državna uprava za zaštitu okoliša. Zagreb. 4. POTOČNIK, V. 1997: Obrada komunalnog otpada – svjetska iskustva, MTG Consulting, ZGO d.o.o., Državna uprava za zaštitu okoliša. Zagreb. 5. POTOČNIK, V., LAY, V. 2002: Obnovljivi izvori energije i zaštita okoliša u Hrvatskoj. Ministarstvo zaštite okoliša i prostornog uređenja RH i «Barbat». Zagreb. 6. ŠPANJOL, Ž., 1994: Problematika nacionalnih parkova u svijetu i u Republici Hrvatskoj. Glas.šum. pokuse 30: 61-94, Zagreb. 7. ŠPANJOL, Ž. 1993: Uloga posebno zaštićenih objekata prirode u turizmu, Glas. šum. pokuse,posebno izdanje 4: 231-242, Zagreb. 8. Ekološki leksikon, 2001: Barbat i Ministarstvo zaštite okoliša i prostornog uređenja RH. Zagreb. 9. World Resources 2000-2001: People and Ecosystems: The Fraying Web of life, 2000: Elsevier Science. Oxford. 10. Pregled stanja biološke i krajobrazne raznolikosti Hrvatske sa strategijom i akcijskim planovima zaštite, 1999: Državna uprava za zaštitu prirode i okoliša. Zagreb, 151. 11. časopisi «Šumarski list»,«Priroda»,«World Conservation – IUCN Bulletin».		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Ivan Martinić, Ph.D Asst. Prof. Matija Landekić, Ph.D Prof. Mario Šporčić, Ph.D Matija Bakarić, Ph.D.	1.7. Number of ECTS credits	4
1.2. Course title	Work safety in forestry	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+8
1.3. Course code	226049	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the course is to properly orient students to organize safer and more economically efficient work in forestry. The student develops the ability to reason about the basic principles of interaction between worker and the factors of the work process. Through lectures and methodological exercises with individual tasks, students acquire the skills of requirements assessment and risk analysis in forest work and master the techniques of improving work processes. Through the processing of different aspects of the injury and occupational diseases (number, type, financial consequences, etc.) student develops competence for engineering activities through the definition of preventive		

	measures within the plan of the forest site (preparation phase). Additionally, with the aim of improving the level of safety within the working environment, engineering competencies are being developed for the phase of control and work supervision in harvesting operations, silviculture work, forest protection, etc.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	C3. organise and conduct work safety in forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain work safety in forestry - theoretical basics (role of anthropometry, biomechanics and ergonomics in forestry) 2. Interpret the legal framework of safety in forestry and risk assessment (types of hazards, design and implementation of protection measures). 3. Present the safety working rules for major forestry works (felling and cutting, skidding / forwarding, silviculture, biological hazards in forestry - hornet sting, tick-borne disease). 4. Present the organization of safe work on forest working sites (planning of a temporary forest site, procedure in case of accident at work).
2.5. Course content (syllabus)	L1- Introduction to work safety in forestry (2 h). Subject contents view. Rules of performance, preparation and examination. L2- Safety at work - role and significance (2 h). Safety at work as a social responsibility and business strategy (2 h). M- Methodical exercises (1h). Video "Timber". Analysis of the working safety problems in forestry and health problems of forest workers. L3- Biomechanics of a human and physiology of work. (2 h). Anthropometry and body types. Role of muscle, nervous and circulatory system. M- Methodical exercises (1h). Physical load at work. Measurement of heart rate at rest, at work and in recovery - (individual measurement exercise). L4- Physical load at forest work (2 h). Dynamic and static work. Oxygen consumption and heart rate. Fatigue and recovery. Vision and hearing. M- Methodical exercises (1h). Physical load at work. Analysis of individual pulse measurement data. Determining work capacity and rating the difficulties of work - (calculation exercise). L5- The role of ergonomics in forestry work (2 h). Factors of working environment. Working conditions as sources of hazards and causes of occupational diseases. Harmful effects of noise and vibration. Ergonomic design of forest work. M- Methodical exercises (1h). The concept of "job rotation". Through concrete examples implementation of the concept for the purpose of eliminating ergonomic risk factors (individual task). L6- Legislative framework of safety in forestry (2 h). Occupational safety and health act. Labour Inspection Act. ILO guidelines for safe forest work. Ordinance on occupational safety and health in forestry. Implementing regulations. M- Methodical exercises (1h). Analysis of certain provisions of the Occupational safety and health act and Ordinance on occupational safety and health in forestry. Risk evaluation. L7- Types of hazards and risk assessment (2 h). Sources and types of hazards in forestry. Mechanical hazards. Chemical hazards. Biological hazards. Risk evaluation. Professional diseases in forestry. M- Methodical exercises (1h). Risk and load assessments for the manual handling of loads at forest works (Individual task). L8- Injuries at work in forestry (2 h). The most common causes of injury and type of injury. Principles of protection and work humanization in forestry. M- Methodical exercises (1h). Forest safety indicators. Calculate general indicators of the level of forest safety (Individual task). L9- General rules for safety work in forestry production (2 h). Misconduct and risky situations. M- Methodical exercises (1 h). Instructions for working safely when felling and cutting trees. Analysis of video material from HŠ Ltd. Zagreb (Individual analysis). L10- Safety work when felling and cutting trees (2 h). Rules for safe felling and cutting

<table>
<tr><td></td><td colspan="9">operations. Technical, health, legal and social aspects of protection. M- Methodical exercises (1h). Evaluation of the chainsaw operator working technique (Preparation for field work).
L11- Safety work in skidding/forwarding operations (2 h). Rules for safe skidding/forwarding operations. Technical, health, legal and social aspects of protection. M- Methodical exercises (1h). Evaluation of the forest operator working technique – machine operator and choker-man (Preparation for field work).
L12- Safety work in silviculture (2 h). Rules for safe silviculture operations. Technical, health, legal and social aspects of protection. M- Methodical exercises (1h). Data processing of field evaluation. Critical points of the working technique. Interpretation of results - (Individual calculation exercise).
L13- Safety work on trees in urban areas (2 h). Safety rules for operation in arboriculture. Technical, health, legal and social aspects of protection. M- Methodical exercises (1h). Expertise of fatal accidents in forest work. Field evidence. Documentation. Reconstruction and conclusion.
L14- Organization of safety at forest work site (2 h). Organization of safety work on forest work site. Obligations of employers, workers and authorized persons. Site reporting. Work site study. M- Methodical exercises (1h). Safety aspect of work within the "temporary work site plan". Risk assessment and implementation of preventive measures (individual assignment).
L15- European processes in the field of forest safety (2 h). Licensing and certification of forest contractor. Training for professional and non-professional forest work. Training and certification of forestry tools and machine operators. M- Methodical exercises (1h). Calculation of injury costs at work (individual assignment).</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>4</td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td></td><td colspan="5">Martinić, I., Landekić, M., 2020: Work safety in forestry (internal collection of presentations for the current academic year)</td><td colspan="2">NO</td><td colspan="2">YES; Merlin</td></tr>
<tr><td></td><td colspan="5">Landekić, M., Martinić, I., Bakarić, M., Ricart, R.M., Šporčić, M., 2017: Vocational training of workers in the forestry sector – the</td><td colspan="2">NO</td><td colspan="2">YES; Hrčak</td></tr>
</table>

	situation in Croatia and trends in Europe. Šumarski list. 141 (7/8), 395-407		
	Landekić, M., 2010: Development of safety responsibility model in the private forestry sector. Nova mehanizacija šumarstva. 31 (2010) ; 45-52	NO	YES; Hrčak
	Hrvatske šume Ltd., 2007: Instructions for safe work when felling and cutting wood.	NO	YES; on line
	The Law on Health and Safety (Official Gazette 96/18); Ordinance on occupational safety in forestry (OG 10/86); Ordinance on safety at work in HŠ Ltd.	NO	YES; on line
2.12. Optional literature	1. Landekić, M., Martinić, I., Šporčić, M., Pentek, T., Poršinsky, T., Bakarić, M., 2018: Current State and Improvement Potential of Forestry Workers Training in Croatia. Croatian journal of forest engineering. 39 (2), 289-298 2. Martinić, I., Landekić, M., Šporčić, M., Lovrić, M., 2011: Forestry at the Doorstep of EU – How Much are We Ready in the Area of Occupational Safety in Forestry?. Croatian journal of forest engineering. 32 (2011) , 1; 431-441 3. Health and Safety Executive, 2013: Chainsaws at work. 16 pp. 4. Jurjević, D. 2007. Sigurnost na radu za poslodavce, ovlaštenike i povjerenike. Biblioteka Zaštite na radu, svezak 15. 5. Kestel, B.R., 2005: Chainsaw operator`s manual – The Safe Use of Chainsaw (6TH Edition). 105 pp. 6. Safety and health in forestry work - An ILO Code of practice. ILO, Geneva1998, str. 1-166 7. Ergonomics Plus. A Step-by-Step Guide to Job Rotation. 20 pp.		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Tibor Pentek, Ph.D Asst. Prof. Ivica Papa, Ph.D Mihael Lovrinčević, mag. ing silv.	1.7. Number of ECTS credits	5
1.2. Course title	Forest roads	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+32
1.3. Course code	33877	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The task and the objective of the subject Forest communications is a transfer of basic knowledge to students about the problematic of forest communications, their role in a forest ecosystem, classification, planning procedures, designing, building and maintenance as the basis for subsequent subjects regarding the same problematic. Also, through exercises and field classes students obtain specific knowledge applicable in practice if they decide for an undergraduate study.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the	B10. apply knowledge about techniques and technology of building forest roads D1. continue perfection on university graduate studies on Forestry section on Faculty of		

programme to which the course contributes	Forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain forest roads, planning and design. Gain knowledge of technical features of secondary forest roads, relative forest opennes, forest roads inventory, conceptual and general project, register of forest road infrastructure. 2. Explain the zero line, operational and axial polygon of forest roads (designing zero lines on forest management map and on the ground, integrating the operational polygon into non-linear forest road polygon). 3. Define the ground plan of the forest road (constructive elements of the forest road, main elements of the horizontal circular curves, detailed positioning plan, profiling the axis of the forest road route). 4. Analyze vertical and normal cross-sections of the forest road (constructive elements of the forest road in the design, incurved and curved grade level, calculation of constituents, leveling of the axis profile of forest road). 5. Explain upper and lower forest road layers (calculation of earth volume, earth volume diagram, evidence of measures – preliminary estimate of works and costs). 6. Explain the construction and maintenance of forest roads / roads (technology of construction on plains and slopes, type of forest road maintenance, secondary forest road).
2.5. Course content (syllabus)	Lectures 1. Forest Roads – introduction. General information on the course Forest Roads. Forest Roads – historical overview, their role in forest management and basic division. 2. Technical features of forest roads – basic terms and definitions, phases of establishing optimal forest road network. 3. Forest road planning – basic terms, definitions and formulas. 4. Primary and secondary forest openness (different systems of opening). 5. Forest road designing, (Part 1). Collecting general data. Selecting forest road routes. Direct pole setting. Indirect pole setting. 6. Designing of forest roads, (Part 2). Main/implementing project design of forest roads – basic constituents. 7. Constructive elements of forest roads. Forest road elements in horizontal and vertical road route and cross section. Horizontal road route of forest road 8. Vertical road route – normal and graphical cross-sections of forest roads. 9. Cross-section; normal cross-section of forest roads. 10. Lower forest road layer, basic terms and definitions. 11. Elements for securing and protecting the lower layer on forest roads. 12. Upper forest road layer, basic terms and definitions. 13. Construction of forest roads using different technologies (on different terrains). 14. Maintenance of forest roads and causes of forest road damage. 15. Preparatory lecture for field classes. Practical exercises 1. Forest roads – introduction into practical exercises. 2. Zero line - calculating zero line inclination, defining dividers' segments. 3. Zero line mapping. 4. Written longitudinal section of forest road, calculating deflection angle and main elements of circular curves. 5. Detailed positioning plan M 1:500, design of deflection angle using the triangle method. 6. Detailed positioning plan M 1:500, setting detailed points of horizontal curve using the method of rectangular coordinates, calculating pavement curve widening. 7. Graphical longitudinal section M 1:1000/100, calculating the slope of incurved grade level. 8. Graphical longitudinal section M 1:1000/100, calculating the height of curved grade level.

<table>
<tr><td></td><td colspan="9">9. Graphical longitudinal section M 1:1000/100, calculating vertical curves.
10. Drawing normal cross-sections.
11. Preparing graphical cross-sections 1:100.
12. Calculating the earth volume mass.
13. Preparing bill of quantities.
14. Preparing cost estimate.
15. Preparing technical report on forest roads.

Field classes
In field classes, students apply the knowledge acquired in lectures and practical exercises on specific examples. Through practical field work, applying the direct method of field survey, students collect all data needed to develop the main/implementing project design of forest roads</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>5</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regularly attend and actively participate in lectures, practical exercises and field classes. Take midterm exams, or written and oral exams.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="3">Title</td><td colspan="3">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td></td><td colspan="3">Pentek, T., 2012: Forest roads (.pptx and .pdf lectures 1-15), Faculty of Forestry, University of Zagreb.</td><td colspan="3">NO</td><td colspan="3">YES; Merlin</td></tr>
<tr><td></td><td colspan="3">Pičman, D., 2007: Forest roads (university textbook), Faculty of Forestry, University of Zagreb, pp 1-460, chosen chapters.</td><td colspan="3">YES</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3">Šikić, D. i dr., 1989: Tehnički uvjeti za gospodarske ceste, Znanstveno vijeće za promet JAZU, Zagreb, pp 1-40, chosen chapters.</td><td colspan="3">YES</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Scientific and professional papers on the subject issues of domestic and foreign authors published in scientific journals and conference proceedings.
2. Potočnik, I., 2007: Gozdne prometnice (university script), Univerza v Ljubljani, Biotehniška fakulteta, s. 1-221.</td></tr>
</table>

	3. Dobre, A., 1994: Gozdne prometnice (university script), Univerza v Ljubljani, Biotehniška fakulteta, s. 1-71. 4. Jeličić, V., 1983: Šumske ceste i putevi (university textbook). SIZ odgoja i usmjerenog obrazovanja šumarstva i drvne industrije SRH, Zagreb, Palmotićeva 17a, 1-193 p.

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Mario Šporčić, Ph.D Asst. Prof. Matija Landekić, Ph.D Prof. Ivan Martinić, Ph.D Matija Bakarić, Ph.D	1.7. Number of ECTS credits	5
1.2. Course title	Organization basics in forestry	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+24
1.3. Course code	33878	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Develop basic knowledge of the organization in operation activity, company and at work site. Master the procedures of studying and evaluating work in forestry and integrating this knowledge into the processes of planning and control, recording and analysis of performance.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	C1. plan and organise time study, work rationalisation, conduct works of organization of production in forestry		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain the study of forestry work (models of study for different levels of application, comparative analysis of existing models). 2. Apply time and work study (features of work study in forestry, main areas and procedures, work design, work value study). 3. Analyze work study methods (current observation method, calculation-analytical method of study, work motion study). 4. Present shaping of organization, organizational structure and types of organizations (organizational design factors and company organizing process, elements and types of organizational structure). 5. Define economic organizations, organization management and organizational changes (types of economic organizations, business processes, governance bodies, sources and organizational change drivers).		
2.5. Course content (syllabus)	Lectures 1. Concept and definition of organization, development of organizational thinking, role and significance of organization. 2. Organization as a practical and scientific discipline - subject and methods of organization, organizational goals and organizational theories (schools). 3. Theoretical and practical principles of organization. 4. Work study in forestry - forms of work and work effect, role and task of work study, models, methods and levels of work study.		

	5. Time study of and work standardization - structure of worktime, tasks, objectives and methods of time study, procedures and requirements for work standardization. 6. Workflow study and work rationalization - tasks and objectives of rationalization, basic principles of rationalization, procedures in work analysis and workplace evaluation. 7. Other methods of work study - calculation-analytical method, current observation method etc. 8. Organizational structure - concept and definition, elements and types of organizational structure. 9. Formation of the organization - factors of organization formation, external and internal. 10. Types of organizations - economic organizations, legal regulation, crafts, trades, types and their characteristics. 11. Business processes and business functions in the organization - production, procurement, sales, finances, developmental function and others. 12. Organization design methodology - basic methods and procedures in examining an existing organization and designing a new organization (enterprise, trade company). 13. Organizational dynamics - sources and drivers of change, market dynamics, new technologies, life expectancy of an organization etc. 14. Organizational culture and conflicts in organization - concept of corporate culture, ethics in business, types and process of conflicts in organization. 15. Organization management - business management, management bodies in economic organizations, managerial styles. Exercises 1. Examples of evidence for adequacy of studying general principles in work and production processes in forestry. 2. Application of the basis for planning the elements of work processes in Croatian forestry. 3. Basics of work time measurement, instruments and methods, reading and recording data, control time and measurement error. 4. Chronometric measurement of working time in main types of forest works (felling and wood processing). 5. Chronometric measurement of working time in main types of forest works (wood hauling). 6. Workflow analysis and analytical workplace assessment. 7. Application of the calculation -analytical method of work studying, example with calculation and task. 8. Application of current observation method, example with calculation and task. 9. Analysis of formal organizational structure of the forestry company (Croatian Forests Ltd). 10. Calculation of planning elements for felling, processing and hauling of wood, simulation of the worksite with calculation of the total working time required and the expected volume of assortments. 11. The role of procurement and evaluation of suppliers from the aspect of organization in forestry, an example with calculation and task. 12. Presentation and analysis of an existing company organization. 13. Designing a new organization's model and means of forming organizing solutions. 14. Case study and analysis of organizational culture of a forestry company. 15. Review of the legality of work processes in wood harvesting researched for the needs of Croatian forestry, examples and tasks. Field work 1. Technical standardization of forestry work – felling and processing of wood 2. Technical standardization of forestry work – wood hauling 3. Forestry office - the basic organizational unit of forestry		
2.6. Format of instruction	☒ lectures	☒ independent	2.7. Comments:

	☐ seminars and workshops ☒ exercises ☐ *online in entirety* ☒ partial e-learning ☒ field work			assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)						
2.8. Monitoring student work	Class attendance	YES		Research		NO	Oral exam	YES		
	Experimental work		NO	Report		NO	(other)			
	Essay		NO	Seminar paper		NO	(other)			
	Preliminary exam	YES		Practical work		NO	(other)			
	Project		NO	Written exam	YES		ECTS credits (total)	5		
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.									
2.10. Student responsibilities	Regular attendance and active participation in lectures, exercises and field work. Taking the colloquia, exam.									

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Žugaj, M., Šehanović, J., Cingula, M., 2004: Organizacija. TIVA Tiskara, Varaždin.	NO	YES
	Sikavica, P., Novak, M., 1999: Poslovna organizacija. Informator, Zagreb.	NO	YES

2.12. Optional literature

1. Žugaj, M., Schatten, M., 2005: Arhitektura suvremenih organizacija. Tonimir, Varaždinske Toplice.
2. Buble. M., 2006: Metodika projektiranja organizacije. Sinergija-nakladništvo d.o.o., Zagreb.
3. Šporčić, M., 2003: Uspostava modela potvrđivanja izvoditelja šumskih radova. Magistarski rad, Šumarski fakultet Sveučilišta u Zagrebu.
4. Šporčić, M., 2007: Ocjena uspješnosti poslovanja organizacijskih cjelina u šumarstvu neparametarskim modelom. Disertacija, Šumarski fakultet Sveučilišta u Zagrebu.
5. Drucker, P.F., 2006: Upravljanje u budućem društvu. M.E.P. Consult, Zagreb.

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Danko Diminić, Ph.D Jelena Kranjec Orlović, Ph.D	1.7. Number of ECTS credits	5
1.2. Course title	Forest Phytophatology	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+16
1.3. Course code	33880	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2

1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	YES
2. COURSE DESCRIPTION			
2.1. Course objectives	Students acquire basic knowledge in the field of plant protection - forest tree pathology. By knowing the most important diseases of certain genera of forest trees, students gain knowledge about the causes of diseases, their symptoms, diseases development, the impact of environmental factors on the host plants and pathogens, and their mutual influence / interaction.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B2. Identify and determine the most important species of harmful insects (insects) and fungi on forest species, determine the defects on wood caused by their action. B3. Adopt the basic principles of forest protection from abiotic and biotic factors, especially fire, and apply basic procedures and means in forest protection. B6. Perform professional field work on the establishment, care and restoration of forest stands.		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain the causes of plant diseases (non-infectious or non-parasitic diseases, infectious or parasitic diseases, morphology, reproduction and classification (systematics) of fungi). 2. Interpret the biology and physiology of fungi (division according to lifestyle, reproduction, diet, specialization, mutual ecological relations among fungi). 3. Explain the pathogenesis and resistance of plants to pathogens (types and sources and process of infection, fungal penetration into the plant, incubation of fructifications, factors of resistance to pathogen penetration, plant reaction to the pathogen). 4. Explain diseases of fruits and seeds and drooping (symptoms of the disease, plant hosts, harmful pathogens, consequences on the health of fruits and seeds and young plants). 5. Analyze diseases of needles and leaves, bark, shoots, branches and trunks of forest trees (disease symptoms, biology and harmfulness of pathogens). 6. Analyze forest tree rot (species of forest tree rot fungi, the most common rot fungi in Croatia, symptoms of disease, biology and harmfulness of pathogens, consequences on the health status of infected trees and their economic value) 7. Interpret damage of anthropogenic and abiotic cause (mechanical damage to the bark during felling and extraction, cracks from frost (winter hardiness), damage from drought, sun wounds). 8. Interpret harmful semi-parasitic plants (most often semi-parasitic flowering plants on forest trees).		
2.5. Course content (syllabus)	Lectures: 1. Explain the causes of plant diseases (non-infectious or non-parasitic diseases, infectious or parasitic diseases, morphology, reproduction and classification (systematics) of fungi). 2. Interpret the biology and physiology of fungi (division according to lifestyle, reproduction, diet, specialization, mutual ecological relations among fungi). 3. Explain the pathogenesis and resistance of plants to pathogens (types and sources and process of infection, fungal penetration into the plant, incubation of fructifications, factors of resistance to pathogen penetration, plant reaction to the pathogen). 4. Explain diseases of fruits and seeds and drooping (symptoms of the disease, plant hosts, harmful pathogens, consequences on the health of fruits and seeds and young plants). 5. Analyze diseases of needles and leaves, bark, shoots, branches and trunks of forest trees (disease symptoms, biology and harmfulness of pathogens). 6. Analyze forest tree rot (species of forest tree rot fungi, the most common rot fungi in Croatia, symptoms of disease, biology and harmfulness of pathogens, consequences on the health status of infected trees and their economic value) 7. Interpret damage of anthropogenic and abiotic cause (mechanical damage to the bark during felling and extraction, cracks from frost (winter hardiness), damage from drought, sun wounds). 8. Interpret harmful semi-parasitic plants (most often semi-parasitic flowering plants on		

<table>
<tr><td></td><td colspan="9">forest trees).

Exercises in the microscopic partikum:
1. Basic structure of fungi: hyphae, mycelium, stroma, sclerotia.
2. Examples of diseases of seeds and young plants.
3. Examples of needle and leaf diseases, appearance and anatomical structure of fruiting bodies and spores.
4. Examples of diseases of the bark of shoots, branches and trunks, appearance and anatomical structure of fruiting bodies and spores.
5. Examples of forest tree rot, appearance and anatomical structure of fruiting bodies and spores.

Field work:
1. Examples of infected trees explain the origin of the infection, the development of the disease and the impact (harmfulness) of the recorded pathogens on the health of trees and the forest ecosystems.
2. The examples of infected trees explain the origin of the infection, the development of the disease and the impact (harmfulness) of the recorded pathogens on the health of trees and the forest ecosystems.
3. Examples of infected trees explain the occurrence of infection, the development of rot and the impact (harmfulness) of recorded pathogens on the health of trees and the forest ecosystems.
4. Examples of infected trees explain the origin of the infection and the impact of pathogens on the health of trees and the forest ecosystems.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>5</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td></td><td colspan="4">Glavaš, M., 1996: Osnove šumarske fitopatologije. Sveučilište u Zagrebu, Šumarski fakultet, 140 pp.</td><td colspan="2">YES</td><td colspan="3">2nd level of application of e-learning</td></tr>
<tr><td></td><td colspan="4">Glavaš, M., 1999: Gljivične bolesti šumskoga drveća. Sveučilište u Zagrebu, Šumarski fakultet, 281 pp.</td><td colspan="2">YES</td><td colspan="3">2nd level of application of e-learning</td></tr>
</table>

	Diminić, D., 2013-2020: Introduction to the phytopathology, fundamental principles in mycology on and important and current (new) diseases of trees and shrubs (presentations of all lectures in PDF format).	NO	2nd level of application of e-learning
2.12. Optional literature	1. Butin, H., 1995: Tree Diseases and Disorders. Oxford University Press, Oxford, 252 pp. 2. Strouts, R.G. & Winter, T.G., 1994: Diagnosis of ill-health in trees. HMSO, London, 307 pp. 3. Glavaš, M. & D. Diminić, 2001: Mikološki kompleks obične jele. U: Prpić, B. (ed.) 2001: Obična jela (Abies alba Mill.) u Hrvatskoj. Akademija šumarskih znanosti, Zagreb, 606–625. 4. Diminić, D., 2003: Gljivične bolesti obične bukve. U: Matić, S. (ed.) 2003: Obična bukva (Fagus sylvatica L.) u Hrvatskoj. Akademija šumarskih znanosti, Zagreb, 549–560. 5. Diminić, D., 2005: Mikoze kore i lišća topola i vrba. U: Vukelić, J. (ed.) 2005: Poplavne šume u Hrvatskoj. Akademija šumarskih znanosti, Zagreb, 390–397. 6. Glavaš, M. & D. Diminić, 2011: Bolesti šumskoga drveća. U: Matić, S. (ed.): Šume hrvatskoga sredozemlja. Akademija šumarskih znanosti, Zagreb, 533-555. 7. Diminić, D., D. Kajba, M. Milotić, I. Andrić, J. Kranjec Orlović, 2017: Suceptibility of Fraxinus angustifolia clones to Hymenoscyphus fraxineus in lowland Croatia. Baltic Forestry 23(1): 233-243. 8. D. Diminić, J. Kranjec Orlović, I. Lukić, M. Ježić, M. Ćurković Perica, M. Pernek, 2019: First Report of Charcoal Disease of Oak (Biscogniauxia mediterranea) on Quercus spp. in Croatia. Plant disease 2019 v		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Asst. Prof. Marko Vucelja, Ph.D Asst. Prof. Milivoj Franjević, Ph.D Asst. Prof. Kristijan Tomljanović, Ph.D	1.7. Number of ECTS credits	2
1.2. Course title	Fundamentals of forest protection	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+0
1.3. Course code	226050	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Acquiring knowledge about the impact of biotic and abiotic harmful factors on the forest in realation to forest management plan, environmental impact and a number of other factors at a given time in space. Introduction to forest protection methods and measures: managemental, biological, chemical, biotechnological and technical. Acquisition of theoretical and practical knowledge on the protection of forest fruits and seeds until ripening, and after that, from insects, fungi and small rodents, and the protection of plants in nurseries.		
2.2. Enrolment			

<table>
<tr><td>requirements and/or entry competences required for the course</td><td colspan="9"></td></tr>
<tr><td>2.3. Learning outcomes at the level of the programme to which the course contributes</td><td colspan="9">B3. acquire basic principles of protection of forests from abiotic and biotic factors, especially fires and apply basic procedures and means in protection of forests
B6. perform professional field works on establishing, caring for, and renewing forest stands</td></tr>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="9">1. Describing forest protection methods (forest management, biology, biotechnical, chemical and mechanical methods).
2. Interpreting the damage caused by abiotic and biotic factors in the forests (abiotic factors (late and early frost, floods, sunburn, abundance, drought, wind, snow, ice, fire), damage from fungal pathogenic organisms, large game and small rodents, also interpreting the protection methods).
3. Describing chemical preparations (chemical plant protection products, substitutes for forest protection).
4. Appliying the protection of forest seeds and young plants.
5. Describing forest fires as a damage cause to forest ecosystems (forest outbreaks and types of forest fires, classification of forests regarding the fire risk levels).</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">The task of the protection is to ensure normal growth and development for plants and forests and to protect them directly from harmful organisms and the influence of abiotic factors. Methods of forest protection include forest-economic, biological, chemical and mechanical measures. By acquiring theoretical and practical knowledge it is noticed how to protect fruits and seeds from insects, fungi and small rodents. Plants in nurseries are exposed to numerous soil and epigean harmful insects, fungi, animals and weeds for which specific knowledge of protection is needed. The complex protection specific for lowland, mountainous and coastal forests becomes significant in forests and forest cultures. Therefore, special material is dealt with for each area.

Lectures:

1. Importance of modern forest protection
2. Diagnosis and prognosis in forest protection
3. Protection methods: managemental, biological, biotechnical chemical, mechanical
4.Abiotic causes of damage
5. Damage prevention measures made by abiotic factors
6. Chemicals in plant protection
7. Damage caused by insects, preventive and repressive measures
8. Damage caused by fungi, preventive and repressive measures
9. Damage caused by wildlife, preventive and repressive measures
10. Weeds and their control, preventive and repressive measures
11.Protection of fruits and seeds
12. Plant protection in nurseries and crops
13. Determining the small rodent abundance, preventive and repressive measures
14. Forest fires, assessment of danger from forest fires
15. Review of legal regulations in forest protection</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="4">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="2">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
</table>

	work								
	Essay		NO	Seminar paper	YES		(other)		
	Preliminary exam	YES		Practical work		NO	(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	2	

2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.		
2.10. Student responsibilities			
2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Glavaš, M., 2011: Osnove zaštite šuma (interna skripta), Šumarski fakultet, Zagreb	NO	E-learning platform "Merlin"
	Bjedov, L., Vucelja, M., Margaletić, J., 2016: Priručnik o glodavcima šuma Hrvatske, 55 str.	NO	E-learning platform "Merlin"
	Vajda, Z., 1973: Nauka o zaštiti šuma. Školska knjiga Zagreb, 482 str.	YES	
2.12. Optional literature	1. Hrašovec, B., 1995: Feromonske klopke – suvremena biotehnička metoda u integralnoj zaštiti šuma od potkornjaka. Šumarski list, 109(1-2): 27-31. 2. Hrašovec, B., Margaletić, J., 1996: Štetnici sjemena i njihov utjecaj na obnovu šuma u Hrvatskoj. Šumarski list, 120(3-4): 101–106. 3. Hrašovec, B., Glavaš, M., Diminić, D., Margaletić, J., 1996: Štetnici i bolesti sjemena hrasta, obične jele, smreke i crnoga bora. U: Sever, S., (ur.), Zaštita šuma i pridobivanje drva, Šumarski fakultet Sveučilišta u Zagrebu i Šumarski institut Jastrebarsko, 35–44. 4. Diminić, D., Glavaš, M., Hrašovec, B., Margaletić, J., 1996: Štetni biotski čimbenici na običnoj jeli i smreci u Gorskom kotaru. U: Sever, S., (ur.), Zaštita šuma i pridobivanje drva, Šumarski fakultet Sveučilišta u Zagrebu i Šumarski institut Jastrebarsko, 1–6. 5. Glavaš, M., Hrašovec, B., Diminić, D., Margaletić, J., 1996: Bolesti i štetnici u šumskim rasadnicima. U: Sever, S., (ur.), Zaštita šuma i pridobivanje drva, Šumarski fakultet Sveučilišta u Zagrebu i Šumarski institut Jastrebarsko, 45–52. 6. Margaletić, J., 1998: Rodents and their harmful effects on Turopoljski lug (Turopolje Grove) and on Croatian forests. Glasnik za šumske pokuse, 35:143–189. 7. Glavaš, M., Margaletić, J., Baltić, M., Vuković, M., 1999: Štete od puhova u šumama Gorskoga kotara od 1972. do 1998. godine. Šumarski list, 123(5-6): 211–216. 8. Glavaš, M., Margaletić, J., 2001: Smeđa pjegavost iglica alepskoga bora i mjere zaštite. U: Matić, S., Krpan A.P.B. & Gračan, J. (ur.), Znanost u potrajnom gospodarenju hrvatskim šumama, Šumarski fakultet Sveučilišta u Zagrebu, Šumarski institut Jastrebarsko i "Hrvatske šume" p.o. Zagreb, 277–284. 9. Pernek, M. 2000: Feromonske klopke u integralnoj zaštiti smrekovih šuma od potkornjaka. Rad Šumarskog instituta. Jastrebarsko. 35(2): 89–100. 10. Margaletić, J., Glavaš, M., 2002: Sitni glodavci u šumskim ekosustavima. Glasilo biljne zaštite, 4: 207–211. 11. Cvetnić, Ž., Margaletić, J., Đikić, M., Glavaš, M., Đikić, D., Špičić, S., Jurić, I., Salajpal, K., 2002: Glodavci kao mogući rezervoari leptospiroze u otvorenim sustavima držanja svinja. U: Đikić, M., Jurić, I. & Kos, F. (ur.), Turopoljska svinja,		

165–172.
12. Margaletić, J., Margaletić, M., 2004: Stabilnost šumskih ekosustava–zalog budućim generacijama. U: Pozaić, V. (ur.), Ekologija (Znanstveno–etičko–teološki upiti i obzori), 41–70.
13. Margaletić, J., Margaletić, M., 2003: Požari u šumi i na šumskom zemljištu kao čimbenici degradacije staništa. Šumarski list, 127(9-10): 475–482.
14. Margaletić, J., Angelovski, K., 2006: Upotreba pesticida u šumarstvu Republike Hrvatske u razdoblju od 2000. do 2004. godine. Zbornik radova seminara "DDD i ZUPP – Bolje smjernice bolji rad", 247–273.
15. Margaletić, J., Jurjević, V., 2007: Kronologija suzbijanja gubara (Lymantria dispar L.) u državnim šumama Republike Hrvatske. Zbornik radova seminara "DDD i ZUPP – 60. obljetnica ustroja suvremene djelatnosti dezinfekcije, dezinsekcije i deratizacije u Republici Hrvatskoj", 403–430.
16. Margaletić, J., Hrašovec, B., Diminić, D., Beuk, A., 2015: Zaštita šuma hrasta lužnjaka (Quercus robur L.) protiv biotičkih štetnika na području Uprave šuma Podružnica Vinkovci u razdoblju od 2009. do 2011. godine. Zbornik radova sa znanstvenog skupa "Proizvodnja hrane i šumarstvo-temelj razvoja istočne Hrvatske", 375–393.
17. Bjedov, L., Vucelja, M., Margaletić, J., 2016: Priručnik o glodavcima šuma Hrvatske, 55 str.
18. Margaletić, J., 2019: Gradacija štetnika u šumama Republike Hrvatske u razdoblju od 2008. do 2017. godine. Zbornik radova seminara "DDD i ZUPP", 293–309.

1. GENERAL INFORMATION			
1.1. Course lecturer(s)		1.7. Number of ECTS credits	2
1.2. Course title	Professional practice	1.8. Number of hours in semester (L+E+F+e-learning)	5 days
1.3. Course code	226051	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the course is to gain experience and insight into the activities of companies that employ forestry engineers in jobs that require the specified profile of experts. Within the course, students will connect the current knowledge acquired during their studies with the performance of specific work tasks related to the part of the profession in which the company is engaged, and learn the importance of developing business responsibility, communication skills and teamwork.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A1-apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data A2-apply skills in solving practical side of buisness, either by control measuring, calculations or testing verification B3-acquire basic principles of protection of forests from abiotic and biotic factors, especially fires and apply basic procedures and means in protection of forests B4-participate in the realization of forest management programs B5-perform works on inventorying forests B6-perform professional field works on establishing, caring for, and renewing forest stands		

<table>
<tr><td></td><td colspan="9">B9-apply knowledge about the forest machines, techniques and standard technologies used in forestry above all in timber harvesting from natural forests, forest cultures and plantations
C3-organise and conduct work safety in forestry
C4-conduct professional works on implementation of wildlife management programs and perform organisation od hunting areas</td></tr>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="9">1. independently and responsibly perform entrusted professional tasks in forestry
2. apply in practice the knowledge and skills necessary to carry out the entrusted tasks
3. apply in practice legal regulations from the forestry sector
4. present professional issues in writing</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">During the implementation of professional practice, the student will, on the basis of a previously defined task, and according to the instructions and under the supervision of a mentor in the company to perform professional forestry work for which he is in charge. When performing professional work, the student will, in accordance with the instructions and in agreement with the mentor in the company, independently study the relevant professional literature, business documentation and legislation in the forestry sector. The results of the completed professional practice will be presented by the student to the mentor at the faculty in the form of a written report.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☐ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☒ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td></td><td>NO</td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>Independent work</td><td>YES</td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td>2</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Perform entrusted professional tasks during the implementation of professional practice. Prepare a written report at the end of the professional practice.</td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="3">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="4">Handbook for conducting professional practice in forestry</td><td colspan="3"></td><td colspan="2">YES</td></tr>
<tr><td colspan="4"></td><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="4"></td><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="4"></td><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="4"></td><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9"></td></tr>
</table>

1. GENERAL INFORMATION			
1.1. Course lecturer(s)		1.7. Number of ECTS credits	8
1.2. Course title	Bachelor thesis	1.8. Number of hours in semester (L+E+F+e-learning)	
1.3. Course code	226052	1.9. Expected enrolment in the course	60
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The bachelor thesisis an independent professional work of an experimental nature or a professional work in which the student, under the guidance and with the help of a mentor, deals with the chosen topic. The topic of the bachelor thesis may be related to interdisciplinary knowledge, if it corresponds to the title and objectives of the bachelor thesis. The preparation of a bachelor thesis of an experimental nature means the student's independent work based on a small-scale research or part of it that the student conducts independently and analyzes, describes and presents the results himself. The bachelor thesis should not contain original views and results. The review bachelor thesis has cognitive value because it gives a complete overview of a problem/topic based on already published papers and studies and requires the study and analysis of relevant literature.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A1-apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data A2-use relevance in maintaining, area and possibilities of basic technical components A3-apply skills in solving practical side of buisness, either by control measuring, calculations or testing verification B1-identify tree species based on morphological characteristics, identify parts and tree shapes and apply theoretical and practical knowledge of commercially indigenous and foreign tree species and shrubs B2-recognise and determine the most important types of xylophages bacteria, insects and funghi on trees species and detect wood defects incurred due to their activity B3-acquire basic principles of protection of forests from abiotic and biotic factors, especially fires and apply basic procedures and means in protection of forests B4-participate in the realization of forest management programs total ects credits 180 B5-perform works on inventorying forests B6-perform professional field works on establishing, caring for, and renewing forest stands B7-perform professional field works in the melioration and management of forest areas in the Mediterranean region B8-collaborate in preparation of ecological studies and spatial plans B9-apply knowledge about the forest machines, techniques and standard technologies used in forestry ? above all in timber harvesting from natural forests, forest cultures and plantations B10-apply knowledge about techniques and technology of building forest roads C1-plan and organise time study, work rationalisation, conduct works of organization of production in forestry C2-organise and conduct sale of timber assortments and timber products C3-organise and conduct work safety in forestry C4-conduct professional works on implementation of wildlife management programs and		
2.4. Expected learning	1. be able to apply existing knowledge to solve professional problems for the selected topic		

<table>
<tr><td>outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="9">of bachelor thesis
2. create a term work plan in accordance with the set deadlines for the preparation of the bachelor thesis by components
3. devise a methodology for writing a professional or review paper
4. apply the methodology of writing a professional or review paper
5. present your bachelor thesis in written and oral form</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">The bachelor thesis is an individual written work based on professional research. It is written in a professional form and implies the time load of students with research work that is equivalent to the value of 8 ECTS. The bachelor thesis is usually prepared during the 6th semester of undergraduate study, and ends with a defense (presentation and answering questions).</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☐ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☐ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☒ laboratory
☒ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td></td><td>NO</td><td>Research</td><td>YES</td><td></td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td>YES</td><td></td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td>8</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Choose the topic and mentor of the bachelor thesis, prepare the bachelor thesis and submit it to the mentor of the bachelor thesis, report the defense of the bachelor thesisand defend the bachelor thesis.</td></tr>
<tr><td rowspan="7">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="5">Ordinance on the preparation and defense of the bachelor thesis</td><td colspan="2"></td><td>website of the Faculty of Forestry and Wood Technology</td></tr>
<tr><td colspan="5">Form ZR-1 Request for approval of the topic and mentor of the bachelor thesis</td><td colspan="2"></td><td>website of the Faculty of Forestry and Wood Technology</td></tr>
<tr><td colspan="5">Instructions on the layout and content of the diploma thesis</td><td colspan="2"></td><td>website of the Faculty of Forestry and Wood Technology</td></tr>
<tr><td colspan="5"></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="5"></td><td colspan="2"></td><td></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9"></td></tr>
</table>

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Sanda Gitt, teacher	1.7. Number of ECTS credits	1
1.2. Course title	Foreign Language-English	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	226053	1.9. Expected enrolment in the course	15
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	- to enable the learner to communicate effectively and appropriately in real life situation, including digital environment -to use English effectively for study purpose across the curriculum - to develop interest in and appreciation of further development - to develop and integrate the use of the four language skills i.e. Reading, Listening, Speaking and Writing - to revise and reinforce structure already learnt		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	Continuous development within the Faculty and participation in various foreign-oriented projects		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• Students will heighten their awareness of correct usage of English grammar in writing and speaking • Students will improve their speaking ability in English both in terms of fluency and comprehensibility • Students will give oral presentations and receive feedback on their performance • Students will increase their reading speed and comprehension of academic articles • Students will strengthen their ability to write academic papers, essays and summaries using the process approach. • Students will read university texts and expand their vocabulary • Students will read for intensive information retrieval and interpretation required by university studies • Students will paraphrase information from outside sources effectively and accurately • Students will summarize information from academic sources, distinguishing between main ideas and details		
2.5. Course content (syllabus)	essons: 1. Introduction to the course (ppt) 2. Unit 1 – No Place Like Home Reading: An inspirational story 3. Revision Language review: Describing trends Dealing with tenses 4. Cultures Listening: Cultural differences Idioms 5. Reading: Culture shock		

<table>
<tr><td></td><td colspan="9">Language review: Advice, obligation and necessity
6.Vocabulary
Climate Change
7. Reading: Amazon Forest
8. Environment Vocabulary
Listening: Helping environmental research
9. Unit 5: An Eye to the Future
10. Deforestation (Forestry Journals)
Vocabulary-Right or wrong
11. Species, Planst, Animals, Trees
12. Grammar: Narrative tenses
National Parks (Exchanging Information)
13. Unit 11: The ends of the Earth
Gheographical Expressions
14.Sustainable Forest Management
15. Presentation, Course Review</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☒ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td></td><td>NO</td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td></td><td></td></tr>
<tr><td colspan="10"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Headway, Upper Intermediate&Advanced</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Forestry Journals_ selected scientific Articles</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="5"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="5"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9"></td></tr>
</table>

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Marijan Grubešić, Ph.D	1.7. Number of ECTS credits	1
1.2. Course title	Manners of game hunting	1.8. Number of hours in	15+0+0

		semester (L+E+F+e-learning)	
1.3. Course code	33882	1.9. Expected enrolment in the course	15
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	YES
2. COURSE DESCRIPTION			
2.1. Course objectives	Students get acquainted with the ways of hunting game, organizing and conducting individual and group hunts. Special emphasis is placed on getting acquainted with hunting rules, hunting safety measures, proper handling of weapons and ammunition, and hunting ethics. Hunting equipment is presented. The legal regulations regulating game hunting in the Republic of Croatia are stated. Through lectures and the use of adequate educational video material, a basis for the application of acquired knowledge in practice is created.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. apply aproach to experimental observing and mathematical modelling, mathematically solving research and practical problems, statistically process, present and analyse data and conclude individually based on analysed data C2. organise and conduct sale of timber assortments and timber products		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Interpret hunting and catching game (individual ways of hunting, group hunting, ways of catching game with traps, ways of catching live game, falconry). 2. Present hunting rules and safety measures, as well as hunting ethics (rules of conduct and safety measures in hunting, treatment of shot or captured game, records of hunting and shot game). 3. Describe hunting clothing and equipment. 4. Organize and lead the hunt		
2.5. Course content (syllabus)	Lectures: 1. Historical development of game hunting 2. Hunting methods I 3. Ways of hunting II 4. Methods and rules of individual hunts I 5. Methods and rules of individual hunts II 6. Methods and rules of group hunting I 7. Methods and rules of group hunting II 8. Safety measures in hunting I 9. Safety measures in hunting II 10. Rules for holding, carrying and handling weapons and ammunition I 11. Rules for holding, carrying and handling weapons and ammunition I 12. Hunting customs and hunting ethics I 13. Hunting customs and hunting ethics II 14. Legislation governing hunting I 15. Legal regulations governing hunting II		
2.6. Format of instruction	☒ lectures ☐ seminars and workshops ☐ exercises ☐ *online in entirety* ☒ partial e-learning	☐ independent assignments ☒ multimedia and the internet ☐ laboratory ☐ work with mentor	2.7. Comments:

	☐ field work			☐ (other)					
2.8. Monitoring student work	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work		NO	Report	YES		(other)		
	Essay		NO	Seminar paper	YES		(other)		
	Preliminary exam		NO	Practical work		NO	(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	1	
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities									

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Mustapić, Z., i suradnici., 2004: LOVSTVO priručnik. Hrvatski lovački savez Zagreb, 597 str.	YES	
	Andrašić, D., 1984: Zoologija divljači i lovna tehnologija. Skripta, Sveučilište u Zagrebu Šumarski fakultet, Zagreb, 294 str.	YES	
	Grubešić, M., Vnučec, Z., Gorišek, R., 2016: Sigurnost u lovu. Hrvatski lovački savez (brošura)	YES	
2.12. Optional literature	Grupa autora: 1967: Lovački priručnik, Lovačka knjiga Zagreb, 704 str.		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Danko Diminić, Ph.D	1.7. Number of ECTS credits	1
1.2. Course title	Forest Mushrooms	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33833	1.9. Expected enrolment in the course	15
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	YES
2. COURSE DESCRIPTION			
2.1. Course objectives	Students acquire basic knowledge of the most important species of fungi in our forest ecosystems and their characteristics and role (mycorrhizal, saprotrophic and parasitic species). Students acquire knowledge about the methods of recognizing certain species and their value with gastronomic points of view, the degree of their toxicity.		
2.2. Enrolment requirements and/or			

<table>
<tr><td>entry competences required for the course</td><td colspan="10"></td></tr>
<tr><td>2.3. Learning outcomes at the level of the programme to which the course contributes</td><td colspan="10">B2. Identify and determine the most important species of harmful insects (insects) and fungi on forest species, ie determine the defects on wood caused by their action.</td></tr>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="10">1. Describe fungi as eukaryotic organisms. Explain and explain the role and systematics of fungi. Expose and interpret mycorrhizae (ecto- and endomycorrhiza). Survive and connect fungal habitats and substrates.
2. Describe, enumerate and distinguish the characteristics of fungal fruiting bodies important for identification. Describe and identify the characteristics of mushroom caps and hymenophores. Describe and recognize the characteristics of the stalk and the sheath and their origins. Explain the significance of the color of the spores in the mass for identification. Describe and recognize the characteristics of hymen and spores in ascomycetes and basidiomycetes. Describe, recognize and expose the importance of sterile elements of hymen in basidiomycetes. Explain, describe and list the anatomical and histological features of the ovary. Explain and explain other characteristics and chemical reactions in fungi and their importance in identification.
3. State the chemical composition of the fungus. Describe and list the medicinal properties of mushrooms. Expose and interpret toxins in fungi, their harmful effects on human health, or the symptoms they can cause, and possible methods of treatment.</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="10">Lectures:
1. Fungi as eukaryotic organisms; the role of fungi; classification (systematics) of fungi; mycorrhiza (ecto- and endomycorrhiza); habitat and substrate of fungi.
2. Characteristics of fungal fruiting bodies important for identification. Chemical reactions in fungal identification; other features used in the identification of fungi; analysis of samples in fungal identification.
3. Chemical composition of fungi; medicinal properties of mushrooms; fungal toxins: cellular toxins; neurotoxins; digestive intoxications; conditional poisoning.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="4">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td>1</td><td></td></tr>
<tr><td colspan="10"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="10">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="10"></td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="3">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
</table>

	Usčuplić, M., 2004: Svijet gljiva. Akademija nauka i umjetnosti Bosne i Hercegovine, Sarajevo, 243 pp.	YES	
	Božac, R., 1989: Gljive naših krajeva. Grafički zavod Hrvatske, Zagreb, 399 pp.	YES	
	Glavaš, M., 1999: Gljivične bolesti šumskoga drveća. Sveučilište u Zagrebu, Šumarski fakultet, 281 pp.	YES	
	Diminić, D., 2016: Forest mushrooms (presentation of lectures in PDF).	NO	2nd level of application of e-learning
2.12. Optional literature	1. Garnweidner, E., 1990: Gljive - džepni gljivarski vodič. Cankarjeva založba, Ljubljana - Zagreb, 255 pp. 2. Tortić, M., 1966: O rasprostranjenosti gljiva u Gorskom kotaru. Acta Botanica Croatica, 25, 21–33. 3. Tortić, M., 1966: Makromiceti Gorskoga kotara I. Acta Botanica Croatica, 25, 35–50. 4. Glavaš, M. & Diminić, D., 2001: Mikološki kompleks obične jele. U: Prpić, B. (ed.) 2001: Obična jela (Abies alba Mill.) u Hrvatskoj. Akademija šumarskih znanosti, Zagreb, 606–625. 5. Glavaš, M. & D. Diminić, 2011: Bolesti šumskoga drveća. U: Matić, S. (ed.): Šume hrvatskoga sredozemlja. Akademija šumarskih znanosti, Zagreb, 533-555.		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Marilena Idžojtić, Ph.D Asst Prof. Igor Poljak, Ph.D	1.7. Number of ECTS credits	1
1.2. Course title	Ornamental Dendrology	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33883	1.9. Expected enrolment in the course	15
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The students acquire theoretical and practical knowledge about the ornamental dendroflora in Croatia. The theoretical knowledge includes biological features, morphological characteristics, intra-species variability (with special emphasis on cultivars), natural range, special characteristics, as well as the horticultural importance of species. Practically, the students acquire the ability to recognize the most important ornamental woody species on the basis of different morphological characteristics.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. Identify woody species according to morphological characteristics, identify parts and shapes of trees and apply theoretical knowledge about economically important authothonous and alohthonous tree and shrub species.		
2.4. Expected learning	To use International Code of Nomenclature for Cultivated Plants;		

outcomes at the level of the course (3 to 10 learning outcomes)	To categorise the most common ornamental species and cultivars of gymnosperms and angiosperms according to morphological characteristics and horticultural importance in Croatia, using a plant list and literature; To choose the most common ornamental species and cultivars of gymnosperms and angiosperms for various purpose in urban forestry and horticulture, using a plant list and literature;
2.5. Course content (syllabus)	Lectures: 1. International Code of Nomenclature for Cultivated Plants. Horticultural importance of Pinaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 2. Horticultural importance of Taxodiaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 3. Horticultural importance of Cupressaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 4. Horticultural importance of Araucariaceae, Taxaceae and Cephalotaxaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 5. Horticultural importance of Magnoliaceae, Calycanthaceae, Ranunculaceae and Berberidaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 6. Horticultural importance of Platanaceae, Hamamelidaceae, Ulmaceae and Moraceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 7. Horticultural importance of Fagaceae and Betulaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 8. Horticultural importance of Nyctaginaceaee, Paeoniaceae, Theaceae, Tiliaceae and Malvaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 9. Horticultural importance of Salicaceae, Ericaceae and Hydrangeaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 10. Horticultural importance of Rosaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 11. Horticultural importance of Mimosaceae, Caesalpiniaceae, Fabaceae and Myrtaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 12. Horticultural importance of Cornaceae, Celastraceae, Aquifoliaceae, Buxaceae, Sapindaceae and Hippocastanaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 13. Horticultural importance of Aceraceae, Anacardiaceae, Rutaceae, Araliaceae and Apocynaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera. 14. Horticultural importance of Lamiaceae, Buddlejaceae, Oleaceae and Bignoniaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars

<table>
<tr><td></td><td colspan="9">within these genera.
15. Horticultural importance of Caprifoliaceae, Asteraceae, Arecaceae and Agavaceae genera. Biological features, morphological characteristics and distribution of ornamental species within these genera not included in the Dendrology course. Ornamental cultivars within these genera.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td>1</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance at lectures. Passing final exam.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td>Availability via other media</td></tr>
<tr><td></td><td colspan="5">Idžojtić, M., 2005: Listopadno drveće i grmlje u zimskom razdoblju. Šumarski fakultet Sveučilišta u Zagrebu. 256 pp.</td><td colspan="2">YES</td><td></td></tr>
<tr><td></td><td colspan="5">Idžojtić, M., 2009: Dendrologija – List. Šumarski fakultet Sveučilišta u Zagrebu. 904 pp.</td><td colspan="2">YES</td><td></td></tr>
<tr><td></td><td colspan="5">Idžojtić, M., 2013: Dendrologija – Cvijet, češer, plod, sjeme. Šumarski fakultet Sveučilišta u Zagrebu. 672 pp.</td><td colspan="2">YES</td><td></td></tr>
<tr><td></td><td colspan="5"></td><td colspan="2"></td><td></td></tr>
<tr><td></td><td colspan="5"></td><td colspan="2"></td><td></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Bärtles, A., Schmidt, P.A., 2014: Enzyklopädie der Gartengehölze. Verlag Eugen Ulmer, Stuttgart.
2. Brickell, C. (Ed.), 2003: RHS A-Z encyclopedia of garden plants, Vol. I-II. Dorling Kindersley, London.
3. Cullen, J., Knees, S.G., Cubey, H.S. (Eds.), 2011: The European garden flora flowering plants: a manual for the identification of plants cultivated in Europe, both out-of-doors and under glass. Vol. I-V. Second edition. Cambridge University Press.
4. Dirr, M.A., 2011: Dirr's encyclopedia of trees and shrubs. Timber Press.
5. Farjon, A., 2010: A handbook of the world's conifers. Vol. I-II. Brill, Leiden.
6. Fiala, J.L., 2008: Liliacs – a gardener's encyclopedia. Timber Press, Portland, London.
7. Fitschen, J., 2007: Gehölzflora. Quelle und Meyer Verlag, Wiebelsheim.
8. Fryer, J., Hylmö, B., 2009: Cotoneasters: a comprehensive guide to shrubs for flowers, fruit, and foliage. Timber Press, Portland & London.</td></tr>
</table>

	9. Galle, F.C., 1997: Hollies: the genus Ilex. Timber Press, Portland. 10. Gooch, R., Gooch, J., 2011: Clematis – an essential guide. The Crowood Press Ltd., Wiltshire. 11. Idžojtić, 2019: Dendrology: Cones, Flowers, Fruits and Seeds. Elsevier – Academic Press, London, San Diego, Cambridge, Oxford. 12. Krüssmann, G., 1972: Handbuch der Nadelgehölze. Verlag Paul Parey, Berlin und Hamburg. 13. Krüssmann, G., 1976: Handbuch der Laubgehölze. Band I-III. Verlag Paul Parey, Berlin und Hamburg. 14. Lis-Balchin, M. (Ed.), 2002: Lavender: The genus Lavandula. Taylor & Francis, London. 15. Quest-Ritson, C., Quest-Ritson, B., 2003: The Royal Horticultiral Society encyclopedia of roses. Dorling Kindersley Ltd., London. 16. Roloff, A., Bärtels, A., 2008: Flora der Gehölze. Bestimmung, Eigenschaften und Verwendung. Eugen Ulmer KG, Stuttgart. 17. van Gelderen, D.M., de Jong, P.C., Oterdoom, H.J., 1994: Maples of the world. Timber Press, Portland, Oregon. 18. van Gelderen, D.M., van Hoey Smith, J.R.P., 1996: Conifers: The illustrated encyclopedia. Timber Press, Portland, Oregon. 19. Vertrees, J.D., 2001: Japanese maples. Timber Press, Portland.

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Željko Španjol, Ph.D Asst Prof. Roman Rosavec, Ph.D	1.7. Number of ECTS credits	1
1.2. Course title	Fires of open space	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	73817	1.9. Expected enrolment in the course	15
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Interpretation of forest fires Knowledge of fire of open space management Analyze the location, time and manner of fires of open space		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B3. acquire basic principles of protection of forests from abiotic and biotic factors, especially fires and apply basic procedures and means in protection of forests B7. perform professional field works in the melioration and management of forest areas in the Mediterranean region		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Identify the relevance and relevance of the subject matter, consider previous experience at the national and international levels, identify and recognize implementation in similar legal frameworks. Identify the key factors of open space fire, summarize and correlate the importance of the occurrence factors, differentiate between flammability, fuel and moisture content factors. Group firefighting techniques, adapt firefighting systems, describe ways and forms of propaganda		
2.5. Course content (syllabus)	1. Over the last few years there has been an increase in the number of open fire and burned areas in the wider Mediterranean, and also in our country.		

<table>
<tr><td></td><td colspan="9">2. Open-air fireplaces largely prevent the protection of the forest ecosystem, which is closely linked to biodiversity and sustained sustainable development.
3. Improvement of prevention methods and combating forest fires makes it possible to significantly reduce burnt forest areas.
4. Knowing the factors that cause the fires as well as the factors that cause the initial spread of the fire is essential for the preparation and conduct of preventive activities.
5. One of the most important preventive measures is knowledge of the characteristics of forest fuels, primarily their combustibility, fuel and moisture content.
6. The purpose of the course is to familiarize students with the basic settings of the mentioned problem.
7. The envisaged teaching units are the basic prerequisites for a good understanding and knowledge of the open space fire.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td>1</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td></td><td colspan="5">Bertović, S. i dr. (1987): Osnove zaštite šuma od požara, Zagreb</td><td colspan="2"></td><td colspan="2"></td></tr>
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<tr><td></td><td colspan="5"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td></td><td colspan="5"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">•Barčić, D. & Španjol, Ž. (2001): Sukcesija vegetacije na požarištima kultura alepskog bora (Pinus halepensis Mill.) u šumariji Pula. Znanost u potrajnom gospodarenju hrvatskim šumama, Šumarski fakultet Sveučilišta u Zagrebu. Šumarski institut Jastrebarsko: 19-29, Zagreb.
•Dimitrov, T. (1994): Šumski požari u priobalnom dijelu Jadrana s otocima tijekom 1994. godine. Izvanr. meteorol. hidrol. prilike Hrvat. 18, 121-125, Zagreb.
•Dimitrov, T. (1994): Biološki parametri prikladni za poboljšanje indeksa opasnosti od šumskih požara. Šumarski list, CXVIII (3-4): 105-113, Zagreb.</td></tr>
</table>

	•Dimitrov, T. (1996): Kratak prikaz razvoja kanadskoga sustava procjene opasnosti od šumskog požara (CFFDRS) i mogućnost primjene u našoj zemlji. Šumarski list, CXX, 5-6: 267-273, Zagreb. •Dimitrov, T (2000): Budući šumski požari u odnosu na globalno zatopljenje. Šumarski list, CXXIV, (3-4): 203-209, Zagreb •Gaži-Boskova, V. & Šegulja, N. (1978): Prilog poznavanju promjena vegetacije izazvanih požarom. Šumarski list, CII, (11-12): 477-488, Zagreb. •Martinović, J. (1978): Utjecaj požara vegetacije na tlo i ishranu šumskog drveća. Šumarski list (3-4): 139-148, Zagreb. •Španjol Ž. (1997): sanacija požarišta sastojina alepskog bora (Pinus halepensis Mill.) u makarskom primorju. Glas. šum. pokuse 34: 67-93, Zagreb. •Španjol, Ž. & Barčić, D. (2001): Biološka sanacija šumskih požara u sastojinama crnog bora (Pinus nigra Arnold) – Šumarija Senj. Znanost u potrajnom gospodarenju hrvatskim šumama, Šumarski fakultet Sveučilišta u Zagrebu. Šumarski institut Jastrebarsko: 141-152, Zagreb. •Trinajstić, I. (1993): problem sukcesije vegetacije na požarištima alepskog bora (Pinus halepensis Mill.) u Hrvatskom primorju. Šumarski list CXVII (3-5): 131-137, Zagreb. •Španjol Ž. (1996): Prilog poznavanju šumskih požara u sastojinama alepskog bora (Pinus halepensis Mill.). Unapređenje proizvodnje biomase šumskih ekosustava, Šumarski fakultet Sveučilišta u Zagrebu. Šumarski institut Jastrebarsko, Knjiga 1: 391-412, Zagreb.

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Saša Bogdan, Ph.D Asst. Prof. Ida Katičić Bogdan, Ph.D	1.7. Number of ECTS credits	1
1.2. Course title	Management of forest genetics resources	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	73818	1.9. Expected enrolment in the course	15
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Interpretation of the theoretical settings for conservation of genetic diversity of forest trees. To interpret the importance of genetic diversity in forest management. Selection and application of in situ and ex situ conservation of genetic diversity of forest trees. Knowledge on relevant legislation.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B4. participate in the realization of forest management programs B6. perform professional field works on establishing, caring for, and renewing forest stands B8. collaborate in preparation of ecological studies and spatial plans		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. To explain and to distinguish categories of forest genetic resources; 2. To explain the basic methods and procedures for conservation of genetic diversity of forest trees; 3. To identify key legal acts, rules and subjects in the field of conservation of genetic diversity of forest trees. 4. To discuss the current understanding of the impact of various management interventions on the genetic diversity of forest trees;		

<table>
<tr><td></td><td colspan="9">5. To apply practical recommendations for good forest management practices.</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">Lectures:
1. Concepts of biological and genetic diversity.
2. Methods of determining genetic diversity by genetic testing.
3. Methods of determining genetic diversity by genetic testing II.
4. Methods of determining genetic diversity using DNA markers.
5. Methods of determining genetic diversity using DNA markers II.
6. Factors shaping genetic diversity (mutations, gene migrations).
7. Factors shaping genetic diversity (selection, genetic drift, inbreeding).
8. Geographical variability of forest trees (provenances, races, ecotypes, ecoclines).
9. Spatial genetic variability at the population (stand) level.
10. Temporal changes in the genetic diversity of forest trees.
11. Effective population size, population sustainability analysis, minimum viable population.
12. Legal regulation on biodiversity.
13. Methods of in situ conservation of genetic diversity.
14. Ex situ methods of conservation of genetic diversity.
15. Management of genetic conservation units (seed stands, clonal archives, genetic banks</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td>1</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="4">Bogdan, S. and I. Katičić Bogdan, 2016. Genetics and breeding of trees and shrubs. Internal peer-reviewed script. 224. p. (selected chapters)</td><td colspan="2">NO</td><td colspan="3">YES, MERLIN</td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">Young, A., Boshier, D., Boyle, T. 2000. Forest Conservation Genetics: Principles and</td></tr>
</table>

	Practice. CABI. 368 str. Frankham, R., Ballou J.D., Briscoe, D.A., 2002. Introduction to Conservation Genetics. Cambridge University Press. 640 str. Oudraogo, A.S., Palmberg-Lerche, C. J., Turok, J., Skroppa, T., 1998.Conservation of Forest Genetic Resources in Europe. International Plant Genetics Research Institute. Forest Genetic Resources Conservation and Management: In Managed Natural Forests and Protected Areas (in Situ). International Plant Genetics Research Institute (2002).

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Asst. Prof. Kristijan Tomljanović, Ph.D	1.7. Number of ECTS credits	1
1.2. Course title	Animal physiology	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	226056	1.9. Expected enrolment in the course	15
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	During the course, through fifteen thematic units, students get acquainted with the basics of physiology of birds and higher mammals, organ functions, physical and chemical processes within cells, senses and the influence of the external environment on the basic functions of organisms. The specifics of individual physiological processes important for omnivorae, carnivorae and herbivorae are discussed.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A3 apply skills in solving practical side of buisness, either by control measuring, calculations or testing verification B8. collaborate in preparation of ecological studies and spatial plans C1. plan and organise time study, work rationalisation, conduct works of organization of production in forestry D1. continue perfection on university graduate studies on Forestry section on Faculty of Foresty		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain the basics of basic cellular and intercellular processes 2. Interpret the processes of growth and development of animal organisms, metabolism and external influences 3. Explain the specifics of digestion and metabolic processes of certain groups of higher mammals (ruminants, omnivores, carnivores) 4. Explain the basic physiology of birds (breathing, flight, moulting) 5. Introduction to the physiology of growth and development of horns in full-horned and hollow-horned		
2.5. Course content (syllabus)	Weekly curriculum: 1. P - Introduction to animal physiology (1 h) 2. P - Cellular and intercellular activity, metabolism (1 h) 3. P - Biochemical processes (1 h) 4. P - Nervous systems of birds and mammals (1 h) 5. P - Environmental impact and senses 6. P - Functions of bird and mammalian organs (1 h) 7. P - Oxidative processes, nutrition and respiration (1 h)		

	8. P - Metabolism of herbivores (1 h) 9. P - Metabolism of omnivores (1 h) 10. P - Metabolism of carnivorae (1 h) 11. P - Photoperiodism of birds and mammals (1 h) 12. P - Regeneration, reparation and reproduction (1 h) 13. P - Physiology of growth and development of horns of full-horned and hollow-horned (1 h) 14. P - Habitat adaptations, migrations (1 h) 15. P - Disorders of physiological functions (1 h)

2.6. Format of instruction	☒ lectures ☐ seminars and workshops ☐ exercises ☐ *online in entirety* ☒ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:

2.8. Monitoring student work									
	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work		NO	Report		NO	(other)		
	Essay		NO	Seminar paper	YES		(other)		
	Preliminary exam		No	Practical work		NO	(other)		
	Project		NO	Written exam		NO	ECTS credits (total)	1	

2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.
2.10. Student responsibilities	

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Moyes, C. D., Schulte, P. M. 2006: Principles of Animal Physiology, 2nd Edition		YES
	Sherwood, L. Klandorf, H., Yancey, P. 2012: Animal Physiology: From Genes to Organisms 2nd Edition		YES

2.12. Optional literature	Hill, R., Wyse, G. A., Anderson, M. 2016: Animal Physiology 4th Edition

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Željko Škvorc, Ph.D, Assoc. Prof. Daniel Krstonošić, Ph.D,	1.7. Number of ECTS credits	1
1.2. Course title	Melliferous herbaceous plants	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0

1.3. Course code	226059	1.9. Expected enrolment in the course	15
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	Students get acquainted with the general and specific characteristics of melliferous herbaceous plants (systematic affiliation, biological and morphological characteristics, ecological requirements, distribution in Croatia, etc.). In addition, they get acquainted with the basics of apiculture and the possibilities of growing melliferous plants.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B4. participate in the implementation of forest management programs B6. perform professional field work on the establishment, care and restoration of forest stands B7. perform professional work on land reclamation and management of forest areas in the Mediterranean area
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. To know the most important melliferous herbaceous plant species. 2. To define and explain the characteristics of melliferous herbaceous plant species (their systematic affiliation, phenology, biological and morphological characteristics, ecological requirements and distribution in Croatia). 3. To explain the role of honey species in the ecosystem and the possibilities of their cultivation.
2.5. Course content (syllabus)	1. Introduction to the course. General characteristics of melliferous herbaceous plants. Pollen. 2. Apiculture and honey production. 3. Melliferous species from the family Rosaceae. 4. Melliferous species from the family Brassicaceae. 5. Melliferous species from the family Fabaceae. 6. Melliferous species from the family Asteraceae. 7. Melliferous species from the family Lamiaceae. 8. Melliferous species as a part of an ecosystem 9. Possibilities of cultivation of melliferous plants. Sowing of Melliferous plants.
2.6. Format of instruction	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *online in entirety* ☐ partial e-learning ☐ field work ☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)
2.7. Comments:	

2.8. Monitoring student work									
	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work		NO	Report	YES		(other)		
	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam		NO	Practical work		NO	(other)		
	Project		NO	Written exam		NO	ECTS credits (total)	1	

2.9. Assessment methods	Assessment is conducted in accordance with Assessment methods and criteria for the

and criteria	current academic year.		
2.10. Student responsibilities	Regular class attendance.		
2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Bačić, T., Sabo, M., 2007: Najvažnije medonosne biljke u Hrvatskoj. Grafika d. o. o., Osijek.	YES	
	Bučar, M., 2008: Medonosno bilje kontinentalne Hrvatske. Matica hrvatska Petrinja.	YES	
2.12. Optional literature	Šimić, F., 1980: Naše medonosno bilje. Znanje. Zagreb. Tucak, Z., Bačić, T., Horvat, S., Puškadija, Z., 1999: Pčelarstvo. Poljoprivredni fakultet, Osijek. Umeljić, V., 2004: U svijetu cvijeća i pčela – atlas medonosnog bilja 1, Nakladnik Ilija Borković. Laktić, Z., Šekulja D., 2008: Suvremeno pčelarstvo. Nakladni zavod Globus. Zagreb.		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Renata Pernar, Ph.D Asst. Prof. Mario Ančić, Ph.D	1.7. Number of ECTS credits	1
1.2. Course title	Basics of digital cartography	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	226061	1.9. Expected enrolment in the course	15
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Briefly introduce students with the latest achievements in the field of digital cartography in our country and in the world, theoretical foundations, and possibilities of application in forestry (ecology, silviculture, management and forest protection, wildlife management,…), and urban forestry, nature and environmental protection.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A1.independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem anlysed in different ways B2.establish forest management programs and wildlife management programs B9.prepare ecological studies and forestry parts of spatial plans B15.develop current technologies as well as implement new technologies D4.professionally and scientifically upgrade through different educational ways and postgraduate study		

<table>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="9">1. Describe the goals and tasks of digital cartography.
2. Categorize types and forms of data.
3. Pronounce the term of cartographic generalization.
4. Compare and analyze vector and raster digitalization.
5. Explain and show the georeferencing and orthorectifying procedure.
6. List the basic elements and characteristics of the map.
7. Combine a topographic, thematic map with a digital relief model and a digital orthophoto.
8. Present a database editing and performing various searching with a purpose to obtain a new digital cartographic layer.</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">Lectures:

1.Definition, goals and tasks of digital cartography
2.Cartographic data, equipment and software support, advantages and disadvantages of digital cartography
3.Types and forms of data (geometric, graphic, attributive)
4.Models of data (vector, raster)
5.Types of maps, topographic and thematic maps
6.Basic elements and characteristics of the map (spatiality, measurability, modeling, accuracy, ...)
7.Components of the map - external or formal part, internal or content part of the map
8.Map making processes, cartographic generalization, scale, minimum size, map purpose and geographic features of space
9.Sources and procedures of collecting data for creating thematic maps
10.Digitalization procedure, manual - vector and automatic - raster digitalization
11.Georeferencing, orthorectifying
12.Cartography and GIS, connection between cartography and GIS
13.Application of remote sensings in cartography
14.Map updates based on methods of RS, creating orthophoto plans
15.Data sources for DRM creation, ways of making and visualizing DMRs, application in forestry</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td>1</td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9"></td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
</table>

	Frančula, N. (2004): Digitalna kartografija, 3. prošireno izdanje. Sveučilište u Zagrebu Geodetski fakultet. 211 str.	NO	YES
	Pernar R. (2019): Lecture presentations	NO	YES
	Frančula, N. (2003.): Kartografska generalizacija. Geodetski fakultet, Sveučilište u Zagrebu, Zagreb, 117 str.	NO	YES
	Falkner, E. & Morgan, D. (2001): Aerial Mapping: Methods and Applications. Lewis Publisher, USA, 192 str.	NO	YES
2.12. Optional literature	1. Ključanin, S., Poslončec-Petrić, V., Bačić, Ž. (2018): Osnove infrastrukture prostornih podataka, 166 str. 2. Andričević R., H. Gotovac, I. Ljubenkov, 2007: GEOSTATISTIKA: umijeće prostorne analize, Udžbenik		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Igor Anić, Ph.D Asst. Prof. Stjepan Mikac, Ph.D	1.7. Number of ECTS credits	1
1.2. Course title	History of Croatian forestry	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	226062	1.9. Expected enrolment in the course	15
1.4. Study programme	Undergraduate Studies in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	3.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The course is conceived on the analysis of the interaction between man and forest throughout the history. It contains lectures including the analyses of literature, documents, maps, sketches and photography. By mastering the programme of this subject, students will learn about the development of forestry profession, education and science in Croatia. They will become acquainted with the basic specialist literature and the manner of its analysis, and will learn to find out how the individual specialist and scientific ways and methods, legislative solutions, and historical circumstances have contributed to the present status of Croatian forests. They will thus learn about the short-term and long-term impacts of the natural and technical forest management approach upon forest status. The tuition is organised through lectures, including a visit to the Croatian Forestry Society		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A2.explain position and trends of forestry proffesion in the country and worldwide		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning	Construct appropriate time intervals from the history of man - to - tree relationships. Link Visual and Mathematical Data Presented in Maps, Tables, Charts, and Other Graphic Views Explaining and Illustrating Information on Geography, Statistics, and Forest Ownership Structure in		

outcomes)	Croatia. Formulate a view on the significance of forests for the development of civilization, especially in the Mediterranean area. Evaluate the provisions of the oldest statutes of our coastal towns where the relationship between the tree and the forest and their consequences is regulated Critically evaluate the influence of the Venetian Republic on the state of the forest in our coast. Valorize the influence of French authorities at the time of the Illyrian provinces on forestry. Compile the timing of constructing events in the development of forestry from 1814 to 1945. To evaluate the meaning of the activities of the Royal Inspectorate for the afforestation of the grazing of the Krajina area - Inspectorate for the afforestation of cliffs, bays and landscaping for the development of forests, forestry and forestry. Build a timeline in the design of events in the development of forestry starting from the end of the Second World War to the independence of the Republic of Croatia. To build the stand on the development of forestry after the independence of the Republic of Croatia by analyzing the factors involved. Critically evaluate the impact of forest law provisions on forestry Create a timeline with the years of the most important events from Croatian forest history. Evaluate the significance of forestry educational institutions for the development of forestry in Croatia. Assess the cause-and-effect relationship between the state of forests and the development of higher education forestry. Evaluate the main professional and scientific discussions on which some of today's forest management methods are based.
2.5. Course content (syllabus)	1. Course concept and tasks: Importance and role of forestry history. The main periods of the human-forest relationship through history. The structure of Croatian forests throughout history. The units of measure in forestry history. 2. History of forestry in Istria: Venetian rule from the beginning of the 15th century to the end of the 18th century, French rule from 1809 to 1816, Austrian rule and Italian rule until 1943, history of the Motovun forest. 3. History of forestry in Kvarner, Croatian Littoral and Dalmatia: the first most important written documents relating to the forest and man's attitude towards the forest, Venetian rule from the beginning of the 15th century to the end of the 18th century, the period of Austrian and French rule until 1816, the period of Austrian rule from 1815 to 1918, the period from 1918 to 1945, the history of the Marjan park-forest. 4. History of forestry in Central and North Croatia: from the 15th century until the development of the Military Border in 1871, the period from 1871 to 1945: state forests, forests of property municipalities, forests of land communities, forests of other forest owners. 5. Forestry of Slavonia and Baranja until 1945, history of pedunculate oak forests. 6. Croatian forestry in the period 1945-1990. 7. Croatian forestry since 1990. 8. Forest laws and their significance for the development of Croatian forestry: from the Forest Order of Maria Theresa in 1769 until today. 9. Historical development of forestry education: School of Agriculture and Forestry in Križevci, Forestry Academy, Faculty of Agriculture and Forestry, Faculty of Forestry, secondary forestry schools. 10. Historical development of forestry science. Origin and development of the Croatian Forestry Institute in Jastrebarsko. Forestry Department at the Institute for Adriatic Cultures and Karst Ammelioration in Split. 11. History of societies: Croatian Forestry Society, Academy of Forestry Sciences, Croatian Chamber of Forestry Engineers and Wood Technology. Journal review: Šumarski list, Glasnik za šumske pokuse, Mehanizacija šumarstva, CROJFE. 12. Characteristics of Croatian forestry development by fields: silviculture, survey and cartography of forests, forest management planning, forest exploitation. 13. Characteristics of Croatian forestry development by fields: forest protection, wildlife management. 14. Important Croatian foresters and their contribution to the development of Croatian forestry science, education and practice.

<table>
<tr><td></td><td colspan="9">15. Forestry museums. Creating a timeline with the years of the most important events in national forestry history.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☒ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td>1</td><td></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Taking exam.</td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Anić, I., 2020: Povijest šumarstva. PP prezentacije predavanja, Sveučilište u Zagrebu, Šumarski fakultet.</td><td colspan="2">NO</td><td colspan="2">YES, MERLIN</td></tr>
<tr><td colspan="5">Piškorić, O., J. Vukelić, 1992: Pregled povijesti hrvatskih šuma i šumarstva. U: Đ. Rauš, J. Dundović (ur.), Šume u Hrvatskoj, Šumarski fakultet i Hrvatske šume p. o. Zagreb, Zagreb, str. 273-290.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Meštrović, Š., S. Matić, V. Topić, 2011: Zakoni, propisi, uredbe i karte u povijesti šuma hrvatskoga Sredozemlja. U: S. Matić (ur.), Šume hrvatskog Sredozemlja, Akademija šumarskih znanosti, Zagreb, str. 25-39.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="5"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Ivančević, V., 2003: 125. obljetnica osnutka Kraljevskog nadzorništva za pošumljenje krasa krajiškog područja – Inspektorata za pošumljavanje krševa, goleti i uređenja bujica u Senju, naše najstarije šumarske krške organizacije, 1878. – 2003. godine. Šumarski list, pos. izd., 127: 3 – 22.
2. Kauders, A., S. Frančišković, 1983: Hrvatska, povijest šumarstva. Šumarska enciklopedija, Zagreb, knjiga, 2, str. 81 – 86.
3. Jedlowski, D., 1975: Venecija i šumarstvo Dalmacije od 15. do 18. stoljeća. Disertacija, Split.
4. Klepac, D., 1996: Stare šume hrasta lužnjaka i njihov doprinos razvoju Hrvatske. U: D. Klepac (ur.), Hrast lužnjak (Quercus robur L.) u Hrvatskoj, HAZU i Hrvatske šume, p.o. Zagreb, Zagreb – Vinkovci, str. 13 – 26.</td></tr>
</table>

5. Klepac, D., 1997: Iz šumarske povijesti Gorskoga kotara u sadašnjost. Hrvatske šume p. o. Zagreb, Zagreb, 236 str.
6. Matić, S., 1990: Šume i šumarstvo Hrvatske – jučer, danas, sutra. Glasnik za šumske pokuse, 26: 35 – 56.
7. Matić, S. (ur.), 1998: Sveučilišna šumarska nastava u Hrvatskoj 1898. – 1998, knjiga druga: Sto godina Sveučilišne šumarske nastave u Hrvatskoj. Šumarski fakultet Sveučilišta u Zagrebu, Zagreb, 709 str.
8. Meštrović, Š. (ur.), 1998: Sveučilišna šumarska nastava u Hrvatskoj 1898. – 1998., knjiga prva: Šumarska nastava 1860. – 1898. na Kraljevskome gospodarskom i šumarskom učilištu u Križevcima. Šumarski fakultet Sveučilišta u Zagrebu, Zagreb, 194 str.
9. Prpić, B., R. Antoljak, O. Piškorić (urednici), 1976: Povijest šumarstva Hrvatske 1876. – 1976. kroz stranice Šumarskog lista. Savez inženjera i tehničara šumarstva i drvne tehnologije Hrvatske, Zagreb, 427 str.
10. Prpić, B., S. Matić, O. Piškorić, M. Stojković, I. Maričević, H. Jakovac, 1996: Hrvatsko šumarsko društvo 1846. – 1996. Hrvatsko šumarsko društvo, Zagreb, 451 str.