Course description

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Dario Baričević, Ph.D. Assist. Prof. Irena Šapić, Ph.D		1.6. Year of the study	1
1.2. Name of the course	Forest vegetation of southeast Europe		1.7. ECTS credits	35
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	30 + 15 + 16(Field Work)
1.4. Study programme (undergraduate, graduate, integrated)	graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2, 20%
2. COUSE DESCRIPTION				
2.1. Course objectives	The objectives of the course are to introduce students with the forest vegetation of southeast Europe, i.e. the basic patterns of vegetation distribution, synecological factors crucial for their arrival, floral composition, and its importance and value. The student will be able to apply all the achieved knowledge in the management of forest ecosystems, on the principles of naturalness, sustainable forest management, ecological balance and biodiversity. They will also acquire the vegetation knowledge necessary for the preparation and application of all relevant ecological studies and other bases for the management of natural and pre-natural ecosystems, monitoring of vegetation and analysis and valorization of area.			
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods **Directed competencies (B)** 1. Develop and implement forest ecosystem management plans and programmes 7. Draft ecological studies and implement ecological forest monitoring			

	13. Improve the existing technology and introduce new technologies **Organizational competencies (C)** **Other competencies (D)** 1. perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Present and interpret the forest vegetation of southeast Europe from the ecological, floro-genetic, syntaxonomic and biogeographical point of view. 2. Classify forest vegetation of southeast Europe into European forest types. 3. Valorize the forest vegetation of southeast Europe in relation to the forest vegetation of the rest of Europe. 4. Valorize forest ecosystems and spatial plans based on knowledge of different forms of vegetation and their floral composition. 5. Implement forest ecosystem management and monitoring programs.
2.5. Course content (syllabus)	Lectures 1. Forest vegetation of southeast Europe - areas, distribution, synecological conditions of arrival. 2. Forest vegetation of southeast Europe - historical development and current state, biodiversity, endangerment and protection. 3. Forest vegetation of southeast Europe - systematic affiliation, connection with other classifications of forest vegetation in Europe (European forest types, EUNIS, NATURA2000, CORINE). 4. Broadleaved evergreen forests - arrival conditions, distribution, mediterranean evergreen oak forests, olive-carob forests, pine forests, other sclerophlyllous forests. 5. Sub-Mediterranean evergreen forests - arrival conditions, distribution, pubescent oak forests with Oriental hornbeam and European hop-hornbeam and other forests of the sub-Mediterranean zone. 6. Thermophilous deciduous forests - arrival conditions, distribution, sessile oak forests, pubescent oak forests, Turkey and Hungarian oak forests, other thermophilous deciduous forests. 7. Mesophytic deciduous forests - arrival conditions, distribution, oak-hornbeam forests (pedunculate oak-hornbeam forest, sessile oak-hornbeam forest). 8. Mesophytic deciduous forests - arrival conditions, distribution, oak-ash forests; lime-oak forests, maple-lime forests, lime forests; ravine and slope forests. 9. Acidophilous oakwoods and mixed oak-birch forests - arrival conditions, distribution, lowland to submountainous forests dominated by acidophilous oaks *Quercus petraea* and *Q. robur,* sessile oak-birch forests. 10. Beech forests - arrival conditions, distribution, Illyrian submountainous beech forests, Moesian submountainous beech forests, Carpathian submountainous beech forests, central European submountainous beech forest. 11. Mountainous beech forests - arrival conditions, distribution, Illyrian mountainous beech forest, Carpathian mountainous beech forests, Moesian mountainous beech forests, oriental beech and hornbeam-oriental beech forests. 12. Mountain fir, beech-fir forests, spruce forests and subalpine beech forests - arrival conditions, distribution, communities of the Illyrian and Moesian zones. 13. Subalpine coniferous forests - arrival conditions, distribution, subalpine spruce forests, mugo pine forests, relict pine forests - area with *Pinus peuce*, area with *Pinus heldreichii*. 14. Floodplain forests - arrival conditions, distribution, riparian forests, fluvial forests, Mediterranean riparian forests. 15. Other lowland forests - arrival conditions, distribution, alder forests, ash forests, pedunculate oak floodplain forests.

	Exercises: 1. Horizontal and vertical classification of vegetation of southeast Europa. Characteristic and distinctive species of higher systematic units. 2. Morphological and ecological characterization of plant species of evergreen forests. 3. Morphological and ecological characteristics of diagnostic species of the sub-Mediterranean forests. 4. Characterization of floral composition of thermophilic deciduous forests. 5. Morphological and ecological characterization of mesophilic deciduous forests - diagnostic species of oak-hornbeam forests. 6. Morphological and ecological characterization of mesophilic deciduous forests - diagnostic species of noble deciduous forests. 7. Morphological and ecological characterization of the floral composition of acidophilic oak forests. 8. Characterization of floral composition of submontane beech forests. 9. Characterization of the floral composition of mountain beech forests. 10. Morphological and ecological characteristics of diagnostic species of altimontan forests. Illyrian and Moesian floral element. 11. Floral composition of subalpine coniferous forests. 12. Floral composition of riparian forest communities. Hydrophilic and hygrophilous species. Characteristic and distinctive species of syntaxons of riparian forests and their characterization. 13. Floral composition of lowland, periodically flooded forest communities; morphological and ecological characterization. Field work (three days): 1. Field introduction to the functioning (synecology, syndinamic, characteristic plant species) and importance of lowland forest ecosystems. 2. Field introduction to the functioning (synecology, syndinamic, characteristic plant species) and importance of mediterranean forest ecosystems. 3. Field introduction to the functioning (synecology, syndynamics, characteristic plant species) and the importance of Dinaric forest ecosystems.
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:	It would be advisable to include field work as a form of teaching.
2.8. Student responsibilities	

2.9. Monitoring student work	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	**YES**	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	YES	NO	(other)	YES	NO

	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	5

	Title	**Number of copies in the library**	**Availability via other media**
2.10. Required literature (available in the library and/or via other media)	Horvat I., Glavac V., Ellenberg H., 1974. Vegetation Südosteuropas. Stuttgart: Gustav Fischer.	Yes.	
	Vukelić, J., 2012: Šumska vegetacija Hrvatske. Sveučilište u Zagrebu Šumarski fakultet i DZZP, 403 p.p.	Yes.	
	Mucina, L. and all. 2016: Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. Applied Vegetation Science 19 (1): 3-264.		Yes, Web.
2.11. Optional literature	Bohn U., Gollub G., Hettwer C., 2000. Map of the natural vegetation of Europe. Bonn: Federal Agency for Nature Conservation. García Herrera J.J., 2002. Mediterranean woodlands. In: Reyero J.M., editor. The Nature of Spain. Spain: Ministerio de Medio Ambiente; pp. 70–85. Jahn G., 1991. Temperate deciduous forests. In: Röhrig E, Ulrich B, editors. Temperate deciduous forests. Amsterdam: Elsevier; pp. 377–502. Mayer H., 1984. Wälder Europas. Stuttgart-New York: Gustav Fischer. Rodwell J., Schaminèe J., Mucina L., Pignatti S., Dring J., Moss D., 2002. The diversity of European vegetation. An overview of phytosociological alliances and their relationships to EUNIS habitat. Wageningen: Landbouw, Naturbeheer en visserij/European Environment Agency. European Environment Agency, 2007: European forest types Categories and types for sustainable forest management reporting and policy. Copenhagen, 111 p.p.		
2.12. Other (as the proposer wishes to add)			

1. GENERAL INFORMATION			
1.1. Course teacher	Prof. Darko Bakšić, PhD	1.6. Year of the study	1
1.2. Name of the course	Forest soils – Properties and Management	1.7. ECTS credits	5
1.3. Associate teachers	Ass. prof. Ivan Perković, PhD Giacomo Mei, PhD	1.8. Type of instruction (number of hours L + E + S + e-learning)	30+15+15

1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	30
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION				
2.1. Course objectives	The aim is to provide a student the complete picture of soil functions in the forest ecosystem. Emphasis is on the essential chemical, physical and biological properties of forest soils as related to forests and forest management. This course will provide knowledge about soil classification systems, characteristics of different soil types, on a sources and possibilities of soil degradation and on a methods of prevention of soil degradation processes, as well as the role of soil in carbon sequestration and evidence-based approaches.			
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods **Directed competencies (B)** 1. Develop and implement forest ecosystem management plans and programmes 2. Develop, organize and implement strategic plans and more complex tasks in forestry 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 4. Organize and implement professional field tasks to establish, cleaning, thinning and regeneration of forest stands 5. Organize and implement works in forest inventory and pruning 7. Draft ecological studies and implement ecological forest monitoring **Organizational competencies (C)** 3. Manage the most complex tasks in all forms of forestry organizations **Other competencies (D)** 1. perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry			
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Analyze the functions of soil. Critically evaluate the functions of soil. Recognize the importance of soil to forestry. 2. Be able to compare soils according to the national and the main international (USDA and WRB) classification systems. Be able to distinguish the properties of different soil types. Be able to assess the soil properties important for fertility. Be able to assess the soil properties critical to susceptibility to adverse effects. 3. Be able to interpret and to describe forest humus forms according to the European Humus Forms Reference Base			

	4. Be able to apply soil mapping in forestry. Compare examples of the application of soil mapping. Introduce the pedogeographical units of Croatian forest ecosystems. 5. Explain the specificity of soil in the management of forest ecosystems in relation to the management of other terrestrial ecosystems. 6. Evaluate another soil type within the soil quality system. Evaluate the nature and relationship of another soil type in forest ecosystems in Croatia. 7. Measure and interpret different soil parameters (soil texture, soil pH, carbonate content, water content, soil nutrients, trace elements, organic carbon). 8. Analyze and interpret the biotic component of the soil with particular attention to pedofauna 9. Compare geogenic and limit values of pollutants in soil. To upgrade the soil taking into account its degradation. To review the harmful effects on soil in forest ecosystems (management influences, influence of forest fire on soil, multipurpose use of forest land, conversion of forest land) and to present measures for its protection. 10. Organize a soil monitoring of forest ecosystems. Compare the status of soil conservation at global, regional and national levels. Implement and regulations on soil conservation.
2.5. Course content (syllabus)	Lectures: 1. The role and importance of soil in terrestrial ecosystems, especially forest ecosystems; forest soils in space and time 2. Minerals in forest soils 3. Organic matter and organisms in forest soils; forest biogeochemistry 4. Physical properties of forest soils 5. Soil solution chemistry and chemical elements in soil 6. Characterization of soils in space and time: soil genesis and soil development; soil morphology 7. Soil classification systems. History of development and principles of soil classification. Soil classification in Croatia. American Soil Classification. WRB soil classification. 8. Humus forms classification systems. From Duchaufour intuition to Zanella approach. 9. Pedofauna as a proxy for understanding the state and dynamics of the soil 10. Soil classification in Croatia: morphology, physiographic properties, management and use of automorphic soils, hydromorphic soils, halomorphic and subaquatic soils. 11. Soil geography. Pedon and elementary soil area. Soil mapping. Pedogeographical features of Croatia. Pedogeographic units of Croatian forest ecosystems. Zoning of the soil on the earth. 12. Soil in the management of terrestrial ecosystems. The soil in spatial planning. Forest soil management - especially in relation to the soil of other terrestrial ecosystems. 13. The productivity of forest soils and land. The valuation of forest soils and land. Soil degradation and protection measures - soil erosion; degradation of soil chemical properties soil compaction. Fire effects on soil. Soil protection and regulations. Monitoring of

<table>
<tr><td></td><td colspan="3">soil.
14. Management of forest soils - impact on carbon sequestration.
15. Evidence-based approaches

Laboratory exercises:
1. Determination of the particle size distribution in mineral soil material (according to ISO 11277)
2. Determination of soil reaction (according to ISO 10390,1994)
3. Determination of carbonate content – volumetric method (according to ISO 10693, 1995)
4. Determination of water content as volume fraction using coring sleeves – gravimetric method (according to ISO 11461, 2001), Determination of water-retention characteristic; Determination of dry bulk density (according to 11272, 1998); Determination of particle size density (according to 11508, 1998); Determination of soil porosity; Determination of air capacity of soil
5. Determination of organic and total carbon (according to ISO 10694, 1995) and total nitrogen (according to ISO 13878, 1998) by dry combustion
6. Determination of effective cation exchange capacity and base saturation level using barium chloride solution (according to ISO 11260
7. Extraction of trace elements soluble in aqua regia (according to ISO 11466, 1995)
8. Determination of macro- and micronutrients in soil by Mehlich-3 method.
9. Determination of the water-retention characteristic (according to ISO 11274, 1998)
10. Soil mesofauna extraction and evaluation (according to Parisi et al. 2005)

Field work:

Characteristic soil associations and their properties in integrated area management (eg forest administrations, managment units, catchment area, protected nature area etc.)
Weighted sampling methodologies of soil mesofauna</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>
<tr><td>2.8. Student responsibilities</td><td colspan="3"></td></tr>
</table>

2.9. Monitoring student work	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	**YES**	NO	Report	**YES**	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	YES	NO	Practical work	YES	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	5	

	Title	Number of copies in the library	Availability via other media
2.10. Required literature (available in the library and/or via other media)	Binkley, D., R. F. Fisher, 2020: Ecology and management of forest soils, fifth edition, Wiley Blackwell		
	Blume, H-P., G. W. Brümmner, H. Fleige, R. Horn, E. Kandeler, I. Kögel-Knabner, R. Kretzschmar, K. Stahr, B-M. Wilke, 2016: Scheffer/Schachtschabel Soil Science, Springer-Verlag Berlin Heidelberg		
	Osman, K. T., 2013: Forest Soils – Properties and Management, Springer Cham Heidelberg New York Dordrecht London		
	Zanella A., B. Jabiol, J.Ponge, G. Sartori, R. de Waal, B. van Delft, U. Graefe, N. Cools, K. Katzensteiner, H. Hager, et al., 2016: European Humus Forms Reference Base - ffhal-00541496v2 | HAL Id : hal-00541496, version 2 DOI : 10.13140/RG.2.1.1944.0801		

2.11. Optional literature	J. Legros, 2013: Major soil groups of the world. Ecology, genesis,properties and classification. CRC press Taylor and Francis Group. Pp. 464 Eash, N.E., T.S. Sauer, D.Dell, E. Odoi, 2016: Soil science simplified. Sixteen edition – Wiley Blackwell ed. – pp. 260 McRae, S.G., 1988: Practical Pedology. Studying soils in the field. Halsted Press. Pp. 253
2.12. Other (as the proposer wishes to add)	Bašić, F., 2013: The Soils of Croatia, Springer Dordrecht Heidelberg New York London European Soil Bureau Network European Commission, 2005: Soil atlas of Europe, Office for Official Publications of the European Communities, L-2995 Luxembourg

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Ivica Tikvić, PhD Assoc. Prof. Damir Ugarković, PhD		1.6. Year of the study	1
1.2. Name of the course	Forest Ecosystems Ecology		1.7. ECTS credits	5
1.3. Associate teachers	Assoc. Prof. Damir Ugarković, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	30 + 15 + 16 (Field work)
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	+ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2., 20%

2. COUSE DESCRIPTION	
2.1. Course objectives	Acquiring knowledge about the main types of organisms in forest ecosystems, their condition and endangerment. Introduction to the life processes of plants, animals and microorganisms and ecological processes that affect them in forest ecosystems. Training for defining ecological problems of endangered species of organisms in forest ecosystems, causes, consequences and measures for their solution or mitigation. Introduction to measures for the protection of endangered organisms and their habitats in forest ecosystems.
2.2. Enrolment requirements and/or entry competences required for the course	Finished undergraduate study in the field of biotechnology or biology.
2.3. Learning outcomes at the level of the programme to which the course contributes	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways **Directed competencies (B)** 1. Develop and implement forest ecosystem management plans and programmes 2. Develop, organize and implement strategic plans and more complex tasks in forestry 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 4. Organize and implement professional field tasks to establish, cleaning, thinning and regeneration of forest stands 6. Organize and implement works to protect forests from abiotic and biotic factors 7. Draft ecological studies and implement ecological forest monitoring 10. Apply knowledge on the main and secondary forestry products and ecosystem services

	Organizational competencies (C) 3. Manage the most complex tasks in all forms of forestry organizations **Other competencies (D)** 1. perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Adopt basic principles for the protection of forest ecosystems against abiotic and biotic factors and apply basic procedures and means for forest ecosystems protection. 2. Participate in the implementation of the forest management program. 3. Perform professional field work on founding, care and restoration of forest stands. 4. Perform professional work on melioration and landscaping of forest areas in the Mediterranean area. 5. Cooperate on the development of ecological studies and spatial plans
2.5. Course content (syllabus)	Lectures 1. Introduction in ecology and sustainability of forests in Europe 2. European forest ecosystem diversity and classification 3. Energy and productivity in forest ecosystems 4. Biogeochemistry, nutrients and limiting factors in forest ecosystems 5. Ecological diversity of European forest ecosystems 6. Floodplain forest ecosystem hydrology 7. Climate and forest ecosystems interactions 8. Biological diversity at individual, population and community level in forest ecosystems 9. Biological relationships in forest ecosystems 10. Phenology of forest trees 11. Microbial activity in the rhizosphere of forest ecosystems 12. Protection of organisms and their habitats in forest ecosystems 13. Forest ecosystem services and functions 14. Monitoring of forest ecosystems 15. Disturbances in forest ecosystems Exercises 1. Description of habitat factors and forest ecosystems 2. Multifunctional forests across Europe 3. Analysis of climate and climatic elements 4. Analysis of deciduous and generative phenophases of forest trees 5. Forest climate analysis and measurement 6. Assessment of tree canopy defoliation - ICP Forest program 7. Protection and improvement of Natura 2000 forest habitats

2.6. Format of instruction:	X lectures X seminars and workshops X 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. Student responsibilities									
2.9. Monitoring student work	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	**YES**	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	**YES**	NO	(other)	YES	NO
	Preliminary exam	YES	NO	Practical work	**YES**	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	5	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Waring, R.H., S.W. Running, 2007. Forest Ecosystems. Elsevier Academic Press, Burlington, USA, p. 420.		
	Mackenzie, A., A. S. Ball, S. R. Virdee, 2001. Ecology. BIOS Scientific Publishers Ltd, p. 339		
	Vilhar, U., E. Beuker, T. Mizunuma, M. Skudnik, F. Lebourgeois, K. Soudani, M. Wilkinson, 2013. Tree phenology. In: Forest Monitoring, M. Ferretti, R. Fischer (eds.), Elsevier, Kidlington, Oxford, UK. P. 169-181.		Merlin
	An overview of the state of biological and landscape diversity of Croatia with the protection strategy and action plans, 2000. Prepared by Jasminka Radović, Zagreb, Ministry of Environmental Protection and Physical Planning, p. 158.	5	
	Prpić B, 2008. Undesirable hydrotechnical impacts upon Croatian floodplain forests. In: Floodplain Forests of the Temperate Zone of Europe, (eds. Emil Klimo). Lesnická Práce, pp 50-65		
	E.P. Odum, 1971. Fundamentals of Ecology. Third Edition, W. B. Saunders company, Philadelpia USA, p. 574.		
	Prpić B., Vratarić P., Seletković Z., 2005. The power of the river as a crucial factor in the genesis and survival of floodplain forests. In: Floodplain Forests in Croatia, (eds. Joso Vukelić). Academy of Forestry Sciences, pp 174-176.		
	J.P. Kimmins, 2004. Forest Ecology: a foundation for sustainable forest management and		

	environmental ethics. Third Edition, Prentice Hall, New Jersey, p. 690.		
	L. Hansson, 1992. Ecological Principles of Nature conservation. Applications in Temperate and boreal Environments. Elsevier Applied Science, p. 436.		
2.11. Optional literature			
2.12. Other (as the proposer wishes to add)			

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Saša Bogdan, PhD Assist. Prof. Ida Katičić Bogdan, PhD		1.6. Year of the study	1
1.2. Name of the course	Forest Genetics		1.7. ECTS credits	5
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	30 + 15 + 0 + 15
1.4. Study programme (undergraduate, graduate, integrated)	graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	3., 20%
2. COUSE DESCRIPTION				
2.1. Course objectives	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, effective population size, inbreeding, evolutionary-adaptation factors and racial differentiation). Interpretation of the polygenic inheritance basics and application of quantitative genetics (set up and analysis of a genetic test). 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	Understanding basics of genetics.			
2.3. Learning outcomes at the	**General competencies (A)**			

level of the programme to which the course contributes	1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods **Directed competencies (B)** 4. Organize and implement professional field tasks to establish, cleaning, thinning and regeneration of forest stands 7. Draft ecological studies and implement ecological forest monitoring **Organizational competencies (C)** **Other competencies (D)** 1. perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. 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. 2. 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. 3. 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. 4. To explain and to distinguish categories of forest genetic resources. 5. To explain the basic methods and procedures for conservation of genetic diversity of forest trees. 6. To identify key legal acts, rules and subjects in the field of conservation of genetic diversity of forest trees. 7. To discuss the current understanding of the impact of various management interventions on the genetic diversity of forest trees. 8. To apply practical recommendations for good forest management practices
2.5. Course content (syllabus)	Lectures: 1. Introduction to population genetics. Population genetic constitution and genetic structure. 2. Hardy-Weinberg's equilibrium, Crossing-over, Inbreeding. 3. Evolutionary-adaptation factors. 4. Effective population size. Genetic markers. 5. Genetic diversity of forest trees - introduction. 6. Introduction to quantitative genetics. Definitions, settings. 7. Genetic testing (provenance test, progeny test). 8. Determination of quantitative genetic parameters. 9. Genotype by environment interaction. 10. Temporal changes in the genetic diversity of forest trees. 11. Population sustainability analysis, minimum viable population. 12. Legislation 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). Exercises: 1. Introduction to molecular biology laboratory (laboratory). 2. Extracting DNA from plant tissue (laboratory). 3. The use of DNA markers (PCR method, electrophoresis) - laboratory. 4. Determination of genetic constitution of a population (practicum). 5. Calculation of the inbreeding coefficient and the inbreeding depression (practicum). 6. Calculation of the effects of evolution/adaptation factors on the genetic composition of a population (practicum). 7. Calculate the effective size of the population (practicum). 8. Calculation of parameters of genetic diversity (practicum). 9. Analysis of quantitative traits. Calculation of genotypic and additive values of individuals (practicum). 10. Designing a genetic test (practicum). 11. Genetic testing (data collection, statistical analysis, calculation of quantitative genetic parameters) - practicum. 12. Genetic testing (determination of racial variability) - practicum. 13. Selection of forest reproductive material based on genetic testing (practicum). 14. Selecting *in situ* methods for forest genetic resources conservation (practicum). 15. Selecting ex *situ* methods for forest genetic resources conservation (practicum).
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. Student responsibilities	

2.9. Monitoring student work									
	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	YES	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	5	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies 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

	Eriksson, G., Ekberg, I., Clapham, D., 2006. An introduction to forest genetics. Second edition. SLU Repro, Uppsala., 186 str.	No	Yes, authors web site
2.11. Optional literature	White, T. L., W. T. Adams, D. B. Neale, 2007: Forest Genetics. Wallingford, UK, Cambridge, CAB International. p682.		
2.12. Other (as the proposer wishes to add)			

1. GENERAL INFORMATION				
1.1. Course teacher	Assoc. Prof. Mislav Vedriš, PhD		1.6. Year of the study	1
1.2. Name of the course	Applied Forest Biometrics		1.7. ECTS credits	4
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	15 + 15 + 0
1.4. Study programme (undergraduate, graduate, integrated)	Graduate (master)		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Mastering and application of adequate statistical methods for data analysis. Theoretical and practical interpretation of own and given results.
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods

<table>
<tr><td></td><td colspan="3">Directed competencies (B)
5. Organize and implement works in forest inventory and pruning
7. Draft ecological studies and implement ecological forest monitoring
Organizational competencies (C)
Other competencies (D)
1. Perform the duties of a scientific and professional associate in scientific research institutions in the field 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. Calculate and interpret basic population parameters (average values and measures of variation)lnosti)
2. Distinguish and apply theoretical distributions on own data
3. Calculate estimators based on sample (arithmetic mean, variance, proportion), calculate confidence intervals and explain them based on central limit theorem
4. Define sample size and type; design sampling plan for populations in forestry
5. Compare differences of arithmetic means and proportions based on samples and test statistical significance using hypothesis testing.
6. Create, analyse and interpret contingency tables by chi-square test.
7. Compare more than two means by ANOVA and nonparametric test (Kruskal – Wallis)
8. Estimate population correlation coefficient by sample and test its statistical significance.
9. Carry out univariate and multivariate regression analysis and interpret obtained results.</td></tr>
<tr><td>9.1. Course content (syllabus)</td><td colspan="3">Descriptive statistics
Theoretical distributions (Binomial, Gauss, Student’s, Fisher’s, Chi-square)
Introduction to inferential statistics (sample - population, central limit theorem, confidence interval)
Collecting data and sampling (defining sample size and type)
Statistical inference (significance testing and comparisons based on samples) – Parametric and nonparametric tests
Using statistical software (Statistica software)
Testing frequency distributions – analysis of contingency tables (chi-square test)
Analysis of variance (ANOVA) – one sided and factorial
Correlation analysis
Regression analysis – univariate and multivariate; linear and non-linear</td></tr>
<tr><td>9.2. 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
☒ computer work (other)</td><td>9.3. Comments:</td></tr>
</table>

9.4. Student responsibilities									
9.5. 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	YES		(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	5	

	Title	Number of copies in the library	Availability via other media
2.10. Required literature (available in the library and/or via other media)	Lecture materials	-	e-learning system
	Sokal R.R, Rohlf F.J. 1995. Biometry. The Principles and Practices of Statistics in Biological Research, 3rd edition. Freeman and Company. New York, 899 pp.	-	teacher
	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.	-	teacher
	Quinn, G.P., Keough, M.J., 2002. Experimental Design and Data Analysis for Biologists. University Press, Cambridge. 537 pp.	-	teacher
	Schreuder, H.T.; Ernst, R.; Ramirez-Maldonado, H. 2004. Statistical techniques for sampling and monitoring natural resources. Gen. Tech. Rep. RMRS-GTR-126. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 111 p.	-	Open access
	Picard N., Saint-André L., Henry M. 2012. Manual for building tree volume and biomass allometric equations: from field measurement to prediction. Food and Agricultural Organization of the United Nations, Rome, and Centre de Coopération Internationale en Recherche Agronomique pour le Développement, Montpellier, 215 pp.	-	Open Access
2.11. Optional literature			
2.12. Other (as the proposer wishes to add)			

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Saša Bogdan, PhD. Assis. Prof. Ida Katičić Bogdan, PhD.		1.6. Year of the study	2
1.2. Name of the course	Adaptive Tree Breeding		1.7. ECTS credits	3
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	15 + 15 + 0
1.4. Study programme (undergraduate, graduate, integrated)	graduate		1.9. Expected enrolment in the course	10
1.5. Status of the course	☐ mandatory	☒ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	3.

2. COUSE DESCRIPTION	
2.1. Course objectives	Interpretation of the adaptive forest tree breeding theoretical settings within the global change context. Selection and application of classical methods of the breeding (selection, controlled generative and vegetative reproduction, genetic testing, mass production of reproductive material).
2.1. Enrolment requirements and/or entry competences required for the course	Understanding basics of genetics.
2.2. Learning outcomes at the level of the programme to which the course contributes	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods **Directed competencies (B)** 4. Organize and implement professional field tasks to establish, cleaning, thinning and regeneration of forest stands 7. Draft ecological studies and implement ecological forest monitoring **Organizational competencies (C)** **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.3. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. To explain the process of classical breeding of forest tree species, methods of selection; To choose suitable candidates in the process of mass selection; to evaluate individual candidates and choose plus individuals. 2. To perform basic cloning techniques. To explain and compare basic traditional as well as modern methods and cloning

	techniques of woody species. 3. To explain the process of genetic testing of plus individuals and the choice of elite individuals; To calculate genotypic and additive values of individuals, heritability and genetic gain based on data from a genetic test; To choose elite individuals based on genetic testing results. 4. To explain the role of controlled crossing and the activities necessary for the implementation of controlled crossing in the breeding cycle; To choose an option and devise a plan for controlled crossings of elite specimen; To design mass production of genetically improved varieties.
2.4. Course content (syllabus)	Lectures: 3. Polygenic inheritance, quantitative traits, and the environment. 4. Basics of forest tree breeding. General concepts, historical development. 5. Techniques of cloning of tree species. 6. Strategies for the adaptive forest tree breeding. 7. The breeding cycles. Creation of starting plant material, a mother population. 8. Mass selection methods. The selective population. 9. The reproductive and breeding populations. 10. Genotypic selection based on genetic testing. 11. Development of a breeding strategy. 12. Controlled crossing in breeding; Design and techniques. 13. Breeding by hybridization (intraspecies and interspecies hybridization). 14. Breeding for resistance to abiotic factors. 15. Breeding for resistance to biotic factors. 16. Methods of macro-propagation and micro-propagation in the breeding. 17. Methods of biotechnology in the breeding. Exercises: 1. Techniques of forest tree species cloning, grafting (practicum). 2. Cloning techniques, rooting cuttings (practicum). 3. Mass selection (practicum). 4. Selection of plus individuals (practicum). 5. Selection of elite individuals based on genetic testing (practicum). 6. Development of the breeding strategy I (practicum). 7. Development of the breeding strategy II (practicum). 8. Development of the breeding strategy III (practicum). 9. Designing controlled crossing (practicum). 10. Technique of controlled crossing (practicum). 11. Inbreeding management (practicum). 12. Breeding for resistance to abiotic factors, case study 1 (practicum).

	13. Breeding for resistance to abiotic factors, case study 2 (practicum). 14. Breeding for resistance to biotic factors, case study 1 (practicum). 15. Breeding for resistance to biotic factors, case study 2 (practicum).								
2.5. 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)			2.6. Comments:		
2.7. Student responsibilities									
2.8. Monitoring student work	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	YES	NO	(other)	YES	NO
	Project	YES	NO	Written exam	YES	NO	ECTS credits (total)	4	

2.9. Required literature (available in the library and/or via other media)	**Title**	**Number of copies 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
	Eriksson, G., Ekberg, I., Clapham, D., 2006. An introduction to forest genetics. Second edition. SLU Repro, Uppsala., 186 str. (selected chapters)	No	Yes, authors web site

2.10. Optional literature	White, T. L., W. T. Adams, D. B. Neale, 2007: Forest Genetics. Wallingford, UK, Cambridge, CAB International. p682.
2.11. Other (as the proposer wishes to add)	

1. GENERAL INFORMATION				
1.1. Course teacher	Assis. Prof. Ernest Goršić, PhD		1.6. Year of the study	1
1.2. Name of the course	Dendrochronology		1.7. ECTS credits	3
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	30 + 0
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	10
1.5. Status of the course	☐ mandatory	☒ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2., 10%

2. COUSE DESCRIPTION	
2.1. Course objectives	Basic goal of the subject is to give students insight into tree ring formation under different biotical and abiotical factors through increment core sampling procedures and data analyses. Through lectures students will undergo all phases of selection and increment analyses using modern methods. They will acquire the ability to analyse, interpret and implement obtained data in making conclusions and planning. Laboratory practice will teach them how to take, prepare and measure increment cores. The students will get introduced to Dendroarchaeology.
2.2. Enrolment requirements and/or entry competences required for the course	Basic knowledge in statistics.
2.3. Learning outcomes at the level of the programme to which the course contributes	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods **Directed competencies (B)** **Organizational competencies (C)** **Other competencies (D)**
2.4. Expected learning outcomes at the level of the course (3 to 10	1. To acquire knowledge of proper sampling plot location selection and correct increment core extraction 3. To learn correct increment core preparation.

learning outcomes)	4. To properly identify, measure and analyse tree rings. 5. To construct reference tree ring chronology. 6. To make various dendrochronological analyses. 7. To create a report.
2.5. Course content (syllabus)	1. Introduction. History and origins of Dendrochronology with application in the world. 2. Anatomical basis of tree ring and its formation dynamics. 3. Influence of habitat on tree ring formation at various tree species. 4. Species suitable for dendrochronological analysis. 5. Sampling plot location selection and correct increment core extraction. 6. Practical exercise in increment core tools and sampling procedures. 7. Sampling of wet and dry archaeological material. 8. Preservation and preparation of samples for analysis. 9. Practical exercise in sample preparation. 10. Programs for tree ring measurement TSAPWin and Win Dendro. 11. Practical exercise in data entry and increment core measurement in TSAPWin with Lintab. 12. Crossdating in TSAPWin with statistical dating parameters. 13. Construction of reference tree ring chronology in. 14. Practical exercise in crossdating and building tree ring chronology in PAST and TSAP software. 15. Standardization and sample comparison in COFECHA and Arstan. 16. Basic of analysis and graphical display in program R. 17. Application of dendrochronology series in Dendroarcahaeology 18. Application of dendrochronology series in Dendroclimatology
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. Student responsibilities	Class attendance and exercise report

2.9. Monitoring student work									
	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	**YES**	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	4	

2.10. Required literature (available	**Title**	**Number of**	**Availability via**

in the library and/or via other media)		**copies in the library**	**other media**
	Cook, E.R., Kairiukstis, L., 1990: *Methods of Dendrochronology - Applications in the Environmental Sciences.* Dordrecht, Netherlands: Springer Netherlands.	1	
	Vaganov, E. A.,Hughes, M. K.,Shashkin, A. V., 2005: Growth Dynamics of Conifer Tree Rings: Images of Past and Future Environments, Springer, 358pp	1	
	Fritts, H.C., 1976: Tree Rings and Climate. The Blackburn Press, Caldwell, New Jersey. 567pp	1	
	Stokes,M. A., Smiley, T. L., 1996: An Introduction to Tree-Ring Dating,University of Arizona Press, Tucson, 73pp	1	
2.11. Optional literature	R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.		
2.12. Other (as the proposer wishes to add)	Various literature about tree growth and increment		

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Mario Božić, PhD Assis. Prof. Ernest Goršić, PhD		1.6. Year of the study	1
1.2. Name of the course	Forest growth and yield		1.7. ECTS credits	3
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	15 +1 5 + 0
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	10
1.5. Status of the course	☐ mandatory	☒ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2., 10%
2. COUSE DESCRIPTION				
2.1. Course objectives	Together with the basic goal of acquiring necessary knowledge of general principle of growth and increment in individual trees			

	and stands consisting of main tree species, this course will give insight into influential factors for growth and increment, and methods of measurement and increment determination in trees and stands. Lectures will emphasize on acquiring knowledge regarding growth and increment in the field of cultivation of natural and artificially raised stands.
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods **Directed competencies (B)** 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 5. Organize and implement works in forest inventory and pruning 7. Draft ecological studies and implement ecological forest monitoring **Organizational competencies (C)** **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Determining factors which affect growth and increment. 2. To analyze growth and increment of individual trees (height, diameter, cross section area and volume increment) 3.To present development and stand increment (in even-aged stands, pure and mixed; growth and increment of uneven-aged stands, influence of management and habitat changes on tree and stand increment) 4. To determine stand increment when making management plans (methods of stand growth, data quality of increment calculated for management unit/class level) 5. To present growth and increment models (simple and complex models with stratified and nonstratified samples).
2.5. Course content (syllabus)	Within course following thematic units are covered: definition of basic terminology; growth and increment of individual trees; stem analysis, tree height growth and increment progress display; growth and increment of DBH, basal area and volume; comparison of growth and increment for different tree species; development and increment of even-aged stands, pure and mixed; development and increment in selection stands; description of factors which define tree and stand growth, site quality; influence of competition on growth and increment; influence of geomorphological factors on growth and increment; influence of climatic factors on growth and increment; influence of biotic factors on growth and increment; influence of anthropogenic factors (thinning, hydrotechnical interventions, infrastructure, contamination) on growth and increment; determining the connection between increment and management activities in even-aged and selection stands; modeling of tree growth and increment and stand development.

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. Student responsibilities	Class attendance and correct practice report.								
2.9. Monitoring student work	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	**YES**	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary	**YES**	NO	Practical work	**YES**	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	4	
2.11. Required literature (available in the library and/or via other media)	**Title**							**Number of copies in the library**	**Availability via other media**

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Mario Božić, PhD Assis. Prof. Ernest Goršić, PhD		1.6. Year of the study	1
1.2. Name of the course	Forest inventory		1.7. ECTS credits	6
1.3. Associate teachers	Assis. Prof. Ernest Goršić, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	30 + 15 + 16 (Field work)
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2., 10%
2. COUSE DESCRIPTION				
2.1. Course objectives	Acquiring knowledge and skills related to measurements and assessment 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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods **Directed competencies (B)** 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 5. Organize and implement works in forest inventory and pruning **Organizational competencies (C)** **Other competencies (D)** 1. perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. List measured variables, precision and accuracy in measurement, and means of data presentation. 2. Interpret measurement of tree diameter, perimeter and height (instruments, errors). 3. Explain data collection on sample plot, stand and management unit (sample and sample size, types and sizes of sample plots, measurement on sample plots. 4. 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). 5. 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). 6. 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). 7. Describe design of a sample and data collection methods for diameter increment.
2.5. Course content (syllabus)	Within course Forest mensuration, students are introduced to measurement and assessment of quantitative and qualitative variables on tree and stand level followed by introduction to measurement scales and data display with terminology precision, accuracy and bias within measurement. Then students are introduced to importance of planning before measurement and most important tree and stand variables that are measured. Students will learn how to measure tree diameter and height and are familiarized with related instruments. After that, students are introduced with procedure of calculating tree volume. Students will learn how to determine sample size, sample plot type and shape and ways how to set up measurement plots and perform measurement. Measurement on the stand and forest level is demonstrated on a sample plot measurement. Based on measurement data collected in actual stands, students are taught how to calculate stand and forest structure (number of trees, surface area per hectare for certain diameter class, height curve and tariff construction, calculation of stand volume) and importance of comparison of acquired data with data from earlier measurements and expected values (models).

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. Student responsibilities	Class attendance and correct practice and fieldwork report.		

2.9. Monitoring student work									
	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	**YES**	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	**YES**	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	5	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Van Laar, A., Akça, A., 2007: Forest Mensuration. Springer, 383 str.		
	Pranjić, A., Lukić, N., 1997: Izmjera šuma. Šumarski fakultet Sveučilišta u Zagrebu, 410 str., Zagreb	YES	
	Božić, M., Goršić, E., Vedriš, M.: Presentations from classes and practice.		MERLIN

2.11. Optional literature	
2.12. Other (as the proposer wishes to add)	

	Pretzsch, H., 2009: Forest Dynamics, Growth and Yield. Springer-Verlag Berlin Heidelberg		
	Klepac, D., 1963: Rast i prirast šumskih vrsta drveća i sastojina, Znanje, Zagreb.	YES	
	Pranjić, A., Lukić, N., 1997: Izmjera šuma. Šumarski fakultet Sveučilišta u Zagrebu, 410 str., Zagreb	YES	
	Božić, M., Goršić, E.: Presentations from classes and practice.		MERLIN
2.11. Optional literature			
2.13. Other (as the proposer wishes to add)			

1. GENERAL INFORMATION				
1.1. Course teacher	Assoc. Prof. Damir Drvodelić, Phd Assis. Prof. Vinko Paulić, Phd		1.6. Year of the study	1
1.2. Name of the course	Forest establishment		1.7. ECTS credits	5
1.3. Associate teachers	-		1.8. Type of instruction (number of hours L + E + S + e-learning)	30+15+16 (FW)
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	25
1.6. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION				
2.1. Course objectives	The aim of the subject is to familiarize students with forest seed production, forest nursery production and establishment of forest 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, as well as they become able to organize and conduct expert field work on establishment of new forest plantations by afforestation.			

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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 2. Explain the position and trends of the forestry profession in Croatia and the world 3. Apply a simplified scientific research methods **Directed competencies (B)** 4. Organize and implement professional field tasks to establish, cleaning, thinning and regeneration of forest stands 13. Improve the existing technology and introduce new technologies **Organizational competencies (C)** 1. Plan, organize and implement production organization tasks in forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain forest seeds (forest seeds and species, maturation and collection, cleaning and sorting, dormancy, forest seed quality elements). 2. Analyze forest nursery production and propagation methods in forest nurseries (division of nurseries, site selection for the establishment of forest nurseries, generative and vegetative propagation of plants). 3. Explain soil tillage (division, basic and additional soil tillage, depth and volume of soil treatment, basis of equipment and tools used in soil treatment). 4. Present container production of forest seedlings (types of containers, production of seedling in containers, root system deformation in containers, substrate selection, propagation time, seedlings care in containers). 5. Analyze the production technology of forest seedling for the main tree species (genus *Quercus, Fagus, Fraxinus, Alnus, Betula, Populus, Salix, Abies, Pinus, Picea*). 6. Compose appropriate afforestation design for the main species of forest trees (establishment and cultivation of forest plantations of native and non-native species of broadleaf and conifer trees).
2.5. Course content (syllabus)	Lectures: 1. Forest seed anatomical structure. 2. Maturation and harvesting of forest seeds and fruits. 3. Extraction and processing of forest seed 4. Drying and storage of forest seeds. 5. Dormancy of forest seed. 6. Estimation of forest seed quality. 7. General about forest nursery production. 8. Soil tillage if forest nurseries. 9. Sowing forest seed and transplanting of forest seedlings.

	10. Basics of forest seedling fertilization. 11. Container production of forest seedlings. 12. Global trends in afforestation 13. Establishment of new forest plantations. 14. Tending and management of newly established forest plantations. 15. Technology of main forest tree species afforestation and plantations establishment. Exercises: 1. Germination testing of forest seed. Laboratory exercises. Four weeks. 8 hours. 2. Determination of forest seed viability with special reference to indigo carmine and tetrazolium methods. Laboratory exercises. in six hours in total. 3. General about forest nurseries. 4. Calculating capacity of nursery for poplar production. 5. Calculating capacity of nursery for conifer production. 6. Transplanting forest seedlings in nursery. 7. Planting forest seedlings at field. 8. Propagation of forest trees and shrubs in nursery. 9. Forest seed sowing in nursery 10. Care of seedlings in forest nursery. Field work: 1. Forest seed production and forest seedling nursery production. 2. Production of hard broadleaves forest seedlings. 3. Establishment and tending of conifer forest plantations.

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: Exercises are partially taken in Laboratory for forest seed and nursery production and practice work in Faculty of Forestry and Wood Technology nurseries.
2.8. Student responsibilities	Regular attendance and active participation of students at the lectures, exercises and field work. Taking partial exams and final exam.		

2.9. Monitoring student work									
	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	**YES**	NO	Report	YES	NO	(other)	YES	NO

	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	**YES**	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	5	

	Title	Number of copies in the library	Availability via other media
2.10. Required literature (available in the library and/or via other media)	Oršanić, M., Anić, I., Drvodelić, D., 2005: Šumsko sjemenarstvo i rasadničarstvo (Skriptum for internal use, translated to English). Zagreb. 228 str.		Yes, E-learning Merlin
	Oršanić, M., Anić, I., Drvodelić, D., 2005: Priručnik za razmnožavanje drveća i grmlja ((Skriptum for internal use, translated to English). Zagreb. 125 str.		Yes, E-learning Merlin
	Matić, S., B. Prpić, 1983: Pošumljavanje. Savez inžinjera i tehničara	Yes	Yes, E-learning Merlin
2.11. Optional literature	1. Savill, P. E., J. Auclair, D. J. Falck. Plantation Silviculture in Europe. Oxford University Press. 1997.		
2.12. Other (as the proposer wishes to add)	2. Suzka, B. Seeds of Forest Broadleaves: from Harvest to Sowing. INRA Editions. 1996.		

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Igor Anić, PhD Assoc. Prof. Stjepan Mikac, PhD		1.6. Year of the study	1
1.2. Name of the course	Close to Nature Silviculture		1.7. ECTS credits	6
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	30 + 15 + 16 (Field Work)
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2.
2. COUSE DESCRIPTION				
2.1. Course objectives	The course is based on the principles of the Zagreb School of Close to Nature Silviculture, which support: 1. natural dynamics and structure of forests; 2. natural rejuvenation of forests; 3. artificial rejuvenation of forests according to the principles of natural rejuvenation; 4. exclusion of clear felling methods in forest management; 5. intensive forest tending from an early stage; 6.			

	multipurpose, progressive and sustainable forest management. Based on these principles, it prepares students for silvicultural analysis of forest stand, performing and controlling silvicultural procedures and solving silvicultural problems.
2.2. Enrolment requirements and/or entry competences required for the course	1. Enrolled the appropriate year of the study program 2. Completed undergraduate or graduate study of forestry or related field 3. Passed exams in the fields of botany, dendrology and pedology for students of related fields
2.3. Learning outcomes at the level of the programme to which the course contributes	**General competencies (A)** 3. Apply a simplified scientific research methods **Directed competencies (B)** 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 4. Organize and implement professional field tasks to establish, cleaning, thinning and regeneration of forest stands 12. Manage forestry, human and technical resources in conducting forestry works **Organizational competencies (C)** 3. Manage the most complex tasks in all forms of forestry organizations **Other competencies (D)**
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Present forming of the natural structure of forest stand (structure of the primary forest stand and managed forest stand, principles and methods of silvicultural forming of the natural forest stand). Identify the genesis of forest stands and the choice of regeneration methods (physiological, habitat, orographic and biotic preconditions for generative and vegetative natural regeneration, and features of artificial regeneration of forest stands). Present methods of natural regeneration of the forests under shelter, on the bare area, on the edge (classical methods, close to nature methods). Present the special silvicultural methods and conversion methods (forests with protective function, forests of special purpose, cases of decay of different tree species and stands, conversion of different structural forms of forests). Formulate silvicultural planning (sustainable forest management and multipurpose progressive sustainable management concept).
2.5. Course content (syllabus)	Lectures: 1. Silviculture and forest naturalness: The concept of natural forest. Criteria for determining natural forest. Forests according to the degree of naturalness. The impact of silviculture on the establishment and preservation of forest naturalness. 2. Virgin forest dynamics and application in forestry: The concept of silvidynamics. Pioneer forest. Transitional forest. The final forest. Definition and importance of virgin forest. Distribution of virgin forests in the world, Europe and Croatia. Approach to virgin forest research. Developmental stages. Silvidynamics and texture. Virgin forest biodiversity. Virgin forest stability. Application in silviculture. 3. Growth control, formation and maintenance of stand structure: Formation of horizontal and vertical stand structure. The importance of the undergrowth. Historical development of forest thinning methods. An overview of thinning methods. Comparison and evaluation of forest thinning methods. 4. Effects and rationalization of forest tending: Effects of cleaning on tree and stand morphology, and mixture. Influence of thinning method on stand structure, volume production and value of wood stock. Influence of forest tendning on ecological conditions in the

	stand. New approaches to forest tending. Rationalization of forest tending. 5. Characteristics and conditions of natural forest regeneration: Characteristics of generative regeneration. Features of vegetative regeneration. Ecology of forest regeneration: physiological, climatic, climatic-edaphic, edaphic, orographic and biotic preconditions for regeneration. 6. Artificial regeneration according to the principles of the natural: Concept. Types, quality and selection of forest reproductive material for artificial regeneration. Methods of artificial regeneration. Number of plants and quantity of seeds for artificial regeneration in different stand and habitat conditions. Evaluation of artificial regeneration methods. Selection of forest regeneration method with regard to the method and type of reproductive material. 7. Stand regeneration using small scale shelterwood method: The concept of small regeneration area. Regenration period. Regeneration gaps. Comparison of gaps in managed forests and in virgin forests. The shape of small scale regeneration area. Application in practice. Comparison with classic methods of regeneration. Creating of uneven-aged stand structure. 8. Other sylvicultural systems: Additive methods, Irregular Bavarian method, Irregular Swiss metod. Substitution methods, Wagner felling, Eberhard felling, Phillip-Kurtz felling. An overview of combined methods. Some special methods: Free style silviculture. Mosaic forests. 9. Forest conversion: Concept, goals and methods of conversion. Conversion of mixture. Conversion of silvicultural forms. Conversion of even-aged structure into uneven-aged structure and selection structure. Conversion of forest degradation forms. 10. Silviculture and nature protection: Development of the principle of sustainability in the context of the human relationship with the forest. Multipurpose silviculture. Silviculture and special nature protection conditions. Adaptation of silviculture to changes in the environment. Silvicultural practices after forest damage. 11. Silvicultural analysis and silvicultural planning: Principles of silvicultural analysis. The concept, and creation of a silvicultural plan. Principles of silvicultural planning in different stand structural and ecological conditions. 12. Silviculture in lowland belt: Willow and poplar stands. Black alder stands. Narrow leaved ash stands. Pedunculate oak and narrow leaved ash stands. Pedunculate oak and hornbeam stands. Silvicultural procedures in conditions of dieback of trees and stands. 13. Silviculture in low hills belt: Sessile oak stands. Stands of sessile oak and hornbeam. Chestnut stands. Silver birch stands. Silvicultural procedures in degraded stands of hilly vegetation belt. Silviculture in high hills belt: Beech stands. Stands of linden and yew. Silvicultural procedures in degradation stages of mountain forests. 14. Silviculture in mountain belt: Fir-beech stands. Stands of great maple and common ash. Fir-spruce stands. Black pine stands. Scots pine stands. Silvicultural procedures and dieback of trees and stands of pre-Alpine belt. Silviculture in pre-alpine belt: Spruce stands. Stands of beech and mugo pine. 15. Silviculture in the Mediterranean-littoral and Mediterranean-Mountain belts: Silvicultural characteristics of Mediterranean forests. Silvidynamics of Mediterranean forests and importance for silviculture. Aleppo pine stands. Black pine stands. Holm oak stands. Pubescent oak stands. Silvicultural procedures in the degradation stages of Mediterranean forests. Other types of stands of the Mediterranean area. Exercises: 1. Structure and texture of virgin forest stand 2. Comparison of virgin forest stand and and managed forest stand

	3. Tending of young pure stands and young mixture stands 4. Thinning of pure stands and mixture stands 5. Regeneration using shelterwood method over small areas (irregular shelterwood methods) 6. Forest conversion – case studies 7. Conversion of even-aged structure into selection structure 8. Silvicultural procedures after forest damages 9. Silvicultural procedures in lowland forests 10. Silvicultural procedures in forests of the low hills belt 11. Silvicultural procedures in forests of the high hills belt 12. Silvicultural procedures in forests of the mountain belt 13. Silvicultural procedures in forests of the pre-alpine belt 14. Silvicultural procedures in forests of the Mediterranean-littoral zone 15. Silvicultural procedures in forests of the Mediterranean-mountain zone Field work: 1. Close to nature silviculture in lowland forests 2. Selection forest management 3. Close to nature silviculture in Mediterranean forests

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

2.8. Student responsibilities	

2.9. Monitoring student work									
	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	**YES**	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	**YES**	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	5	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Klepac, D. (editor in chief), 1996: Pedunculate oak (*Quercus robur* L.) in Crotia. Croatian academy of sciences and arts, Croatian forests, p.o. Zagreb, Zagreb – Vinkovci, 559 p.	Yes	No

	Matić, S. (editor in chief), 2003: Common beech (*Fagus sylvatica* L.) in Croatia. Academy of forestry sciences, Zagreb, 855 p.	Yes	No
	Matić, S. (editor in chief), 2011: Forests of Croatian Mediteranean. Academy of forestry sciences, Zagreb, 740 p.	Yes	No
	Prpić, B. (editor in chief), 2001: Silver fir (*Abies alba* Mill.) in Croatia. Academy of forestry sciences, Zagreb, 895 p.	Yes	No
	Vukelić, J. (editor in chief), 2005: Floodplain forests in Croatia. Academy of forestry sciences, Zagreb, 455 p.	Yes	No
2.11. Optional literature	Ashton, S. M., M. J. Kelty, 2018: The practice of silviculture: applied forest ecology. Wiley-Blackwell, 758 p. Röhrig, E., N. Barthsch, B. v Lüpke, 2006: Waldbau auf ökologischer grundlage. Ulmer, Stuttgart, 479 p.		
2.12. Other (as the proposer wishes to add)			

1. GENERAL INFORMATION				
1.1. Course teacher	Assis. Prof. Andreja Đuka, PhD		1.6. Year of the study	1
1.2. Name of the course	Harvesting operations		1.7. ECTS credits	6
1.3. Associate teachers	Prof. Tomislav Poršinsky, PhD Prof. Stefano Grigolato, PhD Milica Perić, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	30 + 15 + 8 (FW)
1.4. Study programme (undergraduate, graduate, integrated)	Master continuing		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	3
2. COUSE DESCRIPTION				
2.1. Course objectives	The focus of the subject is on practical knowledge necessary to fulfil the requirements of harvesting operation tasks in forestry.			
2.2. Enrolment requirements and/or entry competences required for the course	-			
2.3. Learning outcomes at the level	**General competencies (A)**			

of the programme to which the course contributes	1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods **Directed competencies (B)** 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 8. Apply knowledge of mechanical means, techniques, and technologies in performing forestry works 11. Apply methods to prepare, plan and organize works in forestry 13. Improve the existing technology and introduce new technologies **Organizational competencies (C)** 2. Plan and calculate production, calculate the basic business success indicators, draft basic financial reports, recognize types of costs, define and analyse costs **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	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). 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). 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). Analyse timber extraction (primary timber transport by: adapted agricultural tractor, tractor-trailer system, skidder, forwarder, forest skyline and helicopter). 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) and processing of trees/timber with a chain saw 4. Mechanised felling and processing 5. Introduction to timber transport and forest accessibility indicators 6. Timber extraction with forestry vehicles 7. Aerial timber extraction with forest skyline and helicopters 8. Steep terrain harvesting in the Alps 9. Long distance timber transport

	10. Obtaining forest biomass for energy 11. Causes and consequences of stand and habitat damage due to harvesting operations 12. Measures to reduce stand and habitat damage due to harvesting operations 13. Harvesting systems 14. Life cycle assessment in forestry 15. Best Practices of Biomass Energy Life Cycle Assessment and Possible Application Practical lessons – exercises 1. Timber measurement 2. Wood defects I (irregularities of round wood, irregularities in anatomy) 3. Wood defects II (irregularities due to physical-mechanical factors, change in colour and consistency of timber, defects due to insects). 4. Assortment structure 5. Wood normisation 6. Evaluation of the standing tree. 7. Calculation of the Logging Plan 8. Components of the Work Study Site 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 "Checklist for environmental impact assessment in forestry – measurements in a selective forest” 14. Analysis of data from fieldwork “Checklist for environmental impact assessment in forestry – measurements in a selective forest” 15. Presentation of the individual Writing Requirement Students are strongly encouraged to fulfil the Writing Requirement during the semester to combine learned knowledge of specialised topics from harvesting operation and compare/analyse current, state-of-the-art situation with their native economy. Students acquire practical skills through fieldwork measurements: "Checklist for environmental impact assessment in forestry – – measurements in a selective forest".		
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 ☐ (other)	2.7. Comments:

	☒ field work		
2.8. Student responsibilities			

2.9. Monitoring student work									
	Class attendance	**YES**	NO	Research	**YES**	NO	Oral exam	**YES**	NO
	Experimental work	YES	**NO**	Report	YES	**NO**	(other)	YES	NO
	Essay	YES	**NO**	Seminar paper	**YES**	NO	(other)	YES	NO
	Preliminary exam	YES	**NO**	Practical work	**YES**	NO	(other)	YES	NO
	Project	YES	**NO**	Written exam	**YES**	NO	ECTS credits (total)	5	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Poršinsky, T., Đuka, A.: Presentations of lectures, practical lessons – excercises and preparation materials for fieldwork measurements from the course Harvesting operations.	NO	ON-LINE

2.11. Optional literature

1. Poršinsky, T., Stankić, I., Bosner, A., 2011: Ecoefficient Timber Forwarding Based on Nominal Ground Pressure Analysis. Croat. j. for. eng. 31(1): 345–356.
2. 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.
3. 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.
4. 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.
5. Đuka, A., Vusić, D., Horvat, D., Šušnjar, M., Pandur, Z. and Papa, I., 2017. LCA Studies in Forestry–Stagnation or Progress?. Croatian Journal of Forest Engineering: Journal for Theory and Application of Forestry Engineering, 38(2), pp.311-326.
6. Đuka, A., Sertić, M., Pentek, T., Papa, I., Janeš, D. and Poršinsky, T., 2020. Round Wood Waste and Losses–Is Rationalisation in Scaling Possible?. Croatian Journal of Forest Engineering 41(2), pp.1-12.
7. Đuka, A., Poršinsky, T., Pentek, T., Pandur, Z., Vusić, D., Papa, I., 2018: Mobility Range of a Cable Skidder for Timber Extraction on Sloped Terrain. Forests 9(9): 526.

2.12. Other (as the proposer wishes to add)	

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Marijan Šušnjar, PhD		1.6. Year of the study	1
1.2. Name of the course	Forest machines		1.7. ECTS credits	3
1.3. Associate teachers	Assist. Prof. Zdravko Pandur, PhD Marin Bačić, MSc.		1.8. Type of instruction (number of hours L + E + S + e-learning)	15 + 15 + 0
1.4. Study programme (undergraduate, graduate, integrated)	graduate		1.9. Expected enrolment in the course	10
1.5. Status of the course	☐ mandatory	☒ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	The aim of the course is to acquaint students in detail with the development, basics and classification of the most important forest machines for mechanization of wood extraction works, the principles of their construction and their most important energy, environmental and ergonomic features.
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways **Directed competencies (B)** 8. Apply knowledge of mechanical means, techniques, and technologies in performing forestry works 13. Improve the existing technology and introduce new technologies **Organizational competencies (C)** 1. Plan, organize and implement production organization tasks in forestry

	Other competencies (D)
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	To compare machines for tree felling and processing – motor chainsaws (energy and environmental suitability of 2-stroke engines, battery tools, ergonomic features). To recommend machines for tree felling and processing – Harvesters (morphological, ergonomic, energy and environmental characteristics of harvester). To recommend forest vehicles for timber logging – Skidders, Forwarders (construction, types of skidders and forwarders, technical features, environmental suitability). to present other machines of mechanized timber logging (forest trucks for timber transport, forest cableways, forest biomass chippers) to judge the need to use hybrid forest vehicles to select optimal drives for different types of forest vehicles and for different forest works
2.5. Course content (syllabus)	Lectures 1. Chainsaws 1. – history development, parts and components 2. Chainsaws 2. – safety at work, ergonomic issues 3. Battery tools in forestry 4. Harvesters and harvesters heads – history development, types, performance 5. Winches 6. Tractors with semi-trailers – development, types, performance 7. Skidders – development, types, performance, kinematics 8. Forwarders – development, types, performance 9. Cable yarders and wire systems 10. Chippers 11. Forest trucks – types, characteristic 12. Energy in forestry – production, costs 13. Remote monitoring of forest machines – FMS 14. Fuel consumption and exhaust emissions of forest vehicles 15. Hybridization of forest vehicles - types and characteristics of hybrid drives Exercises 1. Preparation for measuring exercise „Noise and vibrations of chainsaw“ 2. Measuring exercise „Noise and vibrations of chainsaw“ 3. Ergonomic checklist

	4. Calculation task – calculation of engine speed characteristics of internal combustion engine 5. Calculation exercise - Calculation of forest winch characteristics 6. Calculation exercise: "Vehicle stability". 7. Calculation exercise „Hidraulic tractor power lift“ 8. Preparation for the measurement exercise „Tractive characteristics of skidders“ 9. Measuring exercise „Tractive characteristics of skidders“ 10. Preparation for the measurement exercise „Wheel – soil interaction - Wheel numeric“ 11. Measurement exercise and data processing „Wheel – soil interaction - Wheel numeric“ 12. Calculation exercise: "Axle loads of forest trucks 13. Preparation for the measurement exercise „Energy of forest machines and tools“ 14. Preparation for the measurement exercise "Analysis of exhaust emissions of combustion engines" 15. Measurement exercise and data processing "Combustion engine exhaust gas analysis"

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. Student responsibilities			

2.9. Monitoring student work									
	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	YES	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	2	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Šušnjar, M., Pandur, Z., - Presentations of lectures and exercises		WEB
	Längin, D., i dr.: South African Ground Based Harvesting Handbook. Forest Engineering Southern Africa and Institute for Commercial Forestry Research 2010, s. 45-105.		WEB
	Best Practice Guidelines for Ground-based Logging, FITEC, New Zealand 2000, chapters: 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		WEB

	Wong, J.Y., Theory of ground vehicles. Fourth edition, John Wiley and sons, Inc. 2008, chapter: Performance characteristics of off-road vehicles, s. 319-362.		WEB
	Hellström, T., Ringdahl, O., 2011: Intelligent vehicles in forestry. Umeå University. 1-46.		WEB
	Rieppo, K., Kariniemi, A., Haarlaa, R., 2002: Possibilities to develop machinery for logging operations on sensitive sites. University of Helisinki, Department of forest resource management, 29: s. 1-30.		WEB
2.11. Optional literature	Nokka, J., 2018: ENERGY EFFICIENCY ANALYSES OF HYBRID NON-ROAD MOBILE MACHINERY BY REAL-TIME VIRTUAL PROTOTYPING Acta Universitatis Lappeenrantaensis 785, 1-87. Georgsson F., Hellström, T., Johansson, T., Prorok, K., Ringdahl, O. and Sandström, U., 2005: Development of an Autonomous Path Tracking Forest Machine- a status report. Technical Report UMINF 05.08, Department of Computing Science, Umeå University SE-901 87 Umeå, Sweden. Lajunen, A., Suomela, J., Pippuri, J., Tammi, K., Lehmuspelto, T., Sainio.P., 2016: Electric and hybrid electric non-road mobile machinery – present situation and future trends. World Electric Vehicle Journal Vol. 8.1-12. Laitila, J., Prinz, R., Routa, J., Kari Kokko, L., Kaksonen P., Suutarinen,J., Eliasson, L., 2015: PROTOTYPE OF HYBRID TECHNOLOGY CHIPPER. Skogforsk INFRES – 1-20. Ola Lindroos, O., La Hera, P., Häggström, C., 2017: Drivers of Advances in Mechanized Timber Harvesting – a Selective Review of Technological Innovation. Croatian journal of forest engineering 38(2017) 2, 243-258. La Hera, P.,Mendoza Trejob, O., Ortíz Moralesa D., 2018: AUTOMATION TECHNOLOGY FOR FORESTRY MACHINES: A VIEW OF PAST, CURRENT, AND FUTURE DEVELOPMENTS. Proceedings 6 th International Forest Engineering Conference “Quenching our thirst for new Knowledge” Rotorua, New Zealand, April 16th - 19th, 2018. 1-9. Šušnjar, M., Horvat, D., Kristić, A., Pandur, Z., 2008: Morphological analysis of forest tractor assemblies. Croatian journal of forest engineering, 29 (1): 41-51. Tomašić, Ž.,Šušnjar, M.,Horvat, D.,Pandur, Z., 2009: Forces affecting timber skidding. Croatian journal of forest engineering, 30 (2): 127-139. Šušnjar M., Horvat, D., Pandur, Z., Zorić, M., 2011: Određivanje osovinskih opterećenja kamionskoga i tegljačkoga skupa za prijevoz drva (Axle Load Determination of Truck with Trailer and Truck with Semitrailer for Wood Transportation). Croatian journal of forest engineering, 32 (1): 379-388. Lindroos, O., Wästerlund, I., 2011: Larger loads and decreased damage – the potentials of a new forwarding concept. FORMEC´11: Pushing the boundaries with research and innovation in forest engineering October 9 – 12, 2011, Graz and Rein – Austria.		
2.12. Other (as the proposer wishes to add)			

1. COURSE DECRIPTION – GENERAL INFORMATION				
1.1. Course teacher	Assoc. Prof. Krunoslav Teslak, PhD		1.6. Year of the study	1
1.2. Name of the course	Small scale forest management planning		1.7. ECTS credits	3
1.3. Associate teachers	Prof. Jura Čavlović, PhD		1.8. Type of instruction (number of hours L + S + E + e-learning)	15+10+0+5
1.4. Study programme (undergraduate, graduate, integrated)	graduate study programme		1.9. Expected enrolment in the course	10
1.5.	☐ mandatory	☒ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2, 20%

2. COURSE DESCRIPTION	
2.1. Course objectives	1. to habilitate students with the specifics of planning and management of small scale, private forest estates 2. to train students to manage their own forest estate (forest owners students) 3. to train students for forest management of associated forest owners (association of small scale forest owners) 4. additionally train students to compose of specific forest management programs for small-scale private forests
2.2. Enrolment requirements and/or entry competences required for the course	completed undergraduate study of Forestry, Urban Forestry or related program of biotechnical undergraduate studies
2.3. Learning outcomes at the level of the programme to which the course contributes	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 2. Explain the position and trends of the forestry profession in Croatia and the world **Directed competencies (B)** 1. Develop and implement forest ecosystem management plans and programmes 2. Develop, organize and implement strategic plans and more complex tasks in forestry 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 5. Organize and implement works in forest inventory and pruning 12. Manage forestry, human and technical resources in conducting forestry works **Organizational competencies (C)** 3. Manage the most complex tasks in all forms of forestry organizations **Other competencies (D)**
2.4. Expected learning outcomes	1. Define existing shortcomings in the current management of small scale private forests,

at the level of the course (3-10 learning outcomes)	2. Analyze the existing regulations governing the management of small scale private forests 3. Show and compare the specifics of small scale forest management 4. Recognize and interpret the needs to adapt forest inventory methods for private forests 5. Analyze and adopt skills of drafting regulations based on uneven age management models 6. Plan the implementation of the forest owner's participation in creating the management plans for their forests. 7. Plan and compile guidelines for forest land consolidation within the management unit 8. Evaluate and analyze the adopted management guidelines and estimate degree of the expected implementation
2.5. Course content (syllabus)	Lectures: 1. Introduction, Small scale private forests structure (area share, growing stock, structural deficiencies) 2. Ownership status - comparison status in Croatia and the world 3. Overview of the organizational structure of private forest management in Croatia 4. Existing legislation and the possibility of improvement 5. Small scale spatial planning (internal, strategic) 6. Special features of private forest inventory and management programs 7. Uneven age forest management-a necessity for small private forest estates 8. Land consolidation and joint management 9. Compensation for management restrictions (nature 2000) 10. Guidelines for future management for private forests- amount of cutting 11. Guidelines for future management for private forests-silvicultural works 12. Tolerances in the implementation of private forest guidelines 13. Non-wood products and public functions of forest as opportunities for small scale private forests 14. Establishing management examples of private forest estates 15. Overview and discussion, presentation of student experiences Exercises 1. Forest ownership status - analysis Croatia and the world 2. Forest ownership status - analysis Croatia and the world 3. Review of examples of organizational structure of private forest management 4. Review of examples of organizational structure of private forest management 5. Spatial planning analysis (internal, strategic) 6. Spatial planning analysis (internal, strategic) 7. Construction of forest property consolidation models 8. Construction of forest property consolidation models 9. Calculation Financial compensation for forest management restrictions (natura 2000) 10. Calculation Financial compensation for forest management restrictions (natura 2000) 11. Determining the regulations for future management for private forests- amount of cutting

	12. Determining the regulations for future management for private forests- silvicultural works 13. Small scale management programs- components 14. Small scale management programs- stand level 15. Small scale management programs- forests level									
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. Student responsibilities										
2.9. Monitoring student work	Class attendance	**YES**		Research		NO	Oral exam	**YES**		
	Experimental work	**YES**		Report		NO	(other)			
	Essay		NO	Seminar paper	**YES**		(other)			
	Preliminary exam	**YES**		Practical work		NO	(other)			
	Project	**YES**		Written exam	**YES**		ECTS (total)	4		

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Žunić, M, 2018: Models of private forest management in the Republic of Croatia with regard to the attitudes of forest owners and the characteristics of forest holdings, doctoral dissertation, Faculty of Forestry, Zagreb, 149 p. (mentor for dissertation Teslak)	available	
	Harrison, S.R., Herbohn, J.L. Herbohn, K.F. 2000: Sustainable Small-scale Forestry, 247 str.		available
	Teslak, K.; Žunić, M.; Beljan, K.; Čavlović, J.: 2018: Status and challenges of small-scale private forest management in actual ecological and social circumstances – croatia case study// Šumarski list, 142 (2018), 9/10; 459-471 doi:10.31298/sl.142.9-10.1		available
	Žunić, M., Teslak, K.: 2019. Constraining factors of activities in Croatian forest estates mimic model, Šumarski list Volume: 143, Issue: 1-2 , Pages: 7-17		available

2.11. Optional literature (name the title)	
	1. Čavlović, J., Božić, M., 2011: Research and development of forest management and survey models in forest owners' forests, Small private forest management model, Final project report, Zagreb, 223 pp. 2. Bettinger, P. Boston, K., Siry P.J., Grebner, L.D. 2009: Forest management and Planning, Elsevier inc., 327 pp.

2.12. Other (as the proposer wishes to add)	

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Danko Diminić, PhD		1.6. Year of the study	1
1.2. Name of the course	Fungal Tree Pathogens		1.7. ECTS credits	3
1.3. Associate teachers	Jelena Kranjec Orlović, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	15+10+0+5
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	10
1.5. Status of the course	☐ mandatory	☒ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Students acquire basic knowledge of forest tree pathology and fungal pathogens. By knowing the most important and current diseases of individual genera of forest trees, students gain knowledge about the causes of diseases, their symptoms, disease development, the impact of environmental factors on the host plant 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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 2. Explain the position and trends of the forestry profession in Croatia and the world 3. Apply a simplified scientific research methods **Directed competencies (B)** 1. Develop and implement forest ecosystem management plans and programmes 2. Develop, organize and implement strategic plans and more complex tasks in forestry 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management **Organizational competencies (C)**

	1. Plan, organize and implement production organization tasks in forestry **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Identify and explain fungal plant diseases (morphology, reproduction and classification of fungi). 2. Interpret the biology and physiology of fungi (division according to lifestyle, reproduction, specialization, mutual ecological relations between fungi), and explain the pathogenesis and resistance of plants to pathogens, types and sources and process of infection, infection process, incubation, fructification, factors of resistance to pathogens, plant reactions to pathogens). 3. Analyse the most common and current fungal diseases of needles and leaves, bark, shoots, branches, trunks and roots of forest trees (disease symptoms, biology, harmful pathogens and the impact of habitat and environmental conditions on the occurrence and development of the diseases). 4. Analyse the most common fungal as cause of forest tree rot (species, the most common rot fungi in Croatia and Europe, symptoms, biology and injurious impact, consequences to the health status of infected trees, their economic value, and role in the habitat as pathogens as well as the to the forest biodiversity).
2.5. Course content (syllabus)	Lectures: 1. Definition of disease, deviations from normal plant functions, types of diseases. Disease symptoms, disease development, anatomical and physiological changes in diseased plants. 2. Fungal pathogens of plant diseases: fungi as the most numerous and most common pathogens of tree diseases, fungal morphology, fungal reproduction, classification (systematics) of fungi, saprotrophs and parasites. Reproduction of fungi, environmental impact on fungal growth and development, mutual ecological relations among fungi. 3. Disease development. Infection: infectious potential, time of infection, pathogen strength, infection process. Incubation. Fructification. 4. Diseases of needles and leaves of forest tree species. Most common and new diseases in Croatia and Europe. 7. Diseases of the bark of forest trees. Most common and new diseases in Croatia and Europe. 8. The concept and origin of rot, brown and white type of rot. Species of rot fungi of forest trees. The most common rot fungi in Croatia and Europe. Exercises in the practicum: 1. Basic structure of fungi: hyphae, mycelium, stroma, sclerotia. 2. Examples of needle and leaf diseases, symptoms, appearance and anatomical structure of fruiting bodies and spores. 3. Examples of diseases of the bark of shoots, branches and trunk, symptoms, appearance and anatomical structure of fruiting bodies and spores. 4. Examples of forest tree rot symptoms, appearance and anatomical structure of fruiting bodies and spores. e-Learning: 1. Students follow the relevant literature (articles, reviews) available through the e-system Merlin and Google Scholar and acquire

	knowledge and analyse fungal pathogens in forest ecosystems in Croatia and Europe.								
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. Student responsibilities									
2.9. Monitoring student work	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	**YES**	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)		

2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Tomiczek, C., D. Diminić, T. Cech, B. Hrašovec, H. Krehan, M. Pernek & B. Perny, 2007: Diseases and pests of urban trees. Forestry Institute, Jastrebarsko, University of Zagreb, Faculty of Forestry, 384 pp.	10	WEB
	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).	-	WEB
	Butin, H., 1995: Tree Diseases and Disorders. Oxford University Press, Oxford, 252 pp.	-	WEB
	Strouts, R.G. & Winter, T.G., 1994: Diagnosis of ill-health in trees. HMSO, London, 307 pp.	-	WEB

2.11. Optional literature	Articles and reviews on fungal pathogens of forest trees in the scientific and professional literature available through Google Scholar and other relevant e-Platforms based on teacher recommendations.
17.12. Other (as the proposer wishes to add)	

1. COURSE DECRIPTION – GENERAL INFORMATION			
1.3. Course teacher	Associate prof Vjekoslav Živković PhD Associate prof Andreja Pirc Barčić PhD	1.11. Year of the study	2.
1.4. Name of the course	**Sustainable wood products**	1.12. ECTS credits	3
1.4. Associate teachers		1.13. Type of instruction (number of hours L + S + E + e-learning)	15+15+0
1.5. Study programme (undergraduate, graduate, integrated)	Graduate	1.14. Expected enrolment in the course	5 - 10
1.6. Status of the course	Elective	1.15. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2.

2. COURSE DESCRIPTION	
2.1. Course objectives	Objective of this course is to learn the basics and to stimulate the critical thinking about the sustainability of different wood products, to make a distinction between sustainable and other wood products, to understand the Life-cycle concept, and eco-innovations.
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 2. Explain the position and trends of the forestry profession in Croatia and the world 3. Apply a simplified scientific research methods **Directed competencies (B)** 1. Develop, organize and implement strategic plans and more complex tasks in forestry **Organizational competencies (C)** 1. Plan, organize and implement production organization tasks in forestry **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3-10 learning outcomes)	To define and analyse the criteria of marking wood products as sustainable To interpret actual green initiatives To analyse and interpret carbon footprint of different products To analyze the 'life cycle thinking', concept, 'circular economy' concept and 'cradle - to - cradle' concept and critically interpret

	the advantages and challenges of application in practice in wood industry To research and interpret eco-innovation and its connection with the modernization of the company's business processes To interpret the possible extension of wood products life
2.5. Course content (syllabus)	Definition and the criteria to mark a wood product as sustainable. Wood products in the context of actual “green” initiatives: e.g. EU green deal, New European Bauhaus etc. Eco - impact of wood building products, wood-based components and structures. Carbon footprint of different wood products and in comparison with their non-wood competitors. Introduction and historical overview of the 'Life Cycle Thinking' concept, the 'circular economy' concept, and the concept of 'cradle-to-cradle' in the context of wood product. Overview of the Life Cycle Assessment (LCA) method. Advantages and disadvantages of LCA analysis. The role of sustainable production and sustainable consumption in wood industry development activities and wood products improvement. The importance of eco-innovation as a basis for circular economy development within wood industry companies. The relationship between market and eco-innovation regarding wood processing and furniture production. Extension of products life by cascade use of wood, wood modifications and their impact on sustainability.

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. Student responsibilities	Regular attendance and activity during the lectures. Essay, written and oral exam.		

2.9. Monitoring student work	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	**YES**	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	YES	NO	Practical work	YES	NO	(other)	YES	**NO**
	Project	YES	NO	Written exam	**YES**	NO	ECTS (total)	3	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Kaufmann et al: Building with timber – Paths into the future, Prestel, 2012.		Available from Lecturer

	*** (2002): Wood as an engineering material. Madison, WI: USDA For. Ser., Forest Products Lab.		Available on web
	Collection of articles on wood modifications (European conference on wood modification: 2014., 2015., 2017., 2018.)		Available from Lecturer
	Beyer et al.: Tackle Climate Change - Use Wood, CEI Bois, 2nd revision, 2011.		Available on web
2.11. Optional literature (name the title)			

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Krešimir Krapinec, PhD Assist. Prof. Kristijan Tomljanović, PhD		1.6. Year of the study	2
1.2. Name of the course	Wildlife Management		1.7. ECTS credits	5
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	30+15+16 (Field Work)
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	3.
2. COUSE DESCRIPTION				
2.1. Course objectives	To build up the knowledge for wildlife management. Developing the ability for population status assessment of particularly wildlife species, evolve assessment methods of human and society attitude toward some animal species and apply appropriate measures for particularly species population control or population restoring.			
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the			

	basis of the analysed data, and isolating different interpretations to analyse the problem in different ways **Directed competencies (B)** 1. Develop and implement forest ecosystem management plans and programmes 2. Develop, organize and implement strategic plans and more complex tasks in forestry 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 6. Organize and implement works to protect forests from abiotic and biotic factors 12. Manage forestry, human and technical resources in conducting forestry works **Organizational competencies (C)** **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Define criterion for wild animal classification (conservation and use of wild animals) 2. Feeding strategy (niche, habitat and ecosystem, competition, ecophysiological adaptations of ruminants and carnivores, splitting according to feeding strategy 3. To explain wild animals behaviour and habitat-animal interactions (displaying of behaviour, reproductive behaviour, communication, home range and territory, migrations and migratory species, habitat selection, dispersion patterns and dispersal). 4. Assessment of population dynamic, capacity (limiting factors and the law of tolerance, population structure, sustainable use) 5. Find out types of animal population management on the local and global point of view (population control, causes of extinction or endangerment of populations, introduction, reintroduction, translocation, recovery plans, management plans and legislative).
5.1. Course content (syllabus)	Lectures: 1. Grounds for managing of animals, general and anthropological overview of human-wild animals interactions around the World. – 2 hours 2. Niche, competition, habitat assessment. – 3 hours 3. Feeding behavior and feeding strategies – 3 hours 4. Animal behavior, home range, territoriality with emphasizes to reproductive behavior and reproductive strategies – 3 hours 5. Population ecology and capacities – 3 hours 6. Human-animal interaction, spotting and forecasting potential problems and problematical species. – 3 hours 7. Population control, techniques for preventing damages. – 3 hours 8. Endangered species and recovery plans (agrocenosis, woody habitats). – 4 hours 9. Legislative, management plans. – 3 hours 10. Hunting legislative and organization of hunting in Croatia – 3 hours Exercises: 1. Criterions for animal classification – 1 hour 2. Taxonomy of bird – 2 hours 3. Taxonomy of mammals – 2 hours

	4. Sexing and aging big game – 3 hours 5. Sexing and aging small game – 2 hours 6. Census techniques – 3 hours 7. Guilds – 1 hour Field work (two days): 1. Practical census and wild animal's management in lowland habitats. – 1 day 2. Wild animals management in mountain areas – 1 day

5.2. Format of instruction:		5.3. Comments:
	☒ lectures ☐ seminars and workshops ☒ exercises ☐ online in entirety ☒ partial e-learning ☒ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	

5.4. Student responsibilities	

5.5. Monitoring student work									
	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	YES	NO	Practical work	YES	NO	(other)	YES	NO
	Project	YES	NO	Written exam	YES	NO	ECTS credits (total)	5	

2.12. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Scalet, C.G., Flake, L.D., Willis, D.W., 1996: Introduction to Wildlife and Fisheries: An Integrated Approach; W.H. Freeman and Company; New York; 512 pp.	DA	
	Bolton, M., 1997: Conservation and the use of wildlife resources. Chapman & Hall; London; 278 pp	DA	
	DeGraaf, R.; Miller, R.I., 1996: Conservation of Faunal Diversity in Forested Landscapes. Chapman & Hall; 633 pp.	DA	
	Sutherland, W.J., 2006: Ecological Census Techniques – a handbook, second edition. Cambridge University Press, The Edinburgh Building, Cambridge, 432 pp.	DA	

2.11. Optional literature	
	1. Williams, B. K.; Nichols, J. D.; Conroy, M. J. 2001: Analysis and Management of Animal Population. – Modeling, estimating and decision making. Acadmic Press. 817 pp. 2. Schwartz, M.W., 1997: Conservation in higly fragmented landscapes; Chapman & Hall; New York; 436 pp.

17.13. Other (as the proposer wishes to add)	

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Danko Diminić, PhD Prof. Josip Margaletić, PhD Assis. Prof. Milivoj Franjević, PhD Assis. Prof. Marko Vucelja, PhD		1.6. Year of the study	1
1.2. Name of the course	Tree Pests and Diseases in Forest Ecosystems		1.7. ECTS credits	4
1.3. Associate teachers	Jelena Kranjec Orlović, PhD Linda Bjedov, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	30+15+0+0
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION				
2.1. Course objectives	Students are trained for analytical procedures in complex forest ecosystem management processes. They adopt modern methods and approaches and acquire competencies for decision-making and preparation of the part of the management study in the part related to the protection of forest ecosystems from biotic harmful factors. Relying on knowledge of forest pest and pathogen biology, identification and diagnosis of disease and damage symptoms, planning of forest pest and disease control strategy (importance and role, preventive and curative measures of active protection, identification of the most common pests and diseases, symptoms). In particular, link the impact of invasive alien species and the consequences of their entry into forest ecosystems, diseases and pests control system, quarantine and plant protection system and the most effective methods of prevention and treatment (surveillance, early control, slowing the spread of pests and diseases) in the context of known			

	measures and integrated forest protection procedures. Through the adoption of modern methods and approaches, students acquire competencies for decision-making and preparation of forest habitat management plans in the part related to forest protection.
2.2. Enrolment requirements and/or entry competences required for the course	Entry competencies: basic knowledge of insects, mammals and fungi.
2.3. Learning outcomes at the level of the programme to which the course contributes	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 2. Explain the position and trends of the forestry profession in Croatia and the world 3. Apply a simplified scientific research methods **Directed competencies (B)** 1. Develop and implement forest ecosystem management plans and programmes 2. Develop, organize and implement strategic plans and more complex tasks in forestry 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 4. Organize and implement professional field tasks to establish, cleaning, thinning and regeneration of forest stands **Organizational competencies (C)** 1. Plan, organize and implement production organization tasks in forestry 2. Plan and calculate production, calculate the basic business success indicators, draft basic financial reports, recognize types of costs, define and analyse costs **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Identify and analyse harmful species of insects and rodents and tree pathogens of floodplain forest ecosystems through their harmful role, alone or in synergy with other factors. This forms the basis for an integrated approach to measures to protect the main tree species of lowland and flooded forest ecosystems in order to prevent, reduce damage and repair the damage, with special reference to the conditions of exposure of forest ecosystems to climate change. To connect invasive foreign species of pests and diseases, and the consequences of their entry into forest ecosystems, control system, plant quarantine, and the most effective methods of prevention and cure (control, early eradication, slowing down the spread). 2. Analyse harmful species of insects and rodents and tree pathogens of lowland forest ecosystems through their harmful role, alone or in synergy with other factors. This forms the basis for an integrated approach to measures to protect the main tree species of lowland and flooded forest ecosystems in order to prevent, reduce damage and repair the damage, with special reference to the conditions of exposure of forest ecosystems to climate change. 3. Analyse harmful insect species and tree pathogens of mountain and mountain forest ecosystems through their harmful role,

	alone or in synergy with other factors. This forms the basis for an integrated approach to measures to protect the main tree species of lowland and flooded forest ecosystems in order to prevent, reduce damage and repair the damage, with special reference to the conditions of exposure of forest ecosystems to climate change. 4. Analyse harmful insect species and tree pathogens of Mediterranean forest ecosystems through their harmful role, alone or in synergy with other factors. This forms the basis for an integrated approach to measures to protect the main tree species of lowland and flooded forest ecosystems in order to prevent, reduce damage and repair the damage, with special reference to the conditions of exposure of forest ecosystems to climate change. 5. Present the results of the conducted analyses in order to apply them in order to protect naturally managed forests from harmful biotic factors.
2.5. Course content (syllabus)	Lectures: 1. Introduction, the harmful role of biotic factors and their negative impact on the health status of individual trees and forest ecosystems, alone or in synergy with other biotic factors 2. Forest communities of floodplain ecosystems (in general). Diseases and pests of major tree species. All current biotic harmful factors that by their individual or joint (synergistic) action affect or may affect the stability of floodplain forest ecosystems in the conditions of exposure to climate change are analysed. The anthropogenic impact on forest ecosystems is analysed, and a special review of invasive indigenous and non-indigenous species is given. An integrated approach to measures to protect the main tree species of forest ecosystems in order to prevent, reduce the occurrence of damage and repair the damage. 3. Forest communities of lowland ecosystems (in general). Diseases and pests of major tree species. All current biotic harmful factors that by their individual or joint (synergistic) action affect or may affect the stability of lowland forest ecosystems in the conditions of exposure to climate change are analysed. The anthropogenic impact on forest ecosystems is analysed, and a special review of invasive indigenous and non-indigenous species is given. An integrated approach to measures to protect the main tree species of forest ecosystems in order to prevent, reduce the occurrence of damage and repair the damage. 4. Forest communities of mountain ecosystems (in general). Diseases and pests of major tree species. All current biotic harmful factors that by their individual or joint (synergistic) action affect or may affect the stability of mountain forest ecosystems in the conditions of exposure to climate change are analysed. The anthropogenic impact on forest ecosystems is analysed, and a special review of invasive indigenous and non-indigenous species is given. An integrated approach to measures to protect the main tree species of forest ecosystems in order to prevent, reduce the occurrence of damage and repair the damage. 5. Forest communities of Mediterranean forest ecosystems (in general). Diseases and pests of major tree species. All current biotic harmful factors that by their individual or joint (synergistic) action affect or may affect the stability of Mediterranean forest ecosystems in the conditions of exposure to climate change are analysed. The anthropogenic impact on forest ecosystems is analysed, and a special review of invasive indigenous and non-indigenous species is given. Integrated approach to measures to protect the main tree species of forest ecosystems in order to prevent, reduce the occurrence of damage and repair the

	damage. Exercises in the practicum: 1. On the examples of current diseases, insect pests and small rodents, symptoms and damages caused by them, their biology, their individual influences and indirect synergistic effects on the health status of the main tree species of floodplain forest ecosystems are analysed. Symptoms of diseases and pest attacks, damage assessment, techniques and methods for determining pest population density, PRA (pest risk analysis). Methodology for monitoring the number and damage of small rodents in forest ecosystems (review of monitoring methods, previous experiences of monitoring the number and determining the damage from rodents, development of forecast models). Protection against zoonosis transmitted by small rodents (Rodentia) and hard ticks (Ixodidae) in natural habitats. Application of the principles of integrated protection against pests and diseases. 2. On the examples of current diseases, insect pests and small rodents, symptoms and damages caused and their biology, their individual influences and indirect synergistic effects on the health status of the main tree species of lowland forest ecosystems are analysed. Symptoms of diseases and pest attacks, damage assessment, techniques and methods for determining pest population density, PRA (pest risk analysis). Methodology for monitoring the number and damage of small rodents in forest ecosystems (review of monitoring methods, previous experiences of monitoring the number and determining the damage from rodents, development of forecast models). Protection against zoonosis transmitted by small rodents (Rodentia) and hard ticks (Ixodidae) in natural habitats. Application of the principles of integrated protection against pests and diseases. 3. On the examples of current diseases and insect pests, symptoms and damages caused and their biology, their individual influences and indirect synergistic effects on the health status of the main tree species of mountain forest ecosystems are analysed. Symptoms of pest and pathogen attacks, damage assessment, techniques and methods for determining pest population density, PRA (pest risk analysis). Application of the principles of integrated protection against pests and diseases. 4. On the examples of current diseases and insect pests, symptoms and damages caused and their biology, their individual influences and indirect synergistic effects on the health status of the main tree species of Mediterranean forest ecosystems are analysed. Symptoms of pest and pathogen attacks, damage assessment, techniques and methods for determining pest population density, PRA (pest risk analysis). Application of the principles of integrated protection against pests and diseases. Seminars: 1. Through seminar work, students individually or in groups analyse pathogens, harmful insect pests and small rodents in floodplain forest ecosystems according to principles of close-to-nature forest management. 2. Through seminar work, students individually or in groups analyse pathogens, harmful insect pests and small rodents in lowland forest ecosystems according to principles of close-to-nature forest management.

	3. Through seminar work, students individually or in groups analyse pathogens, harmful insect pests and small rodents in mountain forest ecosystems according to principles of close-to-nature forest management. 2. Through seminar work, students individually or in groups analyse pathogens, harmful insect pests and small rodents in Mediterranean forest ecosystems according to principles of close-to-nature forest management. e-Learning: 1. Students follow the relevant literature (articles, reviews) available through the e-system Merlin and Google Scholar, acquire knowledge and analyse the causes of diseases, harmful insect pests and rodents in floodplain forest ecosystems in Croatia and Europe. 2. Students follow the relevant literature (articles, reviews) available through the e-system Merlin and Google Scholar, acquire knowledge and analyse the causes of diseases, harmful insect pests and rodents in lowland forest ecosystems in Croatia and Europe. 3. Students follow the relevant literature (articles, reviews) available through the e-system Merlin and Google Scholar, acquire knowledge and analyse the causes of diseases and harmful insect pests in mountain forest ecosystems of Croatia in Europe. 4. Students follow the relevant literature (articles, reviews) available through the e-system Merlin and Google Scholar, acquire knowledge and analyse the causes of diseases and harmful insect pests in the Mediterranean forest ecosystems of Croatia in Europe.

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. Student responsibilities			

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

2.10. Required literature (available in the library	**Title**	**Number of copies in the library**	**Availability via other media**

and/or via other media)	Group of authors (J. Vukelić, ed.) 2005: Floodplain forests in Croatia. Academy of Forestry Sciences, Zagreb, 455 pp.	10	WEB
	Group of authors (M. Oršanić, ed.) 2020: Ecology, restoration and protection of floodplain forests of Posavina. University of Zagreb, Faculty of Forestry, Zagreb, 368 pp.	10	WEB
	Group of authors (D. Klepac, ed.) 1996: Pedunculate oak (*Quercus robur* L.) in Croatia. Academy of Forestry Sciences, Zagreb, 559 pp.	10	WEB
	Group of authors (S. Matić, ed.) 2003: Common beech (*Fagus sylvatica* L.) in Croatia. Academy of Forestry Sciences, Zagreb, 855 pp.		WEB
	Group of authors (B. Prpić, ed.) 2001: Common fir (*Abies alba* Mill.) In Croatia. Academy of Forestry Sciences, Zagreb, 895 pp.	10	WEB
	Group of authors (S. Matić, ed.) 2011: Forests of the Croatian Mediterranean. Academy of Forestry Sciences, Zagreb, 740 pp.	10	WEB
2.11. Optional literature	Articles and reviews on diseases, insect pests and rodents of forest trees published in the scientific and professional literature available on Google Scholar and other relevant e-Platforms based on the recommendations of teachers.		
2.12. Other (as the proposer wishes to add)			

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Jura Čavlović, Ph.D.		1.6. Year of the study	2
1.2. Name of the course	Forest Management and Planning		1.7. ECTS credits	5
1.3. Associate teachers	Assoc. Prof. Krunoslav Teslak, Ph.D.		1.8. Type of instruction (number of hours L + E + S + e-learning)	30 + 15 + 16(Field work)
1.4. Study programme (undergraduate, graduate, integrated)	graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2., 10%
2. COUSE DESCRIPTION				
2.1. Course objectives	Goal of this subject is acquiring of knowledge and skills in the synthesis of basic forestry disciplines regarding forest management, as well as the skills for using concrete forest management plans and skills of elaboration of forest management plans. In the framework			

	of this course, based on the results of compiling and surveying, processing and analysis of spatial data for a concrete forest and the management, as well as the synthesis of all forestry disciplines by means of lectures, laboratory work and field work, students will take active part in a complete preparation procedure of management plan elaboration for a concrete forest (management unit), aimed to acquire knowledge on key integral parts of the management plan, as well as planning skills for management procedures at the level of stand and the level of forest.
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 2. Explain the position and trends of the forestry profession in Croatia and the world **Directed competencies (B)** 1. Develop and implement forest ecosystem management plans and programmes 2. Develop, organize and implement strategic plans and more complex tasks in forestry 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 5. Organize and implement works in forest inventory and pruning 12. Manage forestry, human and technical resources in conducting forestry works **Organizational competencies (C)** 3. Manage the most complex tasks in all forms of forestry organizations **Other competencies (D)**
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. To explain, to derive and to calculate models of theoretical forest (regulated forest) under even-aged, selection and multi-aged management systems, and corresponding possible (theoretical) cut in regulated forest (felling-regeneration cut, thinning cut, cut in selection/multi-aged forest). 2. To analyse and to present past management and development of forest resources (impact of natural and anthropogenic factors, usage of relevant dana source, impact of management on ageclass/diameter-class development, review of realized cut and management activities). 3. To assess, to measure, to calculate and to present actual state of forest resources (social-economictechnological factors, elements of site and stand structure, stand border and area, derived structure elements, age-class and diameter-class forest structure, relation between actual and theoretical age-class/diameter class structure). 4. To explain, to project and to valuate elements of prognosis and planning of future forest resources management (types of prognosis and simulation methods of future development, defining of forest management objectives, tending and regeneration influence on forest development, projection of stand selection structure and influence of changes of age class distribution). 5. To calculate and to plan amount and structure of cut and other management activities (thinning cut on stand and forest level,

	regeneration cut on stand and forest level, selection cut on stand and forest level, silvicultural treatments and approaches of forest protection, game management, forest roads and openings, methods of wood extraction)
2.5. Course content (syllabus)	Lectures: 1. Introduction, content and literature. Defining of importance and role of forests, forest regulation and forest management planning 2. Systems of forest management. Advantages/disadvantages of several management system. Selection of appropriate management system. Characteristics of forest sites and stand structure. 3. Dynamics and characteristics of even-aged stand development and of structure changes of selection/uneven-aged stand. Structure of growing volume and volume increment. 4. Principles of sustainable forest management and defining of theoretical models of forests (methods of: mean annual increment of mature age, GYT-s, age-class distribution, growth models, arithmetic series of selection stands, geometric series of selection stands). Defining of theoretic amounts of thinnings, regeneration fellings of even-aged stands and selection fellings. 5. Temporal and spatial components of forest regulation and management planning. Forest maturiti, rotation, selection cutting cycle, target diameter. Levels of forest division: clasification of forest areas, basic division of forests (management units), division of management unit. 6. Forest management planning process (content and analyses) in relation to content and structure of strategic and operational forest management plans. 7. Purpose, importance and specifics of analyses of past forest development. Analyses of social-economic trends and processes. Review of past management in management plans and plan proceeding. 8. Assessment of actual (present) state of forest resource. Type of information and information extraction of forest state and management. State of social and economic-technological factors, and state of nature factors and comparison with past (forest area, land use, forest trees within agricultural land, forest sites. 9. Assessment of actual (present) state of nature factors and comparison with past (forest stands, growing volume, volume increment, defining and description of management classes, age class structure of forest, diameter class structure of forest, health status of forest) 10. Defining of forest management objectives and aims. Forest management objectives: types, spatial levels, approaches, dynamics and rules of defining. Planning of strategy, guidelines and approaches of forest management. Starting points, basic techniques of planning. 11. Planning of forest development. Strategy of forest regeneration, tending and protection. Basic planning on management class level. Silvicultural aims and management guidelines. Detail planning of forest development. 12. Planning of available cut. General starting points and elements. Prescribing of cut – even-aged management system: F-2, F-6 and F-7. 13. Prescribing of cut in selection forest management: general, stand level – F-3, forest level – F-8. 14. Analysis of past and projection of future management of selection forest – management unit case study. 15. Planning of other management activities: silvicultural treatments and approaches of forest protection, game management, forest

roads and openings, methods of wood extraction. Adaptive forest management.

Exercises

1. Forest management plan elaboration – planning end performance of field works.
2. Preparation and processing of assessed and measured elements of site and of stand structure.
3. Area review of forests and forest land – assessment of stand areas.
4. Stand delineation, elements of site characteristics and stand structure in even-aged and selection stands – site and stand description.
5. Elements of site characteristics and stand structure in even-aged and selection stands – construction of height curves and volume tables (models).
6. Elements of site characteristics and stand structure in even-aged and selection stands – calculation of quantitative structure elements.
7. Assessment of site quality, defining of management classes, theoretic models and management aims.
8. Tables of age class distribution of the even-aged forest – comparison between actual and theoretical structure.
9. Tables of diameter class distribution of the selection forest – comparison between actual and theoretical structure.
10. Analysis of past development of age-class/diameter-class structure, and prescribed vs. realised cut amount.
11. Prescription of future management, allowed cut on stand and forest level for even-aged forest management system.
12. Prescription of future management, allowed cut on stand and forest level for selection forest management system.
13. Prescriptions of silviculture treatments and measures of forest protection.
14. Approach of forest management plan evaluation. Computer programs for forest management planning.
15. Computational revision of forest management plan. Method of tree crossing.

Field work:

1. First day. In a case-study management unit based on the processed and assessed data of site and stand characteristics, and acquired experience of spatial characteristics within 35-ha compartment, students on field perform dividing of the compartment on potential stands (sub-compartments), and record border between stands in compartment, to assess area of each stand and to group (join) belonging sample plots to each stand, followed with processing of measured and assessed qualitative and quantitative data on the stand level.

2. Second day. After left side (actual state of stand) of form F-2 filled (Exercises), students on field on appropriate samples assess elements needed for prescription of future management related on stand regeneration and stand tending and thinning. Approach is based on data in F-2 and relevant equations – and on the field is perform check of prescriptions (possibility of realization), aimed to get feed-back information to correct eventually wrong prescribed cut amount.

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. Student responsibilities			

2.9. Monitoring student work									
Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
Experimental work	YES	NO	Report	**YES**	NO	(other)	YES	NO
Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
Preliminary exam	**YES**	NO	Practical work	**YES**	NO	(other)	YES	NO
Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	5	

2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Bettinger P, Boston K, Siry JP, Grebner DL (2009). Forest management and Planning. Academic Press, eBook ISBN: 9780080921587, 360 p.		
	Davis, LS, Johnson KN (1987). Forest management. McGraw-Hill Book Company, New York.		
	Čavlović, J (2013). Osnove uređivanja šuma. Šumarski fakultet Sveučilišta u Zagrebu, Zagreb, 322 p.	YES	
	Čavlović, J., Teslak, K.: Presentations from classes and practice.		MERLIN

2.11. Optional literature	
	Čavlović, J., Antonić, O., Božić, M., Teslak, K., 2012: Long-term and country scale projection of even-aged forest management: a case study for *Fagus sylvatica* in Croatia. *Scandinavian Journal of Forest Research,* 27 (1): 36-45. Čavlović, J., Kremer, D., Božić, M., Teslak, K., Vedriš, M., Goršić, E., 2010: Stand growth models for more intensive management of Juglans nigra: A case study in Croatia. *Scandinavian Journal of Forest Research*, 25(2): 138-147 Čavlović, J., Božić, M., Bončina, A., 2006: Stand structure of an uneven-aged fir-beech forest with an irregular diameter structure: modeling the development of the Belevine forest, Croatia. European Journal of Forest Research 125(4): 325-333 Čavlović, J., Bončina, A., Božić, M., Goršić, E., Simončić, T., Teslak, 2015: Depression and growth recovery of silver fir in uneven-aged Dinaric forests in Croatia from 1901 to 2001, *Forestry*, 07/2015. Bončina, A., Čavlović, J., Curović, M., Govedar, Z., Klopčić, M., Medarević, M., 2014: A comparative analysis of recent changes in Dinaric uneven-aged forests of the NW Balkans. *Forestry*, 87: 71-84.

	Beljan K., Posavec S., Čavlović J., Teslak K., Knoke T., 2019: Economic Consequences of Different Management Approaches to Even-Aged Silver Fir Forests. Croatian Journal of Forest Engineering, 39(2): 299-312.
2.13. Other (as the proposer wishes to add)	

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Željko Zečić, PhD Assist. Prof. Dinko Vusić, PhD Prof. Francisco X. Aguilar, PhD		1.6. Year of the study	2
1.2. Name of the course	Sustainable Forest Products		1.7. ECTS credits	5
1.3. Associate teachers	Prof. Željko Zečić, PhD Assist. Prof. Dinko Vusić, PhD Prof. Francisco X. Aguilar, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	30+15+16(Field Work)
1.4. Study programme (undergraduate, graduate, integrated)	graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION				
2.1. Course objectives	The aim of this course is to introduce students to all forest products and their use, with particular emphasis on the aspect of sustainability in their production and use. Students will acquire the knowledge and skills necessary for the preparation, implementation and supervision of the production of wood forest products and the preparation of documentation when placing forest products on the market.			
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	**General competencies (A)** **Directed competencies (B)** 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 10. Apply knowledge on the main and secondary forestry products and ecosystem services **Organizational competencies (C)** 1. Plan, organize and implement production organization tasks in forestry **Other competencies (D)**
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Present the division of forest products (classification and reporting of wood forest products according to UNECE / FAO methodology, nomenclature of commercial tree species, classification of tree biomass according to standards, wood and non-wood forest products) 2. Analyze methods of forest products records (traditional and current methods, methods of measurement according to different standards, methods of measurement and expression of results) 3. Classify wood forest products according to the different standards (wood defects, quality grading, minimum dimensions and allowed defects, quality assurance system). 4. Valorize non-wood forest products.
2.5. Course content (syllabus)	Lectures 1. Sustainable supply of forest products. Concept of sustainable forest management. Forestry and Sustainable Development Goals. 2. Terminology and classification of forest products. 3. Forest products global market. Trends in production, trade and consumption of forest products. 4. Forms and properties of wood forest products through history - the dynamics of change with reference to the stage of development of techniques and technology. 5. Documentation in wood forest products production. Measurement methods and calculation of results. Conversion factors. 6. Defects and features of wood. 7. Classification of deciduous roundwood. Quality classes; minimum dimensions and permissible defects. 8. Classification of coniferous roundwood. Quality classes; minimum dimensions and permissible defects. 9. Classification of pulpwood. Quality classes; minimum dimensions and permissible defects. 10. Classification of energy wood. Types and quality classes of energy wood. 11. Forestry as a producer of renewable energy. Biofuels and bioenergy. 12. Forest products and carbon sequestration. Cascading use of wood. 13. Non-wood forest products. 14. Responsible trade in forest products. Implementation of EUTR and FLEGT Regulation. 15. Certification and labelling of forest products. Implementing forest certification schemes in the supply chain. Exercises 1. Wood as a renewable material. General properties.

	2. Biomass equations and expansion factors. 2. UNECE/FAO methodology in forest products statistics. 3. Measuring timber assortments and determining quantity. 4. Defects and features of wood – determination. 5. Defects and features of wood – measurement. 6. Bucking simulation and roundwood value. 7. Preparation of documentation for the sale of timber assortments. 8. Sampling of solid biofuels. Design of sampling plan and preparation of laboratory sample. 9. Wood chips bulk density determination. 10. Wood chips moisture content determination. 11. Wood chips ash content determination. 12. Wood chips particle size determination. 13. . Wood chips calorific value determination. 14. Calculation and reporting of results. Conversion factors. 15. Certification and labelling of forest products – preparation of documentation. Field work Bucking and classification of timber assortments; the concept of maximum natural utilization and the concept of maximum financial utilization. Defects and features of wood – the impact on the properties of the product. Use of wood as an energy source.

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. Student responsibilities	Regular class attendance. Taking a colloquium or exam.		

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

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Zečić, Ž., Vusić, D., 2020: Katalog drvnih šumskih proizvoda. Sveučilište u Zagrebu Šumarski	20	

	fakultet, 1–217. (selected sections translated to English)		
	United Nations, Economic Commission for Europe, 2018: Wood Energy in the ECE Region: Data, trends and outlook in Europe, the Commonwealth of Independent States and North America. Aguilar, Francisco X. (ur.)., Geneva, 1–93.		web
	UNECE: Forest Products Annual Market Review (last edition).		web
2.11. Optional literature	Hakkila, P., 1989: Utilization of Residual Forest Biomass. Springer-Verlag, Berlin, 1–568.		
2.14. Other (as the proposer wishes to add)			

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Tibor Pentek, PhD		1.6. Year of the study	1.
1.2. Name of the course	Forest roads		1.7. ECTS credits	5
1.3. Associate teachers	Assist. Prof. Ivica Papa, PhD Prof. Igor Potočnik, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	24 + 26 + 16 (FE) + 10
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION				
2.1. Course objectives	The objective of the subject Forest communications is a transfer of knowledge to students about the role of forest communications in a forest ecosystem, their classification, basic procedures of establishing an optimal forest roads network in a field with special emphasis on the planning and designing phases. Also, through lectures, exercises and field classes students obtain specific knowledge applicable in forest 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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods **Directed competencies (B)** 9. Apply knowledge of techniques and technologies to open forests and build forest roads 13. Improve the existing technology and introduce new technologies **Organizational competencies (C)** **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Lectures 1. Introduction. Basic division of forest roads. Role and basic tasks of forest roads during forest management. Legal (primary) framework and secondary legislation connected with phases of planning, design and construction of forest roads. 2. Technical features of forest roads – basic terms and definitions. Phases of establishing optimal forest road network. 3. Forest road planning – basic terms, definitions. Strategic planning of forest roads. Tactical planning of forest roads. Operational planning of forest roads. 4. Parameters for estimating the quantity and quality of forest road network. Definitions, formulas and interrelations. Classical forest accessibility. 5. Mean extraction distance. Relative forest openness. Space between forest roads. 6. Primary forest accessibility – different systems of primary forest accessibility. Secondary (fine) forest accessibility – different systems of secondary forest accessibility. 7. Forest road design – basic terms, definitions. Basic types of forest road designs. Conceptual design of forest road – basic components. General design of forest road – basic components. Final design of forest road – basic components. 8. Collection of general data. Forest road routing. Direct pole setting. Indirect pole setting. 9. Constructive elements of forest roads. Horizontal road route of forest road. Vertical road route – normal and graphical cross-sections of forest roads. 10. Cross-section of forest roads. Normal cross-section of forest roads 11. Lower forest road layer, basic terms and definitions. Upper forest road layer, basic terms and definitions. 12. Construction of forest roads using different technologies (on different terrains). 13. Organization, management and supervisor of forest roads construction. 14. Causes and types of forest road damage. Maintenance/repair of forest roads. Regular maintenance of forest roads. Investment maintenance of forest roads. Periodical maintenance of forest roads. 15. Preparatory lecture for field classes.

Practical exercises

1. Forming databases. Establishment of GIS of the research area. Defining classical forest accessibility of research area with extracting unopened area.
2. Basic phases of establishing optimal forest road network on the field. Fundamental differences between strategic, tactical and operational planning of forest roads. Operational planning of forest roads, basic terms and definitions.
3. Zero-line polygon, calculate the slope of individual segments and design the zero-line polygon on a digital map.
4. Basic principles of working with the “CESTA” software. Work with Menus. (General principles of working with Menu functions). Creating a new design with the definition of basic principles (open a new design, new variants of an existing design, general information, accessory tools, work area).
5. Inserting terrain measurements obtained through contemporary methods. Preparation and automatized insertion of terrain measurement data (defining the layout of data and quick transfer of important points by layer).
6. Classical method of terrain measurement and insertion of measurement data. Insertion of axial polygon (insertion of all layouts with explanations of different possible insertion methods). Editing horizontal curves (editing the existing polygon points, radiuses, pavement widenings).
7. Control method for the calculation of altitudes. Insertion of altitudes and cross sections in route layouts.
8. Principles of working with the CS (cross section) Menu. Definition of road sections and insertion of construction material categories. Linking field and design data.
9. Editing the profile and adjusting the settings of a selected forest road category.
10. Principles of working with the VS (vertical section) Menu. Fitting the incurved grade level. Vertical curves – curved grade level.
11. Adjusting the settings for normal cross sections (determining the cut slope and the fill slope, defining the components of the normal cross section – widenings, ditches, the thickness of the pavement structure, etc.). Verifying and editing cross sections (verification of the heights of cut and fill slopes, correction of “fake” cuts).
12. Description of the calculation of earth volume. Defining the minimum distance for transport. Earth volume diagram. Editing the curved grade.
13. Positioning of the road structures. Passing-by areas, landings, turning points. Editing the situational design. Drawing up of the road stakeout.
14. Defining the pavement construction. Calculation of the cut slope/fill slope. Layer volume calculation. Calculation of the surfaces of the subgrade daylight distance, the subbase and the base (execution of all written computing components of the forest road design).
15. Technical report. Drawing up the bill of quantities. Drawing up the cost estimation. Defining and printing of all components.

Field classes

In field classes students apply the knowledge acquired in lectures and practical exercises using a specific example of forest road

	design. After determination cardinal points of the future forest road route, they calculate and design the zero-line polygon on field. Later in to the zero-line polygon students fit operational and at the end axial polygon, by using contemporary terrain measurement methods and collect all necessary terrain data needed to develop the main/final forest road design.
2.5. Course content (syllabus)	

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

2.8. Student responsibilities								
2.9. Monitoring student work	Class attendance	**YES**	NO	Research	YES	**NO**	Oral exam	**YES**	NO
	Experimental work	YES	**NO**	Report	YES	**NO**	(other)	YES	NO
	Essay	YES	**NO**	Seminar paper	**YES**	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	**YES**	NO	(other)	YES	NO
	Project	**YES**	NO	Written exam	**YES**	NO	ECTS credits (total)	5	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Pentek, T., 2021: Forest roads (.pptx lectures 1-15: selected parts of selected lectures translated to English), Faculty of Forestry, University of Zagreb.	NO	Yes, Merlin
	Pentek, T., 2021: Forest accessibility (.pptx lectures 1-15: selected parts of selected lectures translated to English), Faculty of Forestry, University of Zagreb.	NO	Yes, Merlin
	Pentek, T., 2021: Forest road design (.pptx lectures 1-15: selected parts of selected lectures translated to English), Faculty of Forestry, University of Zagreb.	NO	Yes, Merlin
	Pičman, D., 2007: Forest roads (university textbook), Faculty of Forestry, University of Zagreb, pp 1-460, chosen chapters translated to English.	YES	
	Dietz, P., H. Löffler, & W. Knigge, 1984: Walderschließung, Eine Lehbruch für Studium und Praxis unter besonderer Berücksichtigung des Waldwegebaus. Verlag Paul Parey, Hamburg und Berlin, pp 1-196,	YES	
2.11. Optional literature	Scientific and professional papers on the subject issues of domestic and foreign authors published in scientific journals and		

	conference proceedings. 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. Pentek, T., Đuka, A., Papa, I., Damić, D., Poršinsky, T., 2016: The effectiveness study of primary forest road traffic infrastructure – an alternative to study of primary forest opening or just a short-term solution? Šum. list 140(9–10): 435–453. 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.
2.12. Other (as the proposer wishes to add)	

1. GENERAL INFORMATION				
1.1. Course teacher	Assist. Prof. Marko Vucelja, PhD		1.6. Year of the study	2
1.2. Name of the course	Behavioural ecology		1.7. ECTS credits	3
1.3. Associate teachers	Prof. Josip Margaletić, PhD Linda Bjedov, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	10+0+15+5
1.4. Study programme (undergraduate, graduate, integrated)	Graduate: Close to Nature Forestry		1.9. Expected enrolment in the course	10
1.5. Status of the course	☐ mandatory	☒ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	This course should familiarize students with central features in behavioural ecology and animal behaviour in an evolutionary perspective. Obtained knowledge should also provide the forestry students with a link between the importance of behavioural ecology and conservation of wild animals.
2.2. Enrolment requirements and/or entry competences required for the course	Completed undergraduate study program
2.3. Learning outcomes at the level of the programme to which the course contributes	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways **Directed competencies (B)** 1. Develop and implement forest ecosystem management plans and programmes

	3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 7. Draft ecological studies and implement ecological forest monitoring **Organizational competencies (C)** **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Identify the main scientists and their research that set the foundations of ethological research. 2. Identify the difference between the ultimate and proximal causes of animal behaviour. 3. List the types of innate and learned behaviours. 4. Identify the mechanisms responsible for the innate and learned behaviour. 5. Identify examples of natural and sexual selection and the impact of both on the development and behaviour of animal species. 7. Identify in nature different types of behaviour and appearance of animals due to natural and sexual selection. 8. Classify different reproductive strategies of animals with an emphasis on monogamy and polygamy. 9. Identify various mechanisms in females and males responsible for brood care. 10. Identify sexual dimorphism and identify intrasexual and intersexual selection.
2.5. Course content (syllabus)	2. Introduction to behavioural ecology: history background with emphasis on work of Tinbergen, Lorenz and Darwin. Explanation of basic terms and definitions needed for understanding the behavioural and ecological studies. 3. Introducing different types of behaviour; different analysis and interpretations of behaviour. 4. Proximate and ultimate mechanisms of behaviour 5. Evolution of behaviour: Understanding behaviour through mechanisms of sexual and natural selection. 6. Intra- and inter- specific interactions 7. Foraging theory 8. Learning in animals: operant and classical conditioning, non-associative learning, imprinting 9. Selection types: balancing, directional, disruptive, stabilizing, r-strategy and k-strategy 10. Aggressive and territorial behaviour 11. Hormones and behaviour 12. Social behaviour in animals and humans 13. Conservation biology 1 14. Conservation biology 2 15. Importance of behavioural in comparison of different field of study (ecology, neurobiology, sociology and psychology) 16. Short summary of lectures 1-12; consultation for students with questions concerning the lectures
2.6. Format of instruction:	☒ lectures ☒ seminars and workshops ☐ exercises ☐ online in entirety ☒ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor
	2.7. Comments:

	☒ partial e-learning ☐ field work	☐ (other)	
2.8. Student responsibilities	Mandatory class attendance, seminar papers, oral presentation		

2.9. Monitoring student work									
	Class attendance	**YES**	NO	Research	**YES**	NO	Oral exam	YES	NO
	Experimental work	YES	NO	Report	**YES**	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	**YES**	NO	(other)	YES	NO
	Preliminary exam	YES	NO	Practical work	YES	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	4	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Alcock J. Animal Behavior: An Evolutionary Approach. Seventh Edition. Sunderland (MA): Sinauer Publishers, 2001.	NO	e-learning platform „Merlin“

2.11. Optional literature	1.Eibel-Eibesfeldt, I. Grundriss der vergleichenden Verhaltensforschung. München : Verlag Piper, 1969. 2. Pullin, A. S. Conservation Biology. Cambridge University Press, 2002.
2.15. Other (as the proposer wishes to add)	

1. GENERAL INFORMATION			
1.1. Course teacher	Assoc. Prof. Mislav Vedriš, PhD	1.6. Year of the study	2
1.2. Name of the course	Inventory of greenhouse gases in forestry	1.7. ECTS credits	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + E + S + e-learning)	15+15+0

1.4. Study programme (undergraduate, graduate, integrated)	Graduate (master)		1.9. Expected enrolment in the course	
1.5. Status of the course	☐ mandatory	☒ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION				
2.1. Course objectives	Learn importance of forests and forestry in sequestration of atmospheric greenhouse gases. Get to know the components of reporting system for emission and removal of greenhouse gases. International agreements that regulate reporting on world and national level. Get to know procedures for data collection and calculation on state level and in forestry sector.			
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 3. Apply a simplified scientific research methods **Directed competencies (B)** 5. Organize and implement works in forest inventory and pruning 7. Draft ecological studies and implement ecological forest monitoring **Organizational competencies (C)** **Other competencies (D)** 1. perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry			
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Appoint and describe basic terms in emission/removal of greenhouse gases, their monitoring and reporting 2. Relate and explain components of reporting system (activities, institutions, sources/sinks) 3. Recognize the importance of forests and forestry for reporting of greenhouse gases 4. Explain the role of forest inventory in collection of data on greenhouse gases 5. Calculate the level of greenhouse gases based on available data in forestry sector 6. Compare levels of greenhouse gas emission between states and in time series 7. Assess reporting system based on accessibility of data and calculation methods 8. Determine possibilities for improvement the emission reporting 9. Propose measures to sustain and increase the removals of greenhouse gases in forestry			
2.5. Course content (syllabus)	1. Atmospheric greenhouse gases, their sources, origin and influence on climate change (2L+0E) 2. Role of forests and forestry in removal of greenhouse gases (2L+0E) 3. Institutions appointed for reporting greenhouse gases on world, European and national level (UN, EU, Ministry) (2+0)			

	4. International, European and national agreements and regulations on greenhouse gases (2+1) 5. Definitions and methodology of reporting greenhouse gases (1+2) 6. Data collection – measurement and monitoring the factors for emission/removal of greenhouse gases (1+2) 7. Forest inventory as a source for greenhouse gases data (1+2) 8. Calculation and reporting an annual state of greenhouse gases in forestry sector on a state level (1+4) 9. Influence of emission/removal of greenhouse gases and regulations on forest management (1+2) 10. Possibilities of forest management practices to increase a sequestration of greenhouse gases 1+1) 11. Emission trading on international level – "carbon market" (1+1)

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

2.8. Student responsibilities	

2.9. 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	YES		Practical work		NO	(other)		
	Project	YES		Written exam	YES		ECTS credits (total)	4	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Lecture materials	NO	e-learning system
	Ministarstvo zaštite okoliša i energetike, 2020. Croatian greenhouse gas inventory for the period 1990 – 2018 (National Inventory Report 2020)	NO	pdf, free access via internet
	Pearson, T.R.H.; Brown, S.L.; Birdsey, R.A. 2007. Measurement guidelines for the sequestration of forest carbon. Gen. Tech. Rep. NRS-18. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 42 pp.	NO	pdf, free access via internet
	Ravindranath, N.H., and M. Ostwald, M.2008. Carbon Inventory Methods. Handbook for Greenhouse Gas Inventory, Carbon Mitigation and Roundwood Production Projects. Springer, 315. pp.	NO	pdf, free access via internet
	The Intergovernmental Panel on Climate Change (IPCC), 2006. 2006 IPCC Guidelines for	NO	pdf, free access

	National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.		via internet
	The Intergovernmental Panel on Climate Change (IPCC), 2014. 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Hiraishi, T., Krug, T.,Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds) Published: IPCC, Switzerland. 268 pp.	NO	pdf, free access via internet
2.11. Optional literature	1. Berndes, G., Abt, B., Asikainen, A., Cowie, A., Dale, V., Egnell, G., Lindner, M., Marelli, L., Paré, D., Pingoud, K., Yeh, S. 2016. Forest biomass, carbon neutrality and climate change mitigation. From Science to Policy 3. European Forest Institute. 28 pp. 2. Broekhoff, D., Gillenwater, M., Colbert-Sangree, T., and Cage, P. 2019. Securing Climate Benefit: A Guide to Using Carbon Offsets. Stockholm Environment Institute & Greenhouse Gas Management Institute. 60 pp. 3. GOFC-GOLD, 2010, A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation. GOFC-GOLD Report version COP16-1, GOFC-GOLD Project Office, Natural Resources Canada, Alberta, Canada. 210 pp. 4. Iversen P., Lee D., Rocha M., 2014. Understanding Land Use in the UNFCCC. Climate and Land Use Alliance. 66 pp. 5. Sedjo, R.A., 2001. Forest Carbon Sequestration: Some Issues for Forest Investments. Discussion Paper 01–34. Resources for the Future. 26 pp.		
2.14. Other (as the proposer wishes to add)			

1. GENERAL INFORMATION				
1.1. Course teacher	Assoc. Prof. Ivana Katurić, PhD		1.6. Year of the study	2
1.2. Name of the course	European Green Deal		1.7. ECTS credits	3
1.3. Associate teachers	Sven Simov, MS		1.8. Type of instruction (number of hours L + E + S + e-learning)	30+0+0
1.4. Study programme (undergraduate, graduate, integrated)	Underraduate		1.9. Expected enrolment in the course	10
1.5. Status of the course	☐ mandatory	☒ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	3.

2. COUSE DESCRIPTION	
2.1. Course objectives	The aim is to provide students with knowledge in the field of sustainable urban development in Europe, introducing them to the concept of urban areas, the ideas of the EU Urban Agenda. Students will gain knowledge about different approaches in the use of urban spaces and the possibilities of financing sustainable urban development projects. The European Green Plan as a strategy for achieving sustainability will be introduced to students, as well as the popular phrases of green infrastructure, nature-based solutions and brownfield regeneration, all through selected examples from 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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 2. Explain the position and trends of the forestry profession in Croatia and the world **Directed competencies (B)** 2. Develop, organize and implement strategic plans and more complex tasks in forestry **Organizational competencies (C)** **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Adopt theoretical definitions of sustainable urban development and circular cities 2. Describe the basic settings of the key documents Urban Agenda for the EU, Lepis Charter 3. Discuss the basic settings of the European Green Plan 4. Explain the concept of green infrastructure and nature-based solutions 5. Analyze the possibilities of financing sustainable urban development projects 6. Critically discuss the limitations of the OECD and EUROSTAT definitions of urban areas 7. Explain the role of combating climate change in defining urban development plans and policies
2.5. Course content (syllabus)	Lectures: 1. Urban areas in Europe 2. Urban areas in the Croatian legislative framework 3. Key documents of sustainable urban development - Urban Agenda for the EU, Leipzig Charter 4. Sustainable development goals - goal 11 5. Urbanization and land use practices in European regions 6. Stopping the new urbanization by 2050 7. European Chapter on Spatial Planning 8. EU funding systems

	9. Models of implementation of the EU Green Plan 10. National Resilience and Recovery Program - Elements of Urban Development 11. Solutions based on nature 12. Green infrastructure - opportunities and guidelines 13. Circular cities - possibilities of urban renewal 14. Strategic development projects 15. Revitalization of the brownfield area

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

2.8. Student responsibilities	

2.9. Monitoring student work									
	Class attendance	**YES**	NO	Research	YES	**NO**	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	**NO**	(other)	YES	NO
	Essay	YES	**NO**	Seminar paper	YES	**NO**	(other)	YES	NO
	Preliminary exam	YES	**NO**	Practical work	YES	**NO**	(other)	YES	NO
	Project	YES	**NO**	Written exam	**YES**	NO	ECTS credits (total)	5	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	European commission, 2019: European Green Deal		
	Regional Development Act of the Republic of Croatia, NN 147/14, 123/17, 118/18		
	A guide to sustainable urbanisation and land-use, ESPON SUPER, 2020		
	SUPER – Sustainable Urbanization and land-use Practices in European Regions, Main report, 2020		
	Wiliams, J., 2021: Circular Cities: A Revolution in Urban Sustainability, Routledge		

2.11. Optional literature	
	Devisscher, T. i dr., 2019: Chapter 11 - SDG 11: Sustainable Cities and Communities – Impacts on Forests and Forest-Based Livelihoods, Cambridge University Press, pp 349-385 Evers, D., Cotella, G., Katurić, I., 2020: Urbanisation and land-use practices in European regions, TerritoriAll - the ESPON magazine - Green Infrastructure & Reuse of Spaces, 28-29. Katurić, I.; Tandarić, N.; Simov, S., 2016: Integrirane teritorijalne investicije kao instrument urbane obnove u Republici Hrvatskoj,

	Strategije urbane regeneracije, Društveni i ekonomski aspekti, 290-299. Katurić, I., 2021: The future of green infrastructure in the EU: opportunities and guidelines; u: Cuadernos de Ordenacion del Territorio, FUNDICOT Momčilović, S., Katurić, I., 2020: ESPON evidence in planning practice and policy development, TerritoriAll - the ESPON magazine - Green Infrastructure & Reuse of Spaces, 32-33
2.12. Other (as the proposer wishes to add)	

1. COURSE DECRIPTION – GENERAL INFORMATION			
1.5. Course teacher	Assistant prof. Vinko Paulić PhD	1.16. Year of the study	2.
1.6. Name of the course	Urban forestry	1.17. ECTS credits	2
1.5. Associate teachers		1.18. Type of instruction (number of hours L + S + E + e-learning)	30+0+0+0
1.6. Study programme (undergraduate, graduate, integrated)	Graduate	1.19. Expected enrolment in the course	5 - 10
1.7. Status of the course	Elective	1.20. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2.
2. COURSE DESCRIPTION			
2.12. Course objectives	With regards to the fact that two third of population lives in urban settlements this course aims to introduce Urban forestry as integrative and innovative approach to manage urban forest resource thus providing multiple benefits to urban society. This discipline investigates different ecosystem services and benefits of urban forests and trees and aims to pinpoint suitable species for urban environments through species selection criteria and climate change context. Appropriate planting and establishment of urban trees and analysis and modification of urban tree planting site aim to ensure successful establishment and provision of ecosystem services. Management of urban trees through lifespan and to understand various causes and processes of their protection. To understand the importance of legislation and policy in urban forestry and to get familiar with different urban tree management practice across Europe.		
2.13. Enrolment	-		

requirements and/or entry competences required for the course	
2.14. Learning outcomes at the level of the programme to which the course contributes	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways **Directed competencies (B)** 1. Develop and implement forest ecosystem management plans and programmes 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 7. Draft ecological studies and implement ecological forest monitoring **Organizational competencies (C)** **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.15. Expected learning outcomes at the level of the course (3-10 learning outcomes)	1.To explain basic terminology and concepts in urban forestry and to define its historical development in different context 2. To explain on example different ecosystem services and benefits of urban forests and trees 3. To identify suitable tree species for urban environments and to associate them with future climate change trends 4. To explain planting and establishment of urban trees with regards to urban tree planting site conditions 5.To critically address management of urban trees and to suggest appropriate measures for their protection 6. To discuss legislation and policy in urban forestry and harmonization of urban tree management across Europe
2.16. Course content (syllabus)	1. Introduction to urban forestry (concepts, definitions, basic terminology) 2. Historical development of urban forestry (European, North American and global overview) 3. Urban forests and trees benefits (social, aesthetic and architectural, ecological, climate and economical) 4. Ecosystem services of urban trees (social aspect, microclimate, pollution mitigation, biodiversity, disservice) 5. Planning and design of urban forests (types of urban green spaces, green infrastructure, brownfields, fragmentation of urban sites, periurban forests) 6. Species selection in urban forestry (criteria for species selection for urban environment, climate change) 7. Planting and establishment of urban trees (selection of planting stock, planting techniques, staking and guying, establishment period after planting) 8. Analysis and modification of urban tree planting site (site assessment, modifications of urban tree site conditions) 9. Urban tree management I (pruning) 10. Urban tree management II (irrigation and fertilization of urban trees) 11.Tree risk assessment (visual and device supported methods) 12. Protection of urban trees during development activities (critical root zone, tree protection measures, root trenching) 13. Veteran tree management (enchasing biodiversity in urban landscapes, habitat trees, conservation arboriculture status and trends)

	14. Legislation and policy in urban forestry (guidelines on urban and periurban forestry, Green deal, action plans, communication with citizens and stakeholders) 15. Harmonization of urban tree management practice across Europe (European standards for tree care operations, certification schemes for tree works)

2.17. Format of instruction:			2.18. Comments:
☒ lectures ☒ seminars and workshops ☐ exercises ☐ online in entirety ☒ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)		

2.19. Student responsibilities	Regular attendance and activity during the lectures. Essay, written and oral exam.

2.20. Monitoring student work									
Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
Essay	**YES**	NO	Seminar paper	YES	NO	(other)	YES	NO
Preliminary exam	YES	NO	Practical work	YES	NO	(other)	YES	**NO**
Project	YES	NO	Written exam	**YES**	NO	ECTS (total)	2	

2.21. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Ferrini, F., Konijnendijk van den Bosch, C. C., Fini, A., 2017: Routledge handbook of urban forestry. London ; New York : Routledge.		Available from Lecturer
	Miller, R.W, Hauer, R. J., Werner, L.P., 2015: Urban forestry: Planning and Managing Urban Greenspaces, Third Edition. Waveland press Inc.		Available from Lecturer
	Harris, R. W., Clark, J. R., Matheny, N. P., 2003: Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines. 4th edition. Prentice Hall		Available from Lecturer
	Roloff, A., 2016: Urban Tree Management: For the Sustainable Development of Green Cities. Wiley-Blackwell		Available from Lecturer

2.22. Optional literature (name the title)	Pearlmutter, D., Calfapietra, C., Samson, R., Liz O'brien, L., Silvija Krajter Ostoic, S., Giovanni Sanesi, G., Alonso del Amo, R., 2017: The Urban Forest : Cultivating Green Infrastructure for People and the Environment. Springer International Publishing AG

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Anamarija Jazbec, PhD Assis. Prof. Azra Tafro, PhD		1.6. Year of the study	2.
1.2. Name of the course	Applied Statistics in Forestry		1.7. ECTS credits	4
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	30+15+10+5
1.4. Study programme (undergraduate, graduate, integrated)	graduate		1.9. Expected enrolment in the course	20
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	3

2. COUSE DESCRIPTION	
2.1. Course objectives	The objective of the course is to introduce students to several selected statistical methods commonly used in forestry and to teach them to independently process, present and analyse compiled data. To introduce students to the possibility of various interpretations of the same problem analysed in different ways.
2.2. Enrolment requirements and/or entry competences required for the course	Biometrics, Forest Biometrics, Fundamentals of Statistics. Passed some basic statistical subject.
2.3. Learning outcomes at the level of the programme to which the course contributes	1. Skilled at utilizing and processing information 2. Ability to analyse and synthesize 3. Ability to apply theoretical and practical knowledge for solutions of forestry and nature conservation problems Science and research skills
3.1. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• Design an experiment, collect and prepare data • Perform basic statistical inference and interpret the results • Communicate statistical concepts in an applied context • Interpret and comprehend statistical results in technical and scientific research in forestry
3.2. Course content (syllabus)	1. Statistical Graphical Techniques 2. Analysis of Contingency Tables (Chi2 Test, Kappa Statistics, Mc Nemar Test) 3. Validity of Classification Tests (Sensitivity, Specificity, ROC Curve) 4. Nonparametric Tests (Mannwhitney, Kruskal Wallis Test) 5. Basics of Experiment Design (Random Block Design, Block Design, Latin Square, Nested Design)

	6. Generalized Linear Models (GLM) 7. Height Equations, Volume and Biomass Equations 8. Allometric Remote Sensing Based Equations 9. Transformation and Validation Methods 10. Basics of Time Series Analysis 11. Rare Events, Outliers and Extremes

11.1. 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)	11.2. Comments:
11.3. Student responsibilities	Regular attendance and active participation in lectures and exercises. Self-learning and solving exercises outside regular classes. Writing and presenting seminar papers.		

11.4. Monitoring student work									
	Class attendance	**YES**	NO	Research	**YES**	NO	Oral exam	YES	**NO**
	Experimental work	YES	**NO**	Report	**YES**	NO	(other)	YES	NO
	Essay	YES	**NO**	Seminar paper	**YES**	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	**YES**	NO	(other)	YES	NO
	Project	**YES**	NO	Written exam	YES	**NO**	ECTS credits (total)	5	

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	http://www.fao.org/		WEB
	Teaching materials		Merlin platform

2.11. Optional literature	Montgomery D.C. (2005) Design and Analysis of Experiment, Wiely&Sons. Joanne C. White, Piotr Tompalski, Mikko Vastaranta, Michael A. Wulder, Ninni Saarinen, Christoph Stepper, Nicholas C. Coops (2017) A model development and application guide for generating an

	enhanced forest inventory using airborne laser scanning data and an area-based approach,CANADIAN FOREST SERVICE CANADIAN WOOD FIBRE CENTRE
2.12. Other (as the proposer wishes to add)	

1. GENERAL INFORMATION				
1.1. Course teacher	Assoc. Prof. Stjepan Mikac, PhD		1.6. Year of the study	2
1.2. Name of the course	Global change and forest ecosystems		1.7. ECTS credits	4
1.3. Associate teachers	Domagoj Trlin, , PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	30+15+0
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2. 20%
2. COUSE DESCRIPTION				
2.1. Course objectives	The objectives of the course are to acquire knowledge about the impact of global changes (natural and anthropogenic) on the current and future state of forest ecosystems in the world. Special attention will be paid to the impact of recent climate change on the global state of forests in the world with an emphasis on future development and the state of the world's forests. They will get acquainted with conceptual models of natural dynamics of forest ecosystems and indicators of composition, structure, and function. They will acquire basic understanding of natural disturbances genesis and impact.			
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways 2. Explain the position and trends of the forestry profession in Croatia and the world			

	3. Apply a simplified scientific research methods **Directed competencies (B)** 7. Draft ecological studies and implement ecological forest monitoring **Organizational competencies (C)** **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Interpret, project and evaluate the impact of global changes on the state of forest ecosystems in Europe and the world 2. Evaluate indicators for monitoring the impact of climate change 3. Explain and apply conceptual models of forest ecosystem dynamics as a model for forest management 4. Explain methods and measures for climate change mitigation 5. Explain methods and measures for adaptation to climate change
2.5. Course content (syllabus)	**Lectures:** 1. Introduction to global changes on Earth (paleoclimate, natural and anthropogenic causes, projections of climate change). 2. The main drivers of change. 3. Forest ecosystems, structure, composition and function. 4. Historical development of forests. 5. Natural dynamics of forest ecosystems - conceptual models. 6. Impact of climate change on forest ecosystems. 7. Natural disturbances in forest ecosystems (definition, categories) 8. Ecology and regime of natural disturbances 9. Natural disturbances and biodiversity 10. Gap dynamics 11. Resilience of forest ecosystems 12. Adaptation to climate change 13. Climate change mitigation 14. Predicting future forest development 15. Monitoring changes in forest ecosystems **Exercises:** 1. Computer analysis of long-term trends of climatic factors 2. Synthesis of publicly available data and models of change 3. Spatial-temporal changes of forest ecosystem indicators 4. Analysis of forest ecosystem dynamics using basic stand elements 5. Analysis of natural disturbances dynamics: remote sensing 6. Analysis of natural disturbances dynamics: terrestrial research

	7. Analysis of natural disturbances dynamics: dendroecological methods of forest dynamics analysis 8. Analysis of natural disturbances dynamics: dendroecological methods of data collection 9. Analysis of natural disturbances dynamics: dendroecological laboratory methods 10. Analysis of natural disturbances dynamics: dendroecological data analysis I 11. Analysis of natural disturbances dynamics: dendroecological data analysis II 12. Computer simulations of future forest development: MOSES 13. Computer simulations of future forest development: ILand 14. Computer simulations of future forest development: Forclim, Landclim 15. Computer simulations of future forest development: r3PG **Fieldwork (2 days):** Revitalisation of areas affected by decline and forest degradation in the subalpine zone (bark beetles) Revitalisation of areas affected by decline and forest degradation in the mountain belt (wind, drought, ice)

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

2.8. Student responsibilities								
2.9. Monitoring student work	Class attendance	**YES**	NO	Research	**YES**	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	**YES**	NO	Practical work	**YES**	NO	(other)	YES	NO
	Project	**YES**	NO	Written exam	YES	NO	ECTS credits (total)	5	

2.12. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Pickett S.T.A., White P.S, The ecology of natural disturbance and patch dynamics. London: Academic Press, 1986.	No	Yes, MERLIN
	Oliver C.D., Larson B.C., Forest stand dynamics. New Jork: John Wiley and Sons, 1996. (	No	YES
	Mikac S. Powerpoint material .ppt	No	Yes

2.11. Optional literature			
2.16. Other (as the proposer wishes to add)			

1. GENERAL INFORMATION				
1.1. Course teacher	Assoc. Prof. Ivana Katurić, PhD		1.6. Year of the study	2
1.2. Name of the course	Fundamentals of strategic planning and sustainable development		1.7. ECTS credits	4
1.3. Associate teachers	Sven Simov, MS		1.8. Type of instruction (number of hours L + E + S + e-learning)	30+15+0
1.4. Study programme (undergraduate, graduate, integrated)	Underraduate		1.9. Expected enrolment in the course	25
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	3.

2. COUSE DESCRIPTION	
2.1. Course objectives	The aim is to provide students with an insight into the basics and issues of the system of strategic planning and territorial governance in Europe, with special emphasis on the Republic of Croatia. The course will provide students with knowledge of strategic spatial planning, selected methods and techniques in the process of drafting planning documents with numerous examples of good practice and insight into an interdisciplinary approach to planning, with emphasis on sustainable planning.
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	**General competencies (A)** 1. Independent collection of data, statistical processing, display and analysis of collected data, discussion and conclusions on the basis of the analysed data, and isolating different interpretations to analyse the problem in different ways **Directed competencies (B)** 2. Develop, organize and implement strategic plans and more complex tasks in forestry

	Organizational competencies (C) 1. Plan, organize and implement production organization tasks in forestry **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	11. Analyze soil functions. Critically evaluate the functions of soil. Identify the importance of soil in forestry. 12. Be able to compare soils according the national and WRB classification system. To distinguish the properties of different soil types. Evaluate the soil properties essential to the fertility. Evaluate the soil properties crucial for the sensitivity to harmful influences. 13. Application of soil mapping in forestry. Compare examples of soil map using. To present the pedogeographical units of Croatian forest ecosystems. 14. Explain the specificity of the soil in forest ecosystem management in relation to the management of other terrestrial ecosystems. 15. Evaluate a different soil type within the soil quality system. Evaluate the nature and relationship of a different soil type in forest ecosystems in Croatia. 16. To measure and interprete different soil parameters (soil texture, soil pH value, carbonate content, water content, soil nutrients, trace elements, organic carbon). 17. Compare geogenic and limit values of harmful substances in the soil. Valorization of soil considering with his degradation. Review harmful effects on soil in forest ecosystems (managment influenes, influence of forest fire on the soil, multipurpose uses of forest land, conversion of forest land) and present measures for its protection. 18. Organize soil monitoring of forest ecosystems. Compare the state of soil protection at a global, regional and national level. The implementation and regulations on the soil protection.
2.5. Course content (syllabus)	Lectures: 1. Theory and practice of strategic planning 1 - Early models and traditions of planning 2. Theory and practice of strategic planning 2 - Institutionalism and planning 3. Strategic planning systems 1 4. Strategic planning systems 2 5. Planning and climate change 6. Selected methods and techniques in space planning 7. Social cohesion and planning 8. Strategic planning system in the Republic of Croatia 1 9. Strategic planning system in the Republic of Croatia 2 10. Coordination of national planning systems in the Republic of Croatia - practice 11. Examples of strategic planning documents in the Republic of Croatia 12. The role of foresters in spatial planning 13. Stakeholder involvement and governance model

	Exercises: 1. Comparison of strategic and spatial planning documents in the national planning system 2. Comparison of the strategic framework of the national and EU examples of the strategic document 3. Models of making an analysis of the state of the selected area - chapter Urban environment 4. Development of a strategic framework for the selected area - chapter Urban environment 5. Methods of participatory planning 6. Planning methods - scenario planning 7. Manner of designing indicators and limitations of spatial data infrastructure 8. Methods of ex-ante and ex-post evaluation of the selected strategic development document

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. Student responsibilities			

2.9. Monitoring student work	Class attendance	**YES**	NO	Research	YES	NO	Oral exam	**YES**	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	**YES**	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	YES	NO	Practical work	YES	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	5	

	Title	Number of copies in the library	Availability via other media
2.12. Required literature (available in the library and/or via other media)	Law on the System of Strategic Planning and Development Management of the Republic of Croatia, NN 123/2017		
	Regional Development Act of the Republic of Croatia, NN 147/14, 123/17, 118/18		
	Comparative Analysis of Territorial Governance and Spatial Planning Systems in Europe, Final Report, 2018		
	Wiliams, J., 2021: Circular Cities: A Revolution in Urban Sustainability, Routledge		
2.12. Optional literature			
2.15. Other (as the proposer wishes to add)	Albrechts, L., 2000: How to Proceed from Image and Discourse to Action: As Applied to the Flemish Diamond Albrechts, L., 2004: Strategic (Spatial) Planning Reexamined, *Environment and Planning B Planning and Design* 31(5):743-758		

	Katurić, I., Šmit, K., Kranjec, K., Hajdinjak, I., 2019: Razvojne strategije kao čimbenik održivog razvoja gradova; Komparativna analiza Antwerpena, Bratislave, Krakowa i Zagreba, Prostor Vol 27., No. 1 (57) Katurić, I.; Tandarić, N.; Simov, S., 2016: Integrirane teritorijalne investicije kao instrument urbane obnove u Republici Hrvatskoj, Strategije urbane regeneracije, Društveni i ekonomski aspekti, 290-299. Katurić, I., 2006: Strateško prostorno planiranje - evolucija i inovacije, Čovjek i prostor (ČIP), God. 53, 11/12, 44-45 Oosterlynck, S. et al., 2011: Strategic Spatial Projects Catalysts for Change, Routledge

1. GENERAL INFORMATION				
1.3. Course teacher	Assoc. Prof. Damir Ugarković, PhD		1.6. Year of the study	1
1.4. Name of the course	Ecology and dynamics of complex systems for biodiversity and landscape conservation		1.7. ECTS credits	3
1.3. Associate teachers	Giacomo Mei, PhD Marko Orešković, MS		1.8. Type of instruction (number of hours L + E + S + e-learning)	30+15
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	10
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION				
2.10. Course objectives	Aim of the course is to allow a multidisciplinary and dynamic reading and analysis of the forest ecosystems of the Mediterranean area, whether they are natural, artificial, managed, abandoned or never directly affected by anthropogenic activities. The course provided Indications to understand the functioning and self-regulation mechanisms underlying the functioning and perpetuation of a complex system; the effects of direct and indirect disturbances and their interaction on the balance and dynamics of the forest system. The course will also provide the elements for a correct interpretation and management of the areas of high naturalistic value present in the Mediterranean area (with particular attention to the areas included in the Natura 2000 network) in terms of environmental value but almost always the result of completely ecological dynamics. Different and therefore not similar.			
2.11. Enrolment	1. Enrolled the appropriate year of the study program			

requirements and/or entry competences required for the course	2. Completed undergraduate or graduate study of forestry or related field 3. Passed exams in the fields of botany, pedology, ecology, forestry, zoology, phytopathology for students of related fields
2.3 Learning outcomes at the level of the programme to which the course contributes	**General competencies (A)** 3. Apply a simplified scientific research methods **Directed competencies (B)** 3. Manage and make independent business decisions in the areas of silviculture, forest protection, forest management and exploitation, and wildlife management 4. Organize and implement professional field tasks to establish, cleaning, thinning and regeneration of forest stands 7. Draft ecological studies and implement ecological forest monitoring 12. Manage forestry, human and technical resources in conducting forestry works 13. Improve the existing technology and introduce new technologies **Organizational competencies (C)** **Other competencies (D)** 1. Perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Ability to identify and evaluate the ecological impact of the various forest management methods in short, medium and long temporal range; 2. Ability to identify, evaluate, contextualize and contrast the main causes of loss of biotic, environmental and landscape diversity at different geographical and temporal scales; 3. Ability to identify and interpret possible strengths and criticalities of forest habitats in relation to different forest management, different socio-economic scenarios and different adaptations to climate change; 4. Ability to identify and use to one's advantage the strengths and criticalities of forest habitats in relation to the different economic, productive aspects or ecosystem services to be enhanced, conserved or restored; 5. Ability to correctly interpret the ecological dynamics underlying the presence of species and forest habitats protected at Community level by the Natura 2000 directive;
2.5. Course content (syllabus)	Lectures: 1. Definitions and levels of ecology 2. Concepts of dynamism, stability and balance in ecology 3. Elements of autoecology (ecological factors) 4. Elements of sinecology (structuring of ecosystems) 5. Elements of “disturbance ecology” 6. Definition, characteristics and functioning of complex systems 7. Impacts on biomes from the Paleolithic to nowday 9. Origin of the current European forest heritage: forest management in the Mediterranean area from the Greeks to the present day

	10. Outlines of ecological dynamics in virgin forests 11. Outlines of ecological dynamics in managed forests (high forests & coppice woods) and effects of abandonment 13. Protected areas: conceptual and methodological evolution 14. definition and evaluation of ecosystem functions and services Field work and exercises: 1. Forest vegetation as a key indicator 2. Plant and soil relationships; 3. Different effects of the forest structure 4. Effects of management and abandonment 5. Virgin forests 6. Ecosystems at risk 5. The forest as a complex system

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. Student responsibilities			

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

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	L.D. Harris - The fragmented forest. Island biogeography theory and the preservation of biotic diversity (1984) – The University of Chicaco Press – pp. 211	Yes	No
	P.A. Thomas, J.R. Packham – Ecology of Woodlands and Forests. Description, dynamics and diversity (2007) – Cambridge University Press – pp. 528	Yes	No

	J. Vukelić - Šumska vegetacija Hrvatske [Forest vegetation in Croatia] (2012) - Šumarski fakultet, Sveučilište u Zagrebu, DZZP – pp. 403	Yes	No
	N.E. Eash, T.S. Sauer, D.Dell, E. Odoi - Soil science simplified. Sixteen edition (2016) – Wiley Blackwell ed. – pp. 260	Yes	No
	A. Zanella, B. Jabiol, J.Ponge, G. Sartori, R. de Waal, B. van Delft, U. Graefe, N. Cools, K. Katzensteiner, H. Hager, et al. - European Humus Forms Reference Base (2011) - ffhal-00541496v2 | HAL Id : hal-00541496, version 2 DOI : 10.13140/RG.2.1.1944.0801	Yes	No
	European Commission D.G. Environment - Interpretation manual of European Union Habitats – EUR28 (2013) – European commission press – pp. 144	Yes	No
2.11. Optional literature	R. Macartur & E.O. Wilson - The theory of island biogeography. Thirteenth printing, and first Princeton Landmarks in Biology edition, with a new preface by E.O. Wilson (2001) – Princeton University Press – pp. 203 J.B. Losos & R.e. Ricklefs– the theory of Island Biogeography revisited (2010) - Princeton University Press – pp. 476		
2.12 Other (as the proposer wishes to add)			

1. COURSE DECRIPTION – GENERAL INFORMATION				
1.7. Course teacher	Vibor Roje, Ph.D., Associate professor		1.21. Year of the study	1.
1.8. Name of the course	Methods of Scientific Research		1.22. ECTS credits	2
1.6. Associate teachers	–		1.23. Type of instruction (number of hours L + S + E + e-learning)	15+10+0+5
1.7. Study programme (undergraduate, graduate, integrated)	Graduate study - Forestry		1.24. Expected enrolment in the course	15
1.8. Status of the course	☒ mandatory	☐ elective	1.25. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COURSE DESCRIPTION	
2.23. Course objectives	The main objectives of the course are to acquaint students with the phases of scientific research, making them aware of the role of scientific information, to train students for searching of scientific information and their critical use and to provide guidelines for preparation of professional or scientific communication.
2.24. Enrolment requirements and/or entry competences required for the course	−
2.25. Learning outcomes at the level of the programme to which the course contributes	The course will contribute to: a) the general engineering competencies − to collect data independently, statistically process them, to analyze and present the collected data, discuss and draw conclusions based on the analyzed data b) the focused engineering competencies − to apply methods of preparation and planning of works in forestry c) the other engineering competencies − to perform the duties of a scientific and professional associate in scientific research institutions in the field of forestry and hunting − to teach courses in vocational secondary and related schools − to collect, process and interpret sources of literature and prepare simpler written professional or scientific work.
2.26. Expected learning outcomes at the level of the course (3-10 learning outcomes)	After attending this course, the student will be able: 1) to distinguish phases of a research work 2) to distinguish the characteristics of the scientific methods from non-scientific ('common') approach 3) to select relevant literature in the context of learning of a specific area of interest 4) to make a plan of an own research work 5) to analyse own results critically and objectively 6) to prepare and hold methodically shaped oral presentation 7) to prepare written scientific report on own research.
2.27. Course content (syllabus)	Classes will be held in the form of a workshop; student engagement in teaching will be combined with the teacher's mini-lecture method. Part of the classes will be held in a computer classroom or library/reading room using a computer. Teaching units: **1)** Introduction to the subject, its scopes and aims, expected learning outcomes, students' obligations. **2)** What science is, types of scientific research, scientific methods, characteristics of the scientific approach *vs.* non-scientific ('common') approach.

	3) Phases of a research process I: a topic of a research/research question; insight in existing information in the research field; hypothesis. **4)** Phases of a research process II: planning of an experiment; collection of own results (measuring); critical analysis of own results ('testing of the hypothesis') **5)** Phases of a research process III: interpretation of the results; publication of the results of own results. Co-operation in research work. Ethics in a scientific research. **6)** What is information? Information sciences. Scientific information. **7)** Dissemination of scientific knowledge. Primary, secondary and tertiary publications. Scientific and professional publications. **8)** Communications on professional and scientific conferences. Oral and poster presentations. **9)** Scientific databases, citation bases. *Web of Science*, *Current Contents*, *Google Scholar*, *Scopus* and evaluation of a journal quality according to the ranking in a database. **10)** Assessment/evaluation of a research performance of an individual researcher. Citation bases. **11)** Approach to the preparation of a primary scientific publication. Review process. Students' theses. Scandinavian model of a doctoral thesis. **12)** Approach to the preparation of a review (scientific or professional) paper. **13)** How to prepare a successful oral expose, .ppt-presentation. How to hold a successful oral presentation: attitude, speech, relationship with listeners, use of the technical devices. **14)** Closing of the subjects and assessment of the students' achievements.
2.28. Format of instruction:	☐ lectures **X** seminars and workshops **X** exercises ☐ online in entirety ☐ partial e-learning ☐ field work ☐ independent assignments **X** multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other) 2.29. Comments:
2.30. Student responsibilities	Class attendance, preparation of a presentation and a seminar paper.

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

2.32. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Teaching materials		'Merlin' on-line

			platform
	S. Bhushan Mishra, S. Alok, Handbook of Research Methodology – A Compendium for Scholars & Researchers, Educreation Publishing, New Delhi, 2017.		web
2.33. Optional literature (name the title)	N. Walliman, Research Methods − The Basics, 3rd ed., Routledge, London, 2021. In Croatian: M. Gačić, Pisanje u znanosti i struci, Narodne novine, Zagreb, 2017. V. Silobrčić, Kako sastaviti, objaviti i ocijeniti znanstveno djelo, 6. dopunjeno izdanje, Medicinska naklada, Zagreb, 2008. Đ. Težak, Pretraživanje informacija na Internetu, Hrvatska sveučilišna naklada, Zagreb, 2002. Đ. Težak i sur., Profesor Božo Težak, lučonoša znanosti, Hrvatska sveučilišna naklada, Zagreb, 2007. R. Zelenika, Znanost o znanosti, Ekonomski fakultet u Rijeci, Rijeka, 2004.		

1. GENERAL INFORMATION				
1.1. Course teacher			1.6. Year of the study	2
1.2. Name of the course	Master thesis		1.7. ECTS credits	10
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	
1.5. Status of the course	☒ mandatory	☐ elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	

2. COUSE DESCRIPTION									
2.1. Course objectives	Thesis is an independent comprehensive and highly independent task in which the student must demonstrate knowledge of the basics of the profession and scientific research, or coping in defining hypotheses and research objectives, research planning, data collection and processing and writing a scientific paper. It includes the expansion and deepening of knowledge from the content of the curriculum, individual engagement on problem topics, gaining experience in writing professional papers, the ability to apply scientific methods and tools in problem processing and paperwork, the ability to independently serve appropriate domestic and foreign literature, ie the use of knowledge, facts and attitudes published in the cited sources.								
2.2. Enrolment requirements and/or entry competences required for the course	Completed all subjects from previous semesters of study								
2.3 Learning outcomes at the level of the programme to which the course contributes	1. apply previous knowledge to define the scientific-professional problem when choosing the topic of the paper 2. create a term work plan in accordance with the given deadlines for the preparation of the diploma thesis in stages 3. independently design the methodology of research work 4. apply the methodology of writing a professional and scientific work 5. present your work in written and oral form, using the skills of concise interpretation of results and conclusions and anticipate guidelines for future development of the topic of the paper								
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Thesis is an individual written work based on their own research that is written in scientific form and involves the time load of students with research work that is equivalent to the value of 14 ECTS. As a rule, the diploma thesis is prepared during the 4th semester of the graduate study, and ends with an oral defense (presentation and answering questions).								
2.5. Course content (syllabus)									
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. Student responsibilities									
2.9. Monitoring student work	Class attendance	YES	NO	Research	YES	NO	Oral exam	YES	NO
	Experimental work	YES	NO	Report	YES	NO	(other)	YES	NO
	Essay	YES	NO	Seminar paper	YES	NO	(other)	YES	NO
	Preliminary exam	YES	NO	Practical work	YES	NO	(other)	YES	NO
	Project	YES	NO	Written exam	**YES**	NO	ECTS credits (total)	6	
2.10. Required literature (available in the library	**Title**						**Number of copies in the**	**Availability via other media**	

and/or via other media)		**library**	
2.11. Optional literature			
2.12 Other (as the proposer wishes to add)			