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

Graduate Study Forestry; Programme: Techniques, Technology and Management in Forestry

Syllabus

from Acad. Year 2022/23

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

Year of study: I							
Semester: Winter							
COURSE	COURSE TEACHER	L	E	F	e-learning	ECTS	Compulsory /elective
Timber Harvesting Systems	Assist. Prof. Dinko Vusić, PhD.	30	30	8		6	compulsory
Mechanization of Timber Logging	Prof. Marijan Šušnjar, PhD. Assist. Prof. Zdravko Pandur, PhD.	30	15	16		5	compulsory
Management and entrepreneurship in forestry	Prof. Ivan Martinić, PhD. Prof. Mario Šporčić, PhD Doc.dr.sc.Matija Bakarić	30	30	16		6	compulsory
Forestry politics and legislation	Prof. Ivan Martinić, PhD. Assist. Prof. Matija Landekić, PhD. doc.dr.sc. Matija Bakarić	30	0	0		4	compulsory
Digital cartography in forestry	Prof. Renata Pernar, PhD. Assist. Prof. Mario Ančić, PhD.	30	15	0		3	compulsory
Torrent control	Associate Prof. Hrvoje Nevečerel, Ph. D.	15	0	0		2	elective
Phisycal and mechanical properties of wood	Prof. Tomislav Sinković, PhD	15	0	0		2	elective
Work humanization in forestry	Assist. Prof. Matija Landekić, PhD	15	0	0		2	elective
Corporative culture	Prof. Mario Šporčić, PhD	15	0	0		2	elective
Organizational behaviour in forestry	Prof. Mario Šporčić, PhD Assist. Prof. Matija Landekić, PhD.	15	0	0		2	elective
In total		195	90	40		30	

Year of study: I							
Semester: Summer							
COURSE	COURSE TEACHER	L	E	F	e-learning	ECTS	Compulsory / elective
Forest Accessibility	Prof. Tibor Pentek, Ph.D. Prof. Tomislav Poršinsky, Ph.D. Assist. Prof. Ivica Papa, Ph.D. Assist. Prof. Andreja Đuka, Ph.D.	30	30	16		6	compulsory
Forest products	Assist. Prof. Dinko Vusić, PhD.	30	15	16		4	compulsory
Integrated forest protection	Assist. Prof. Marko Vucelja, PhD. Prof. Boris Hrašovec, PhD. Prof. Danko Diminić, PhD.	30	15	16		4	compulsory
Silviculture	Prof. Igor Anić, PhD. Associate Prof. Stjepan Mikac, PhD	30	30	24		5	compulsory
Forest Management	Professor Mario Božić, PhD	30	15	16		5	compulsory
Mechanical technologies of wood processing	Prof. Tomislav Sinković, PhD	15	0	0		2	elective
Forest fires	Assist. Prof. Milivoj Franjević, PhD.	15	0	0		2	elective
Forest fire-prevention infrastructure	Associate Prof. Hrvoje Nevečerel, Ph. D.Assist. Prof. Kruno Lepoglavec, PhD.	15	0	0		2	elective
Alternative forest vehicle drives	Prof. Marijan Šušnjar, PhD.	15	0	0		2	elective
Hunting management planning	Assist. Prof. Kristijan Tomljanović, PhD	15	0	0		2	elective
In total		195	105	88		30	

Year of study: II							
Semester: Winter							
COURSE	COURSE TEACHER	L	E	F	e-learning	ECTS	Compulsory / elective
Forest road design	Prof. Tibor Pentek, Ph.D. Assist. Prof. Ivica Papa, Ph.D.	30	30	32		6	compulsory
Economics of forest company	Associate Prof. Stjepan Posavec, Ph.D. Doc.dr.sc. Karlo Beljan	30	15	8		4	compulsory
Marketing in forestry	Associate Prof. Stjepan Posavec, Ph.D. Doc.dr.sc. Karlo Beljan	30	15	0		3	compulsory
Production organization in forestry	Prof. Mario Šporčić, PhD Prof. Ivan Martinić, PhD Assist. prof. Matija Landekić, PhD	30	30	24		5	compulsory
Ergonomics of forest machines	Prof. Marijan Šušnjar, PhD.	15	15	8		3	compulsory
Forest biomass for energy	.Assist. Prof. Dinko Vusić, PhD.	15	15	0		3	compulsory
Forest products trade	.Assist. Prof. Dinko Vusić, PhD.	15	0	0		2	elective
Technologies of Forest Road Construction	Prof. Tibor Pentek, Ph.D.	15	0	0		2	elective
Evaluation of forest resources	Associate Prof. Stjepan Posavec, Ph.D.	15	0	0		2	elective
Planning of technological operations	Prof. Tomislav Poršinsky, Ph.D. Assist. Prof. Andreja Đuka, Ph.D.	15	0	0		2	elective
Innovations in forestry	Prof. Mario Šporčić, PhD	15	0	0		2	elective
Supervision of forest road construction	Prof. Tibor Pentek, Ph.D.	15	0	0		2	elective
In total		195	120	72		30	

Year of study: II							
Semester: Summer							
COURSE	COURSE TEACHER	L	E	F	e-learning	ECTS	Compulsory / elective
Environmentally sound technologies	Professor Tomislav Poršinsky, PhD Assistant Professor Andreja Đuka, PhD Assistant Professor Zdravko Pandur, PhD	30	30	24		6	compulsory
Professional practice						4	compulsory
Master thesis						20	compulsory
In total		30	30	24		30	

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	.Assist. Prof. Dinko Vusić, PhD. Assist. Prof. Andreja Đuka, PhD.	1.7. Number of ECTS credits	6
1.2. Course title	Timber Harvesting Systems	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+8
1.3. Course code	225889	1.9. Expected enrolment in the course	25
1.4. Study programme	University graduate study Forestry; Programme: Techniques, Technology and Management in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	To master general and specific knowledge which enable the competent planning, execution, supervision and independent decision in the area of complex tasks of timber harvesting, development of techniques and technologies of wood logging and obtaining basic scientific-research knowledge.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	A3. apply simpler methods of operation research B1. organise and perform tasks of greater complexity in forestry, from forest office and forest management unit as the lowest forestry structural units along the vertical B3. manage and make independent professional (business) decisions form the field of timber harvesting, forest opening, designing of forest road network and forestry entrepreneurship B6. recommend and choose forest machines, techniques and standard technologies used in forestry above all in timber harvesting from natural forests, even-aged and unevenaged stands, culture, plantation, and energy forests B7. select and choose mechanical means based on cost analysis and other criteria B12. apply knowledge related to the methods for preparing and planning technical works in forestry B13. manage forest, human resource, and technical potential during performance of forest works C4. plan and calculate production, calculate basic indicators of successful business, compose basic financial reports, recognise and analyse types of costs D5. gather, process and interpret reference sources and prepare simpler written professional or scientific paper
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Present the laws of timber harvesting efficiency (influential factors, ways of carrying out works in forestry, mechanization laws in timber harvesting, interaction with stand and exploitation factors, performance and labor productivity, standardization and labor costs, methods of direct cost calculation). Interpret the development of techniques and technologies in timber harvesting (development of equipment and methods of work, discontinuous evolution theory, system optimization, tree felling theory, tree bucking by the selected method).

	Present timber harvesting system (system elements and timber harvesting subsystems, component interaction, and visualization of the system). Valorize partially mechanized timber harvesting systems (buck-to-quality, tree-length, half-tree-length method, firewood production). Present mechanized timber harvesting systems (cut-to-length and full tree method, centralized timber yards and roundwood processing).
2.5. Course content (syllabus)	Lectures 1. Introduction. Concept of timber harvesting systems and timber harvesting methods. 2. Visualization of the timber harvesting system. Matrix, function diagram and simulation theory of production systems. 3. Productivity of the (sub) system of timber harvesting systems. Laws of mechanization of works in timber harvesting; interaction with stand and exploitation factors. 4. Standardization of work; experiential and technical standards in timber harvesting - a historical overview. Modern standardization systems for felling and processing and primary transport of wood. 5. Labor costs; cost classification; direct cost calculation methods. 6. Development of technique and technology in timber harvesting. Development of means and methods of work, theory of discontinuous evolution, synthesis at the level of modern wood extraction systems. 7. Partially mechanized systems of wood extraction by attraction. Team work. Integration of timber harvesting elements in time and space. 8. Partially mechanized skidding timber harvesting systems. Influencing factors; the pice-volume law. 9. Mechanized forwarding timber harvesting. Influencing factors; unifirom product type law. 10. Mechanized skidding timber harvesting systems. Landing organization. 11. Skyline timber harvesting systems. Prerequisites for efficient operation. 12. Timber harvesting systems for small forest estates. Law of production volume. 13. Logistics in timber harvesting. 14. Timber long-distance transport. Integration with the timber harvesting system. 15. Energy wood harvesting systems. Supply chain optimization. Exercises 1. Design of timber harvesting system. System components, component interaction and main influencing factors. 2. Calculation of the partially mechanized felling and processing productivity based on the influencing factors. 3. Calculation of the mechanized felling and processing productivity based on the influencing factors. 4. Calculation of the skidding productivity based on the influencing factors.. 5. Calculation of the forwarding productivity based on the influencing factors. 6. Direct cost calculation at the (sub) system level. 7. Optimization of the skidding partially mechanized timber harvesting systems; productivity adjustment – standard time method; subsystem time overlap. 8. Optimization of the forwarding partially mechanized timber harvesting system; selection of a suitable means of primary transport - cost breakeven point. 9. Optimization of the forwarding mechanized timber harvesting systems; the impact of machine utilization on the unit cost of timber harvesting. 10. Optimization of the skidding mechanized timber harvesting systems; productivity adjustment - standard time method; subsystem time overlap. 11. Optimizing the skyline timber harvesting systems; selection of the means of work and the level of mechanization - cost analysis. 12. Cost analysis of the use of adapted agricultural machinery in timber harvesting on small forest estates. 13. Harvester information system data analysis; productivity monitoring and product records - logistics system adjustment. 14. Optimization of long-distance timber transport; selection of mode and appropriate means of long-distance transport - - cost breakeven point.

<table>
<tr><td></td><td colspan="9">15. Optimization of wood chip supply system - choice of time, place and means of comminution.

Field work
1. One-day fieldwork with the aim of determining the main influencing factors and their influence on the selection of a suitable timber harvesting system. Analysis of the organization of work on a specific forest site, planned standards, documentation and methods of recording productivity and cost.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">6</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Ordinarily participation and active participation in classes. Examination.</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">1. Zečić, Ž., Vusić, D., 2018: Pridobivanje drva II - Predavanja i vježbe (interna skripta), Šumarski fakultet. Zagreb</td><td colspan="2">NO</td><td colspan="2">YES, Merlin</td></tr>
<tr><td colspan="5">2. Längin, D., Ackerman, P., Krieg, B., Immelmann, A., Potgieter, C., van Rooyen, J., Upfold, S., 2010: South African Ground Based Harvesting Handbook. Forest Engineering Southern Africa and Institute for Commercial Forestry Research, Scottsville, South Africa, 1–182. (Selected sections)</td><td colspan="2">NO</td><td colspan="2">YES, web</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Sundberg, U., Silversides, C.R., 1988: Operational Efficiency in Forestry – Volume 1: Analysis. Kluwer Academic Publishers – Forest Sciences, Dodrechts/Boston/Lancaster, 1 – 219.
2. Silversides, C.R., Sundberg, U., 1989: Operational Efficiency in Forestry – Volume 2: Practice. Kluwer Academic Publishers – Forest Sciences, Dodrechts/Boston/Lancaster, 1 – 169.
3. MacDonald, AJ., 1999: Harvesting Systems and Equipment in British Columbia. FERIC, Handbook No., HB-12: 1–197.
4. Längin, D., Ackerman, P., Krieg, B., Immelmann, A., Potgieter, C., van Rooyen, J., Upfold, S., 2010: South African Ground Based Harvesting Handbook. Forest Engineering Southern Africa and Institute for Commercial Forestry Research, Scottsville, South Africa, 1–182.
5. Taboršak, D., 1987: Studij rada. Tehnička knjiga Zagreb, 1 – 214.</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Marijan Šušnjar, PhD. Assist. Prof. Zdravko Pandur, PhD. Marin Bačić, PhD.	1.7. Number of ECTS credits	5
1.2. Course title	Mechanization of Timber Logging	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+16
1.3. Course code	225890	1.9. Expected enrolment in the course	25
1.4. Study programme	University graduate study Forestry; Programme: Techniques, Technology and Management in Forestry	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	The 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	B6. recommend and choose forest machines, techniques and standard technologies used in forestry above all in timber harvesting from natural forests, even-aged and unevenaged stands, culture, plantation, and energy forests B9. apply scientific insights on wood as renewable material and optimise usage of wood by applying harvesting technologies of forest residual
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Compare machines for tree felling and processing – motor chainsaws (history development, parts and elements, chainsaw use in Croatia, energy and environmental suitability of 2-stroke engines, chain (construction and maintenance), ergonomic features, guidelines of development, morphological analysis of chainsaw). Recommend machines for tree felling and processing – Harvesters (basic technical features, types, morphological, ergonomic, energy and environmental characteristics of harvester). Recommend forest vehicles for timber logging – Skidders, Forwarders (construction, types of skidders and forwarders, technical features, principle of Diesel engine, environmental suitability, morphological features). Present machines for timber transport – tractor assemblies (adapted farming tractor, adaptation for forest work, farming tractor equipped with forest winch, tractor with semi-trailer and crane). Present other machines of mechanised timber logging (forest trucks for timber transport, forest cableways, forest biomass chippers).
2.5. Course content (syllabus)	Lectures 1. Chainsaws 1. – history development, parts and components 2. Chainsaws 2. – safety at work 3. Harvesters – history development, types, performance 4. Harvesters heads– development, types, performance 5. Forwarders – development, types, performance 6. Tractors with semi-trailers – development, types, performance 7. Small sized forwarders for Thinnigs

<table>
<tr><td></td><td colspan="9">8. Skidders – development, types, performance
9. Skidders – characteristics, kinematics
10. Winches
11. Cable yarders and wire systems
12. Cogeneration plants
13. Chippers
14. Forest trucks – types, characteristica
15. Energy in forestry – production, costs

Exercises
1. Preparation for the measurement exercise „Wheel – soil interaction - Wheel numeric“
2. Measurement exercise and data processing „Wheel – soil interaction - Wheel numeric“
3. Preparation for the measurement exercise „Morphological analysis of harvesters“
4. Measurement exercise and data processing „Morphological analysis of harvesters“
5. Preparation for the measurement exercise „Hidraulic tractor power lift“
6. Measuring exercise "Hydraulic tractor power lift"
7. Preparation for the measurement exercise „Tractive characteristics of skidders“
8. Measuring exercise „Tractive characteristics of skidders“
9. Preparation for the measurement exercise „Energy of forest machines and tools“
10. Measuring exercise „Energy consumption of forest machines and tools“
11. Calculation task – calculation of winch
12. Calculation task – calculation of forces during timber skidding
13. Calculation task – calculation of compressor system features
14. Calculation task – calculation of wheel numeric
15. Calculation task – calculation of engine speed characteristics of internal combustion engine

Field work
1. Machine felling and production by harvesters and wood extracting by cable yarders
2. Cogeneration power plants and production of energy wood</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">5</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures, exercises and field teaching. Exam.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
</table>

	1. Šušnjar, M., Pandur, Z., - Presentations of lectures and exercises from the subject Mehanization of wood logging	NO	YES, Merlin
	2. Längin, D., i dr.: South African Ground Based Harvesting Handbook. Forest Engineering Southern Africa and Institute for Commercial Forestry Research 2010, s. 45-105.	NO	YES, web
	3. Harvesting Systems and Equipment in British Columbia, FERIC, s. 49-89.	NO	YES, web
	4. Best Practice Guidelines for Ground-based Logging, FITEC, New Zealand 2000, poglavlja: a) Types of extraction machines, s. 2-7., b) Personal protective equipment, s. 30., c) Wire rope, strops, and other accessories, s. 31-35., d) Forwarder extraction, s. 43.	NO	YES, web
	5. Castro G.P., Malinovski J.R., Nutto L., Malinovski R.A. (2016) Machinery and Equipment in Harvesting. In: Pancel L., Köhl M. (eds) Tropical Forestry Handbook. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-54601-3_183	NO	YES, web
	6. Wong, J.Y., Theory of ground vehicles. Fourth edition, John Wiley and sons, Inc. 2008, poglavlje: Performance characteristics of off-road vehicles, s. 319-362.	NO	YES, web
2.12. Optional literature	1. Šušnjar, M., Horvat, D., Kristić, A., Pandur, Z., 2008: Morphological analysis of forest tractor assemblies. Croatian journal of forest engineering, 29 (1): 41-51. 2. Tomašić, Ž.,Šušnjar, M.,Horvat, D.,Pandur, Z., 2009: Forces affecting timber skidding. Croatian journal of forest engineering, 30 (2): 127-139. 3. 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. 4. Pandur, Z., Vusić, D., Papa, I., 2009: Dodatna oprema za povećanje proizvodnosti forvardera. Nova mehanizacija šumarstva, 30 (2009); 19 – 25. 5. Gužvinec, H. Zorić, M., Šušnjar, M., Horvat, D. Pandur, Z., 2012: Utjecaj načina sidrenja na vrijednosti horizontalne sastavnice vučne sile i faktor prianjanja prilikom privitlavanja drva skiderom i adaptiranim poljoprivrednim traktorom. Nova mehanizacija šumarstva. 33 (2012); 23-33. 6. Pandur, Z., Horvat, D., Šušnjar, M., Zorić, M., Benić, D., Bakarić, M., 2015: Applicability of hydraulic dynamometer for mesuring load mass on forwarders. BULLETIN OF THE FACULTY OF FORESTRY. supplement issue (2015); 101-110. 7. Pandur, Z., Šušnjar, M., Horvat, D., Zorić, M., Matajčić, M., 2015: Ispitivanje tehničkih značajki nove šumske poluprikolice »Lika«. Nova mehanizacija šumarstva. 36 (2015) ; 19-32. 8. Šušnjar, M., Bačić, M., Horvat, T., Pandur, Z., 2019: Analiza radnih obilježja šumskih kamionskih skupova za prijevoz drva. Nova mehanizacija šumarstva. 40 (2019), 1; 11-19. https://doi.org/10.5552/nms.2019.2 9. Pandur, Z., Horvat, D., Šušnjar, M., Zorić, M., Knežević, M., 2015: Load space utilization of forwarder Valmet 860.4. Forest engineering - Making a positive contribution. Formec Book of Abstracts and Proceedings 2015 / Kanzian, C.; Erber, G.; Kühmaier, M. (ur.). Beč: BOKU, 2015. 271-275.		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Ivan Martinić, PhD. Prof. Mario Šporčić, PhD Assist. Prof. Matija Landekić, PhD. Matija Bakarić, PhD.	1.7. Number of ECTS credits	6
1.2. Course title	Management and entrepreneurship in forestry	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+16
1.3. Course code	33902	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	The objective of the course is to develop students' ability to independently perform various tasks in economic and administrative-professional areas of forestry: initiating project cycles, designing measures and organizing resources, managing organizational units, etc. The emphasis is on mastering the knowledge and skills to perform basic and extended tasks of managing functional units and the development of competencies for a team and entrepreneurial approach to business planning and implementation. Students adopt a basic orientation in relation to global and domestic economic flows and business circumstances and acquire skills in preparing and implementing operational plans of business entities in forestry.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem analysed in different ways C5. manage the most complex tasks in all forms of forest organizations, forest and hunting advisory service; forest entrepreneurship D1. conduct businesses of 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)	Interpret the concept, features and basic functions of modern management and explain the functioning of the team in project management Explain the roles of individual actors and project phases in project management and show the life cycle of the project Apply group decision-making techniques in finding ways to achieve project goals Conduct evaluation of team members and develop models of financial and non-financial motivation Conduct an analysis of the entrepreneurial climate and identify favorable entrepreneurial opportunities in the forestry sector Select an appropriate entrepreneurial strategy and create a list of indicators for the evaluation of a specific entrepreneurial venture Explain the elements for the overall (economic, environmental and social) evaluation of the project. Analyze the elements of the business strategy for strengthening the competitiveness of the forestry sector and identify areas for possible application of entrepreneurial projects within the EU operational programs

2.5. Course content (syllabus)	Introduction to management - the concept, definition and features of modern management. Basic functions of management - planning, decision making, organizing, staffing and control. (V) Analysis of internal and external circumstances in finding project solutions through SWOT and PEST analysis; problem and goal analysis - example "problem tree" and "goal tree". Projects: definition, role, significance and characteristics. Types, elements, conception and goals. Main resources in projects: people, resources, time. Project cycle; project idea, situation analysis, input strategy, purpose and object goals, project results. Project tools - stakeholder analysis, SWOT analysis, problem and solution analysis, project tactics, action plan and evaluation. (V) Stakeholder analysis - degree of interest, strength of influence, manner of involvement. Basic about teamwork, basic characteristics, advantages and disadvantages of teamwork. Stages in team development, cohesion and motivation. Team planning and decision making. (V) Group decision making techniques: brainstorming, nominal technique method, Delphi method (individual work). Methods of group decision making. Evaluating team members. (V) Human resources analysis. Methods for assessing the potential and success of associates in teamwork (individual work), Hierarchy of needs and motivational profile of the individual (individual work). Leadership styles, internal communication and forms of motivation. Project life cycle start-up, stabilization, maturity, restart or disappearance. (V) Entrepreneurial climate and the role of the state: legal security, administration and taxes, social security and social policy, the importance of education and research, the importance of technology transfer. Introduction to group seminar work - development of entrepreneurial project (distribution of topics, stages of development) Project management: project organization models, time management, human resource management, risk management, project development monitoring. Project economics: sources of financing, eligible costs, economic, environmental and social effects, key financial performance indicators. Controlling, monitoring and reporting in the project Entrepreneurship - the concept and goals of entrepreneurship. Characteristics and principles of entrepreneurship: innovation, discovery of favorable opportunities, market orientation. (V) SWOT analysis: obstacles and difficulties in the development of entrepreneurship in Croatian forestry. The importance of special skills, continuous learning and technology transfer. Characteristics of entrepreneurship in Croatia. Legislative framework of entrepreneurship. Classification of undertakings according to EU Directive 2013/34. Entrepreneurial climate - legislative, fiscal and social aspects. (V) Elements of an entrepreneurial project: purpose goals, object goals, project tactics, project risks, project economics, project organization. Project control and reporting - criteria for evaluating project success. Time management - Gantt chart (individual work) Entrepreneurial areas and opportunities in forestry - improvements to existing products and services, new products, new services. Examples of entrepreneurial projects - sustainability assessment and feasibility studies. (V) Feasibility account for the entrepreneurial project of forestry engineering services - assessment of ecological and economic potentials of forest holdings (individual work) Entrepreneurial strategies according to P. Druecker - characteristics and conditions of application of a particular strategy. (V) Presentations of seminar papers (presentation of group seminar papers), Characteristics of entrepreneurial strategies according to Druecker: examples for individual strategies. Business strategies for strengthening the competitiveness of the Croatian forestry sector: energy efficiency, ISO quality and environmental management system, occupational safety and health system OHSAS 18001. Corporate Social Responsibility (CSR). (V) Examples of achieving a higher level of competitiveness through CSR and environmental performance instruments Measures for the forestry sector from the Rural Development Program of the Republic of Croatia for the current programming period. Competitiveness strengthening instruments: cohesion policy, EU programs, structural and investment funds; thematic areas and criteria

<table>
<tr><td></td><td colspan="9">for project application and funding. (V) EU cohesion policy - programming principles and priority areas for investment in Croatian forestry</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">6</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures, exercises and field work. Taking group seminar, partial exam and final exam.</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="4">Buble, M.: Osnove menadžmenta, Sinergija nakladništvo, Zagreb, 2006</td><td colspan="2">YES</td><td colspan="3"></td></tr>
<tr><td colspan="4">Martinić, I., Zbirka prezentacija s predavanja 'Menadžment i poduzetništvo u šumarstvu', Šumarski fakultet Zagreb, 2020.</td><td colspan="2"></td><td colspan="3">YES, Merlin</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Bobera, D., Hunjet, A., Kozina, G.: 2015: Poduzetništvo. Sveučilište Sjever, Varaždin, 2015.
2. Balog, A.:Priručnik za online studij kolegija Osnove menadžmenta, Veleučilište Baltazar Zaprešić, Zaprešić, 2018.
3. Martinić, I.: Upravljanje zaštićenim područjima prirode – planiranje, razvoj i održivost, Šumarski fakultet u Zagrebu, Zagreb 2010
4. Strategija razvoja poduzetništva u Republici Hrvatskoj 2013.-2020</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Ivan Martinić, PhD. Assist. Prof. Matija Landekić, PhD.	1.7. Number of ECTS credits	4
1.2. Course title	Forestry politics and legislation	1.8. Number of hours in semester (L+E+F+e-learning)	30+0+0
1.3. Course code	33903	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	The aim of the course is to acquaint students with the meaning, role and principles of forestry policy, primarily in the context of the position of the forest as a renewable natural resource and the forestry sector in relation to global policies, challenges and processes. Especially important is gaining knowledge about the legal and social framework of the EU strategy for the forests and the relevant EU programs and processes (Forest Europe, the role of bio-economy, energy transition, RED directive, the FLEGT Action Plan, LULUCF, Natura 2000, certification, etc.). The emphasis is on adopting the correct orientation of students in terms of respecting intersectoral relationships and the complex role of forestry in meeting global and national environmental, social and economic requirements. Through the course, students are empowered for engineering activities related to forest certification, socially responsible business and contributing to the improvement of sustainability, especially in private forest management. Through understanding the legislative framework and getting acquainted with the strategic goals and measures for the improvement of the sector, students prepare for active participation in the preparation and implementation of projects from the Rural Development Program of the Republic of Croatia, in forestry, environmental protection and nature conservation.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem analysed in different ways A2. explain position and trends of forestry profession in the country and worldwide D3. conduct businesses and tasks in publicist writing and media connected with forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Analyse global programs and forest policy documents (Forest Principles, Ministerial Conferences on European Forest Protection, Convention of Biological and Landscape Diversity, UN Framework Convention on Climate Change and the Kyoto Protocol, Europe 2020 Strategy, EU Forestry Strategy, Natura 2000 Ecological Network CR) Present National Forestry Policy and Strategy: importance, strategic areas, goals and priorities, implementation concept - carriers, timelines, financing (National forestry program goals and tasks, Forestry Policies in Republic of Croatia in the light of National environmental protection program (NEAP), Biodiversity (NSAP), Forestry Measures, Forestry Certification). Define organization of forestry administration in Republic of Croatia - Ministry, regional offices, inspection services (key actors in the forest sector, Forest Law in the Republic of Croatia, EU

<table>
<tr><td></td><td>Guidelines and National subordinate regulations).
Analyse forestry policy in Republic of Croatia with view on EU context (Europe 2020 as a Strategic Framework for Equitable EU Development, EU Cohesion Policy, Programming Principle, Rural Development Program of Croatia, Principles and Criteria for project applications and allocation of funds by measures).</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td>(L1) Introduction to forestry policy and legislation (2 h). View the contents of the subject. Sources and principles of forestry policy.
(L2) Fundamentals of forestry policy. Areas, goals and tasks of forestry policy. Role in sustainable development and global processes.
(L3) The role of the state in creating forestry policy. Basics of forestry policy and strategy of the Republic of Croatia; priorities by areas, goals and measures.
(L4) European forestry framework. The state of the forestry sector in Europe. EU Forest Strategy. National forestry programs. EU forestry organizations and institutions. Forest Europe - Ministerial Conferences on the Protection of European Forests. Common EU regulations and agreements in forestry.
(L5) Legal and social framework of forestry policy. Forestry legislation. Transition processes. Relationships with other sectors. Financial instruments.
(L6) Global programs and processes related to forestry policy. Convention on Biological and Landscape Diversity. AGENDA 21. Habitats Directive. Birds Directive. Climate change and the forestry sector - the impact of climate change on forests and adaptation measures. Kyoto Protocol, Paris Agreement.
(L7) Legislative framework. Fundamentals of the Forest Act. Basic issues regulated by law. Basic provisions of the law. Subordinate legislation. Forestry inspection. Relation to other laws.
(L8) Ecological and social aspects of forestry. The role of forestry in biodiversity conservation. Protected areas and ecological network. The social dimension of forestry. Role in rural development.
(L9) FLEGT action plan. Purpose, objective and measure of FLEGT action plan. Benefits of voluntary partnership agreements. FLEGT license. Establishment of FLEGT system in Croatia.
(L10) Renewable energy sources directive (2 h). Purpose and objectives of the directive. EU Emission trading system. The role of the LULUCF sector. Implementation of the RED directive in the Republic of Croatia.
(L11) Forestry and biodiversity conservation. Natura 2000 ecological network. Natura 2000 concept and requirements in relation to forestry. Legislative and technical framework for implementation in Croatian forestry. Forest management plans as the equivalent of ecological network management plans. Assessment of the acceptability of the plan, program and intervention on the ecological network
(L12) Private forests in the context of forestry policy. Basic indicators of private forests in the Republic of Croatia. Legislative framework and the role of the forestry advisory service. Models of improving private forest management in the Republic of Croatia.
(L13) Certification in forestry. Models and principles of certification. Basic criteria and national certification standards. FSC standard certification. Organization of certification implementation in the Republic of Croatia.
(L14) Forestry and EU funds. Strategic goals and measures for forestry. Financing models. Mechanisms for increasing the competitiveness of the forestry sector.
(L15) The role of the forestry sector in the concept of bioeconomy. The concept of 'green economy' (Green Plan / Green Deal, Green Jobs).</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. Monitoring student work</td><td>
<table>
<tr><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
</table>
</td></tr>
</table>

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

2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.		
2.10. Student responsibilities	Regular attendance and active participation in lectures. Taking partial exam and final exam.		
2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Martinić, I., Landekić, M., 2020: Forestry politics and legislation (internal collection of presentations for the current academic year)	NO	YES, Merlin
	Sabadi, R.: Šumarska politika. Hrvatske šume p.o. Zagreb, Zagreb 1992.	YES	
	MZOE RH, 2017: Development of a working version of the strategy for adaptation to climate change in the Republic of Croatia for the period up to 2040 with a view to 2070 (Green Paper).	NO	YES, online
	Forest Act (Official Gazette 68/18); Forestry policy and strategy of the Republic of Croatia (OG 42/03)	NO	YES, online
2.12. Optional literature	1. Nova Strategija EU-a za šume: za šume i sektor koji se temelji na šumama, EC, Bruxelles 2013 2. A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment (listopad, 2018.) 3. Zakon o provedbi Uredbe Europske Unije o prometu drva i proizvoda od drva (NN 25/18) 4. Strategija niskougljičnog razvoja Republike Hrvatske do 2030. s pogledom na 2050. godinu 5. Bakarić, M., Martinić, I., Landekić, M., Pandur, Z., Orlović, A., 2015: Certifikacija šuma kao mehanizam unaprjeđenja gospodarenja šumskim resursima. Nova mehanizacija šumarstva. 36 (1); 63-76 6. Lovrić, M., Krajter, S., Landekić, M., Zečić, Ž., Lovrić, N., Vusić, D., Martinić, I., Šporčić, M., 2011: Razvoj i posljedice eu zakonodavstva vezanog za nezakonite sječe. Šumarski list : znanstveno-stručno i staleško glasilo Hrvatskoga šumarskog društva. 135 (2011) , 11-12; 595-603		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Renata Pernar, PhD. Assist. Prof. Mario Ančić, PhD. Prof. Ante Seletković, PhD. Assist. Prof. Jelena Kolić, PhD.	1.7. Number of ECTS credits	3
1.2. Course title	Digital cartography in forestry	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+0
1.3. Course code	33911	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	To make a students acquainted with the latest achievements in the field of digital cartography in our country and in the world, theoretical fundamentals and skills for making of cartographic surveys and possibilities for use in forestry.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem analysed in different ways B12. apply knowledge related to the methods for preparing and planning technical works in forestry B16. develop current technologies as well as implement new technologies D4. professionally and scientifically upgrade through different educational ways and postgraduate study
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Pronounce the definition of digital cartography. Describe the goals and tasks of digital cartography. Distinguish cartographic signs. Describe equipment and software support for digital cartography needs. Specify the advantages and disadvantages of digital cartography. Explain the classification and types of maps. List the basic elements and characteristics of the map. Compare the topographic and thematic map. Comment on the purpose of cartographic generalization. Identify the factors on which depends degree of generalization Categorize types and forms of data. Analyze the types of spatial data for the valorization of space. Describe and interpret spatial data models Explain the term of vector and raster digitalization. Present the transformation process/procedure of the coordinates. Compare and analyze vector and raster digitalization. Explain and show the georeferencing and orthorectifying procedure. Create different thematic maps. Pronounce the definition of a digital relief model. Describe and explain the ways of creating and editing of DRM data. Present the creation of the DRM. Show the methods of visualizing DRM. Interpret the data obtained from DRM Link the use of remote research in digital cartography. Carry out the upgrading and improvement of cartographic displays for remote sensing products. Combine a topographic, thematic map with a created digital relief model and a digital orthophoto. Present a database editing and performing various searching with a purpose to obtain a new digital cartographic layer
2.5. Course content (syllabus)	Lectures:

<table>
<tr><td></td><td colspan="9">1. Digital cartography - definition, goals and tasks of digital cartography
2. Cartographic data, equipment and software support, advantages and disadvantages of digital cartography
3. Types of maps, topographic and thematic maps, similarities/differences
4. Data forms, vector and raster data model
5. Georeferencing, orthorectifying, methods of creating thematic maps
6. Basic elements and characteristics of the map (spatiality, measurability, modeling, accuracy, ...)
7. Components of the map - external or formal part, internal or content part of the map
8. Cartographic generalization, quantitative and qualitative generalization
9. Factors that have impact to generalization, scale, minimum size, map purpose and geographic features of space
10. Cartographic projections, transformations of coordinates
11. Digitalization, manual - vector and automatic - raster digitalization
12. Digital Relief Model (DRM), data sources for DRM creation, ways of making and visualizing DMRs
13. Generating new variables based on DMR, quantitative relief analyzes, application in forestry (road design)
14. Application of remote sensing in cartography, map updates based on methods of RS, creating orthophoto plans/maps
15. Digital orthophoto (DOP), ways of making, application in forestry (openness of forests)

Exercises:

1. Cartographic signs, basic elements and characteristics of the map
2. Generalization of dotted, line and surface objects with an emphasis on thematic maps
3. Process of generalization, selection, compression, simplification, magnification, shifting, conversion of the display method
4. Types and data forms (geometric, graphic, attributive), models of data
5. Establishing a database, connecting data from other databases
6. Georeferencing of maps, orthorectification
7. Generating variables for the conduction of fragmentary statistics (area and perimeter of polygons, distance of line objects, number of polygons per unit of surface, number of linear elements in an area, link and distance of the same polygons, analysis of neighbourhood polygons,…)
8. Creating different thematic maps
9. Transformation of the coordinates from the local system of digitizer into a cartographic system or system of geographic coordinates
10. Vectorization of contour lines, data editing to create the DRM
11. Making and visualizing DMRs (2D, 3D)
12. Generating new variables based on DRM (slope, visibility, terrain profiles, ...)
13. Connection thematic data to DRM
14. Creating orthophoto (DOP), interpretation
15. Various analysis and searches with a purpose to obtain a new digital cartographic layer</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="3">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
</table>

<table>
<tr><td rowspan="2"></td><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td colspan="2">3</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Within the course, with the regular attendance of lectures and exercises, students create individual assignments during the semester. Taking an exam is through the 2 midterm exam and oral exam.</td></tr>
<tr><td rowspan="8">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="4">Frančula, N. (2004): Digitalna kartografija, 3. prošireno izdanje. Sveučilište u Zagrebu Geodetski fakultet. 211 str.</td><td colspan="2"></td><td colspan="2">YES</td></tr>
<tr><td colspan="4">Pernar R. & Ančić, M. (2019): Prezentacije s predavanja</td><td colspan="2"></td><td colspan="2">YES</td></tr>
<tr><td colspan="4">Frančula, N. (2004): Kartografske projekcije. Sveučilište u Zagrebu Geodetski fakultet. 228 str.</td><td colspan="2"></td><td colspan="2">YES</td></tr>
<tr><td colspan="4">Falkner, E. & Morgan, D. (2001): Aerial Mapping: Methods and Applications. Lewis Publisher, USA, 192 str.</td><td colspan="2"></td><td colspan="2">YES</td></tr>
<tr><td colspan="4">Frančula, N. (2003.): Kartografska generalizacija. Sveučilište u Zagrebu, Geodetski fakultet, Zagreb, 117 str.</td><td colspan="2"></td><td colspan="2">YES</td></tr>
<tr><td colspan="4">Maguire, D. J., Batty, M. (ur.) (2005): GIS, Spatial Analysis, and Modeling. ESRI Press, USA. 480 str.</td><td colspan="2"></td><td colspan="2">YES</td></tr>
<tr><td colspan="4"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Ključanin, S., Poslončec-Petrić, V., Bačić, Ž. (2018): Osnove infrastrukture prostornih podataka, Sarajevo: Dobra knjiga. 166 str.
2. Mitchell, A. (1999):The ESRI Guide to GIS Analyses, Volume 1: Geographic Patterns and Relationships. ESRI Press, USA. 250 str.
3. Andričević R., H. Gotovac, I. Ljubenkov, 2007: GEOSTATISTIKA: umijeće prostorne analize, Udžbenik
4. Kušan (ur.) (1994): Nove tehnike izmjere i kartografije, Zagreb, 75 str.</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Associate Prof. Hrvoje Nevečerel, Ph. D.	1.7. Number of ECTS credits	2
1.2. Course title	Torrent control	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33943	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	The basic objective and task of this subject, through theoretical and practical base, is to inform students about knowledge and skills necessary for completing individual simple tasks in a drainage basin on a forest land, i.e. in a 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	B5. implement protection of forest protection from abiotic and biotic factors and organize procedures in forest protection B13. manage forest, human and technical potentials when performing works in forestry B16. improve existing technologies as well as introduce new ones
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Apply to hydro engineering (water management areas and branches and water management systems and solutions, hydrology components, hydrometrics, hydraulics, hydrometeorology and basin characteristics - size, shape, decline, altitude relationships, river basin processes etc.). Analyse soil erosion (elements of erosion, factors affecting erosion formation and complex deformation of terrain due to erosion). Present the streams (general characteristics of torrential and torrential regulation, buoy flow classification, buoyancy determination, geomorphologic calming downs, equations and projected torrents, principles and systems for river basin regulation planning, and active and passive flood planning).
2.5. Course content (syllabus)	Lectures: The course "Torrent control" introduces students to a very complex and current issue of editing torrents and the damage they can cause. The introduction is presented by a lecture related to Water Management Areas and Water Management Systems and Solutions. Hydrology, Hydrometry and Hydraulics are further explained. As part of Hydrology, the hydrological cycle and water balance are presented. Basic information is also given on hydrometeorology and physical characteristics of the basin (size, shape, slope of the basin and altitude relations in the basin, etc.). The processes in the basin from evaporation and interception to the processes in the riverbed and runoff were also processed. Within Hydrometry, a number of concepts and ways in which hydrometric measurements are performed and how hydrological data are processed are explained. The basic physical properties of fluids are an introduction to Hydraulics which explains hydrostatics and hydrodynamics. (five lectures – 6 hours) Soil erosion consists of three lectures: Types of erosions according to the causes of origin, Basic factors influencing the formation of erosion and Complex forms due to erosion. In

<table>
<tr><td></td><td colspan="9">these lectures, water erosion, rain erosion, running water erosion, wind erosion and erosion damage are explained. The basic factors of erosion are further explained: climate, soil, vegetation, relief and geological composition of the terrain. Under complex deformations of the terrain we distinguish landslides, debris, etc., and at the end of the method unit, soil losses due to erosion are shown. (three lectures – 5 hours)

The torrents are explained through two lectures: General characteristics of torrents and Torrent control. Within the General characteristics of torrents we discuss the classification of torrent flows, criteria for determination of streaming, falls of geomorphological calming and equalization, and the projected fall of torrents. The lecture also explains the measurement characteristics of torrent flows and sediment movement. Torrent management lecture talks about the basic rules, principles and systems for designing the regulation of torrent beds. There is also talk of modern facilities and transverse structures for the regulation of torrent flows, as well as the regulation of flows and the rehabilitation of landslides as part of the torrent control. The last unit is covered by active and passive interventions in the regulation of torrents and the objectives of the regulation of torrent basins and torrent beds. (two lectures – 4 hours)</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Taking all (2) colloquia with a minimum of 50% correct answers, taking an exam with a minimum of 50% correct answers on the written part of the exam and preparing a seminar.</td></tr>
<tr><td rowspan="4">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="4">Pičman, D. 2002: Uređivanje bujica i vodogradnje (interna skripta), I dio - Osnove hidrotehnike, Šumarski fakultet Sveučilišta u Zagrebu, Zagreb, s. 1-54.</td><td colspan="2"></td><td colspan="2">Merlin</td></tr>
<tr><td colspan="4">Predavanja iz nastavnog predmeta Uređivanje bujica, 2019: Nevečerel, H. - pptx</td><td colspan="2"></td><td colspan="2">Merlin</td></tr>
<tr><td colspan="4">Kostadinov, S. 2008: Bujični tokovi i erozija, Univerzitet u Beogradu, Šumarski fakultet, Beograd, s. 1-494.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Čavlek, E. 1992: Osnove hidrologije, Geodetski fakultet u Zagrebu, s. Zagreb, 1-145.
2. Grupa autora, 1980: Bujice (bujični tokovi), Šumarska enciklopedija, JAZU, Zagreb, s. 205-220.
3. Vuković, Ž. 1994: Osnove hidrotehnike, prvi dio, Akvamarine, Zagreb, s. 1-252.</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Tomislav Sinković, PhD	1.7. Number of ECTS credits	2
1.2. Course title	Phisycal and mechanical properties of wood	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33945	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	Natural defects, reaction wood, compression and tension wood, cross grain, variations in log form and shakes. Knowledge about commercial wood species. Segments and form of tree. Factors, forms and modification of tree. Chemical structure of wood and its influence on wood properties. The wood structure and its influence on wood properties. Properties of wood sections. Sapwood and heartwood. Process of heartwood forming. Theories. Classification. Earlywood, latewood and percentage of latewood. Closeness of grain. Macroscopic properties of domestic commercial wood species. Color and lustre of wood. Odour of wood. Texture of wood. Density and specific gravity of wood. Distribution of density inside the wood and tree. Wood and water, types of water in wood. The method of determining of moisture content. Fiber saturation point. Maximum moisture content of wood. Shrinkage and swelling. Anisotropy of shrinkage and swelling. Thermal properties of wood. Specific heat. Electrical properties of wood. Distribution of physical properties in tree and between trees same species. Hooks law, modulus of elasticity, Poisson ratios, plasticity and creep. Static bending, tensile strength, compression strength, impact test, torsion strength, shearing strength, hardness and abrasion resistance. The wood structure and its influence on mechanical properties of wood.The influenced factors on mechanical properties of wood. . Distribution of mechanical properties in tree and between trees same species. Defects of wood. Classification
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. organise and perform tasks of greater complexity in forestry, from forest office and forest management unit as the lowest forestry structural units along the vertical B8. measure and evaluate quality parameters of timber assortments and interpret their size and meaning C2. organise and conduct sale of timber assortments and timber products on domestic and worldwide market
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	The student gains knowledge about commercial wood species. Segments and form of tree. Distribution of macroscopic and physical properties in tree and between trees same species. Distribution of mechanical properties in tree and between trees same species. Defects and abnormalities of wood.
2.5. Course content (syllabus)	1.Lectures: Introduction and study of wood as woody biomass from forestry production. 1 hour 2. Lectures: Introduction to commercial tree species. Parts and shape of the tree. Factors types and tree modifications. 1 hour 3. Lectures: Wood structure as a factor of wood properties. Macroscopic properties of wood. Wood cross-sectional properties. 1 hour

<table>
<tr><td></td><td colspan="9">4. Lectures: White and marrow. Classification. Conservation. Theories of the process of preservation. Width of the year. Early and late wood zones and share of late wood zones. 1 hour
5. Lectures: Fineness of wood. The color and luster of wood. The smell of wood. Wood texture. 1 hour
6. Lectures: Physical properties of wood. Density of wood and wood matter, methods of determination. 1 hour
7. Lectures: Factors influencing wood density. Density distribution in wood and wood. 1 hour
8. Lectures: Tying water to wood. Free and bound water in the wood. Procedures for determining the water content in wood. Conditions of water content in wood. 1 hour
9. Lectures: Types of gradients of water content in wood. Adsorption and desorption. Hygroscopic equilibrium. Fiber saturation point. Highest water content in wood. 1 hour
10. Lectures: Tightening and swelling. Shrinkage and swelling anisotropy. 1 hour
11. Lectures: Dilatation. Specific heat of wood. Heat conductivity in wood. Heating power of wood. Durability of wood. 1 hour
12. Lectures: Electrical conductivity of wood. Dielectric and piezoelectric properties of wood. Speed and sound resistance in wood. Sound attenuation and resonance in wood. 1 hour
13. Lectures: Tensile strength of wood. pressure, shear, bending and twisting. Cleavage, impact and hardness of wood. Wear resistance of wood. Factors of mechanical properties of wood. 1 hour
14. Lectures: Differences in the properties and structure of wood and their factors. 1 hour
15. Lectures: Wood errors. Classification of Errors due to weather conditions, fires and mechanical injuries to wood, drying and wood processing. Errors of sawn wood. Basic technological properties of wood. 1 hour 1.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Passing the exam.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td>Availability via other media</td></tr>
<tr><td></td><td colspan="5">Horvat, I. i sur.: Osnove nauke o drvu, Zagreb, 1985, str. 1-89.</td><td colspan="2">YES</td><td></td></tr>
<tr><td></td><td colspan="5">Karahasanović, A.:Nauka o drvetu, Sararevo 1988, str. 1-426.</td><td colspan="2">YES</td><td></td></tr>
<tr><td></td><td colspan="5">Ugrenović,A.; Horvat,I.: Tehnologija drveta, Zagreb, 1950,</td><td colspan="2">YES</td><td></td></tr>
</table>

	Teaching materials available on the Merlin system		YES, Merlin
2.12. Optional literature	1. Giordano, G.: Tecnologia del legno, Volume l, Torino, 1971, str. 1-1086. 2. Giordano, G.: Tecnologia del legno, Volume 111, Torino, 1976, str. 1-1351. 3. Kollmann F. R., Cote, W A Jr Principles of Wood Science and Technology l solid Wood, New York, 1968, str. 1-592. 4. Tsoumis, G.: Science and Technology of Wood, New York,1991, str. 1-233.		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Assist. Prof. Matija Landekić, PhD	1.7. Number of ECTS credits	2
1.2. Course title	Work humanization in forestry	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33946	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	Through this course a student achieves a right orientation for complex procedures of advancement of work humanisation in forestry. A student becomes able to evaluate the ergonomic suitability of a forest work and skills (principles, methods) for designing safer and more efficient work regarding the choice of measures, their leaders and financing. A special objective is to teach students about the possibilities of constant work advancement through the application of foreign achievements regarding the systems of work organisation, leadership models and payments for group and individual motivation in work.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem analysed in different ways A2.explain position and trends of forestry profession in the country and worldwide C3. organise and manage work safety in forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Analyze a work humanization in forestry (aim and area of humanization in forestry, workplace design procedures, forest safety guides, examples of good practice, work ability index and psychological loads in forestry practice) Present work environment, ergonomic design, PPE certification (working environment conditions for forestry; allowed, warning and harmful values; risk assessment and risk reduction measures; ergonomic design and cognitive ergonomics; basic health and safety requirements of the PPE and certification process). Define EU certification processes in the field of forestry work (development of training standards and training content for safe and humane work in forestry with the idea of establishing a center for forestry work in Croatia; humanization and safety of nonprofessional work).
2.5. Course content (syllabus)	L1 - Introduction to work humanization in forestry (1 h). Subject contents view. Rules of performance, preparation and examination. L2 - In general about the work humanization in forestry - Part I (1 h). Concept and task of work humanization. Multidisciplinary character of work humanization. L3 - In general about the work humanization in forestry - Part II (1 h). Humanization of work and development of forestry technologies and techniques. Living and working standards of forest workers. Work processes design. L4 - Legislative Framework of Safety and Humanization (1 h). Occupational Safety and Health Act. Ordinance on Occupational Safety and Health in Forestry. ILO Recommendations for Safe Forestry Practice. Principles for reducing injuries and professional illness.

<table>
<tr><td></td><td colspan="9">L5 - How working environment conditions can be more favorable and less harmful? (1 h). Work environment and working conditions. complex loads at forest works. Harmful impacts of the working environment. Ergonomic aspect of forestry work.
L6 - Basic Requirements and PPE certification (1 h). Working tools and personal protective equipment - testing and proof of quality. Categories and basic requirements for PPE. Pictograms of European and Croatian norms.
L7 - Ergonomic working tool design (1 h). Influence of ergonomic design and technological innovations from the aspect of work humanization. Cognitive ergonomics. Ergonomic convenience of forestry equipment.
L8 - Humanization and safety at nonprofessional work (1 h). Legal framework. Types and methods of training. Training centers and confirmation. Possibilities of improvement in Croatia - a model of "two security circuits".
L9 - Measures of work humanization (1 h). Technical, health and social humanization. Payment systems as an element of humanization. Collective motivation.
L10 - Social aspect of work humanization in forestry (1 h). Health measures. Housing and nutrition. Safety and hygiene standards.
L11 - European safety and humanization standards (1 h). Processes for certification of works in forestry. The role of the national center forestry work.
L12 - Working ability of forest machinery operators (1 h). Work Ability Index. Licensing and certification for achieving European standards of safety and humanization in forestry work.
L13 - Vibrations transmitted to the fists and arms (1 h). Risk assessment. Instant tools for calculating daily exposure. Risk mitigation measures. The role of health surveillance.
L14 - Integral risk assessment as a measure of work humanization in forestry (1 h). Risk of emergence and stress development in forestry practice. Mechanisms of detection, prevention and management of stress.
L15 - Modern technology in service of work humanization (1 h). Satellite GPS transponder/messenger as a means of safety in forestry work. Types of device and possibility of application in forestry.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Taking exam.</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="4">Landekić, M., 2020: Work humanization in forestry (internal collection of presentations for the current academic year)</td><td colspan="2">NO</td><td colspan="2">YES, Merlin</td></tr>
</table>

	Bernasconi A., Schroff U. 2011: Professions and Training in Forestry. Results of an Inquiry in Europe and northern America. Federal Office for the Environment, Bern. 84 pp.	NO	YES, online
	Croatian Institute for Health Protection and Safety at Work, 2008: Mental workload - A guide to risk assessment in SMEs.. 15 pp.	NO	YES, online
2.12. Optional literature	Landekić, M., Katuša, S., Mijoč, D., Šporčić, M., 2019: Assessment and Comparison of Machine Operators' Working Posture in Forest Thinning. SEEFOR 10(1): 29–37. Landekić, M., Martinić, I., Bakarić, M., Šporčić, M., 2013: Work Ability Index of Forestry Machine Operators and some Ergonomic Aspects of their Work. Croatian journal of forest engineering. 34 (2); 241-254 Landekić, M., Martinić, I., Lovrić, M., Šporčić, M., 2011: Assessment of Stress Level of Forestry Experts with Academic Education. Collegium antropologicum. 35 (2011) , 4; 1185-1192 Lipoglavšek, M.: Humanizacija dela v gozdarstvu. Biotehniška fakulteta Ljubljana, s. 1-214., Ljubljana, 1998 ILO – Ergonomics in Forestry: The Chilean case (ed. E. Apud, S. Valdes), 1995		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Mario Šporčić, PhD	1.7. Number of ECTS credits	2
1.2. Course title	Corporative culture	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	225898	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	To get acquainted with corporate, ie organizational culture as a factor of success and efficiency of the business system (in forestry) and to master the minimum knowledge and skills of designing, researching and maintaining organizational culture in the company.
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	B13. manage forest, human resource, and technical potential during performance of forest works C1. plan, organise and works of organization of production in forestry C5. manage the most complex tasks in all forms of forest organizations, forest and hunting advisory service; forest entrepreneurship
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Formulate organizational culture in the context of environment and conditions in forestry (elements and functions of organizational culture, organizational climate and culture, classification and typology, design and maintenance of organizational culture, role and importance in forestry, influence of environment and ICT on organizational culture of enterprise, ethical components and contemporary trends in organizational culture, research and features of organizational culture in forestry). Present the measurement and management of organizational culture (methods and models of research, influence of managers on organizational culture, most known theories and models of leadership, subculture and change of organizational culture in the company). Evaluate organizational culture and organization effectiveness (impact of organizational culture on the success and efficiency of business systems, relationship between organizational culture and business strategy, examples of good practice, ie organizational culture of successful domestic and foreign companies).
2.5. Course content (syllabus)	Lectures 1. Introduction – general about corporate culture (concept, definition…) 2. Elements and functions of organizational culture. 3. Classification and typology of organizational culture. 4. Organizational climate and culture: differences and similarities. 5. Organizational culture in the context of the environment. 6. Organizational culture and managerial style. 7. The impact of information and communication technologies on organizational culture. 8. Methods and models in organizational culture research. 9. Organizational culture and effectiveness of the organization. 10. Organizational culture management. 11. Forming and maintaining organizational culture. 12. Changes in organizational culture 13. Contemporary trends in organizational culture. 14. Organizational culture in the implementation of business strategy.

<table>
<tr><td></td><td colspan="9">15. Research and features of organizational culture in forestry</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td></td><td>NO</td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Taking the exam.</td></tr>
<tr><td rowspan="4">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Landekić, M., Šporčić, M., Martinić, I., Bakarić, M., Lepoglavec, K., 2016: Utjecaj stilova vodstva na upravljanje i organizacijsku kulturu šumarskog poduzeća. Šumarski list 140 (1-2): 17–28</td><td colspan="2">YES</td><td colspan="2">YES</td></tr>
<tr><td colspan="5">Sušanj, Z., 2005: Organizacijska klima i kultura. Naklada Slap, Jastrebarsko.</td><td colspan="2">NO</td><td colspan="2">YES</td></tr>
<tr><td colspan="5">Žugaj, M., Bojanić-Glavica, B., Brčić, R., Šehanović, J., 2004: Organizacijska kultura. TIVA Tiskara Varaždin.</td><td colspan="2">NO</td><td colspan="2">YES</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">Landekić, M., Šporčić, M., Martinić, I., Bakarić, M., 2015: Influence of organizational culture on firm efficiency: competing values framework in Croatian forestry. Scandinavian Journal of Forest Research 30(7): 624–636.
Landekić, M., Šporčić, M., 2015: A Link between Business Improvement and Organizational Culture: A Case Study in Croatian State Forestry Sector. In: Organizational Culture - Leadership Strategies, Outcomes and Effectiveness (ed. Camerun P. Fuller), Nova Science Publishers, New York.
Šporčić, M., Landekić, M., Vondra, V., Anić, Z., 2010: Informacija o organizacijskoj kulturi u hrvatskom šumarstvu. Nova mehanizacija šumarstva, vol. 31: 15-26.</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Mario Šporčić, PhD Assist. Prof. Matija Landekić, PhD.	1.7. Number of ECTS credits	2
1.2. Course title	Organizational behaviour in forestry	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	225899	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	To acquire the basic knowledge and skills needed to work successfully with people, to improve interpersonal skills, to develop communicational and motivational skills and the ability to resolve conflicts and manage human resources.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. organise and perform tasks of greater complexity in forestry, from forest office and forest management unit as the lowest forestry structural units along the vertical. B13. manage forest, human resource, and technical potential during performance of forest works C1. plan, organise and works of organization of production in forestry C5. manage the most complex tasks in all forms of forest organizations, forest and hunting advisory service; forest entrepreneurship D4. professionally and scientifically upgrade through different educational ways and postgraduate study
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Predict and explain individual, group, and overall behavior within organizations. 2. Design jobs that motivate, resolve conflicts, and motivate employees. 3. Organize and lead work teams and team tasks. 4. Assess the impact of individuals, groups, and structures on behavior within organizations and apply that knowledge to improve organizational performance.
2.5. Course content (syllabus)	Lectures 1. Introduction to organizational behavior 2. Foundations of individual behavior 3. Attitudes and job satisfaction - in forestry 4. Personality, values, feelings and moods - forestry workers 5. Perception and individual decision making 6. Understanding motivation 7. Designing motivating jobs 8. The foundations of group behavior 9. Understanding teamwork (in forestry 10. Communication 11. Basic approaches and contemporary issues in leadership 12. Conflicts, negotiation and stress management 13. Recruitment and deployment - planning, acquisition, testing and selection of personnel in forestry 14. Performance evaluation and reward systems 15. Human resource management policies and practices

<table>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td></td><td>NO</td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Taking the exam.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td></td><td colspan="4">Robbins, S.P., Judge, T.A., 2010: Organizacijsko ponašanje. Mate d.o.o. Zagreb.</td><td colspan="2">NO</td><td colspan="3">YES</td></tr>
<tr><td></td><td colspan="4">Dessler, G., 2015: Upravljanje ljudskim potencijalima. Mate d.o.o. Zagreb.</td><td colspan="2">NO</td><td colspan="3">YES</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">Landekić, M., Šporčić, M., Martinić, I., Bakarić, M., Lepoglavec, K., 2016: Utjecaj stilova vodstva na upravljanje i organizacijsku kulturu šumarskog poduzeća. Šumarski list 140(1-2): 17–28.
Šporčić, M., Landekić, M., Bakarić, M., Nevečerel, H., Lukec, I., 2015: Promjene nekih vrijednosnih kriterija šumskih radnika u 15-godišnjem razdoblju. Nova mehanizacija šumarstva 36: 5-18.
Bahtijarević-Šiber, F., 1999: Management ljudskih potencijala, Golden marketing, Zagreb</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Tibor Pentek, Ph.D. Prof. Tomislav Poršinsky, Ph.D. Assist. Prof. Ivica Papa, Ph.D. Assist. Prof. Andreja Đuka, Ph.D. Mihael Lovrinčević, BSc	1.7. Number of ECTS credits	6
1.2. Course title	Forest Accessibility	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+16
1.3. Course code	33904	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Cumpulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	The basic objective and task of this subject is to inform students about the phase of planning forest roads. Students obtain theoretical and practical knowledge and skills necessary for solving problematics of forest opening by primary and secondary forest roads with the objective of comprehensive optimisation of forest road infrastructure taking into consideration different criteria for assessing its optimality and different functions that the transport infrastructure performs.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B3. manage and make independent professional (business) decisions form the field of timber harvesting, forest opening, designing of forest road network and forestry entrepreneurship B12. apply knowledge related to the methods for preparing and planning technical works in forestry B14. apply knowledge related to the methods, techniques, and technology of opening of forests, i.e. designing and constructing a network of forest roads
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Analyze strategic and tactical planning of forest roads (types of plans and planning – strategic, tactical and operational planning, strategic and tactical planning of forest roads, study of primary forest accessibility (level of management unit), study of secondary forest accessibility (level of a group of departments), upgrading and optimization of primary and secondary forest road infrastructure). Present the mean timber extraction distance and forest area accessibility (central and parallel extraction, values of correction factors of specific relief areas, actual and target mean timber extraction distance, advantages and deficiencies of the parameter mean timber extraction distance, primary and secondary forest accessibility, efficiency coefficient, advantages and deficiencies of the parameter forest accessibility, optimal forest accessibility and models of its calculation). Assess forest road density, as well as primary and secondary forest accessibility of different relief areas (register of primary and secondary forest road infrastructure, criteria for estimating optimal primary forest road infrastructure, economic, technical technological, environmental ecological and sociological aesthetic criteria of optimization, primary and secondary forest accessibility for timber harvesting by skidding (lowland forests, hilly and mountainous forests), primary and secondary forest accessibility on sloped terrain for timber forwarding).

	Present the classification of the actual network of primary forest roads according to defined criteria for estimating the optimum conditions (methodology study of primary forest accessibility, determination of the actual geometric (Euclidian) distance of timber extraction, criteria for estimating the optimum conditions and classification into priority levels). Define the optimization of the primary forest road network - horizontal and vertical (analysis of selected possible routs of future forest roads and achieving the target primary classical accessibility, optimization of newly planned routes of forest roads in view of vertical development of individual forest road routes, development of the register of upgraded network of primary forest traffic infrastructure, analysis of quantity and quality of upgraded network of primary forest traffic infrastructure). Present methodological study of secondary forest accessibility (design and establishment of GIS on such area, analysis of the actual work on secondary forest traffic infrastructure, selection of possible routes and analysis of future secondary forest roads, optimization of newly planned network of secondary forest roads, construction of planned routes).
2.5. Course content (syllabus)	Lectures 1. Introductory considerations. Planning. Types of planning and plans. Strategic planning. Tactical planning. Operational planning. Planning in forestry. 2. Planning of forest roads. Historical development of forest accessibility in Croatia and the world. Basic components of forest road planning. Strategic planning of forest roads. Tactical planning of forest roads. Operational planning of forest roads. 3. Parameters for estimating the quantity and quality of forest road network. Classical forest accessibility. Mean extraction distance. Relative forest openness. Space between forest roads. Definitions, formulas and interrelations. 4. Mean timber extraction distance – basic types. Central and parallel extraction. Determination of mean timber extraction distance by different methods. Correction factors of mean timber extraction distance. 5. Relative forest accessibility. Calculation of relative forest accessibility. Buffer method. Efficiency coefficient of individual forest roads and the entire forest road network. Target forest accessibility. Optimal forest accessibility. Different models for calculating optimal forest accessibility. 6. Timber harvesting systems with analysis of operations, methods of timber processing, vehicles and tools used in felling and transport. Choosing adequate technology depending on terrain and stand condition and forest traffic infrastructure (primary, secondary, position of landing sites and timber buyers). 7. Primary forest accessibility (forest roads). Different systems of primary forest accessibility. Solving specific issues in providing primary forest accessibility (lowland, slope, karst sinkhole, hill, two roads, etc.) 8. Secondary (fine) forest accessibility (skid roads and skid trails) for skidding and forwarding. Secondary (fine) forest accessibility (skyline cable yarding) for aerial extraction of logs. Solving specific issues in proving fine forest accessibility. 9. Features of secondary forest traffic infrastructure network – analysis of terrain trafficability in GIS through determination of terrain slope and ground obstacles (permanent and occasional watercourses, stoniness and rockiness). Determination of expanding secondary forest traffic infrastructure network according to the analysis of existing parameters (average geometric timber extraction distance, relative openness and real timber extraction distance). 10. Basic influencing factors affecting the optimization of forest road network. Dominant (complex) influencing factors. Simple influencing factors. Functional approach to providing forest accessibility. Criteria for estimating the optimum conditions. Economic optimization. Technical-technological optimization. Environmental-ecological and sociological-aesthetic optimization. Overall optimization. 11. Geographic information system (GIS), definitions, basic components and principle of operation. Establishment of GIS. Possibilities of GIS in an accessible forest area as the basis for making the best decisions when optimizing forest roads. 12. Global positioning system (GPS), introduction, definition and analysis. Use of GPS in recording primary and secondary forest roads. Manner of work and recommended methods.

	13. Methodological study of primary forest accessibility. Phases and methods of work in developing a methodological study. Case study. 14. Methodological study of secondary forest accessibility. Phases and methods of work in developing a methodological study. Case study. 15. Computer models of forest accessibility. Computer simulations. Selection of most favorable options. Practical exercises 1. Introduction. Basic phases in establishing an optimal forest road network: planning, design, construction and maintenance of forest roads. Primary and secondary studies of forest accessibility (presentation by components with the explanation of possibilities offered by tools that students use during exercises). 2. Basics of MS Excel (column, line, cell, definition of mathematical, logical and textual formulas, creating links with space attribute tables). Creating computer databases (*.dbf), possibilities of connection with other databases. 3. Selection of information source (ability to assign different input data). Sorting and analysis of original information needed for connecting with spatial data (CODE, editing of the existing data, control, etc.). 4. Basics of ArcGIS (Arc Catalog, Arc Map, Arc Scene). Creating new topics, adding the existing ones, defining the basic settings of the topic presentation (basic types of data, methods of creating and editing, polishing, joining projections, scale, symbology, classes, colors, types, kinds). 5. Selection of spatial data. Analysis and sorting of the actual data (sorting of the actual polygons, forming the attribute table that can be connected with *.dbf. 6. Forming databases. Establishment of GIS of the research area. Connecting the spatial data with computer databases (connecting all data and controls by attributes, upgrading and entering new calculation attributes). 7. Preparation of thematic components (thematic maps). Defining the basic assessment criteria. Preparing the optimization of primary forest road network (economic classification, type, forest purpose, terrain slope, growing stock, annual allowable cut, etc.). 8. Methods of collecting data on forest roads (classical, GPS, DGPS). Data processing, plotting and editing. Categorization of forest roads. Creating the register of forest roads (primary and secondary). 9. Preparations for fieldwork measurements – types of GPS data (point, line, polygon). Spatial data recording, finding and measuring research areas using a map and GPS device. 10. Data analysis from fieldwork measurements – transfer of recorded spatial data, processing and analysis. Making a thematic map of the research area. 11. Analysis of the existing network of primary forest traffic infrastructure. Determination of the existing primary classical and relative accessibility (calculation of accessibility for the selected parameters, mean extraction distance). Definition of inaccessible areas. 12. Connecting the criteria for the assessment of optimum conditions of primary forest road network (determination of simple and complex influencing factors of individual criteria of assessment of optimal conditions). Definition of priorities and determination of the position of possible forest road routes. 13. Overall optimization and establishment of possible routes of future forest roads (several options). Achievement of optimal accessibility. Analysis of newly designed forest road network 14. Analysis of the existing network of secondary forest traffic infrastructure. Determination of the existing secondary classical and secondary relative accessibility for the existing forest traffic infrastructure. 15. Determination of inaccessible areas. Determination of possible routes of future TP and TV. Analysis of secondary accessibility. 16. Preparation of the obtained results for the final printout. Possibilities of display and presentation of the obtained results (possibilities of export option, print in *.pdf). Printout components. Creating the final look (creating maps with all necessary components – map keys, map scale).

<table>
<tr><td></td><td colspan="9">Field classes
As part of fieldwork, students use GPS devices to collect spatial data of the research area. They record and analyse three types of spatial data (point, line, polygon). Students process recorded data in specialised computer programs and create a thematic map of the research area.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td>YES</td><td></td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">6</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regularly attend and actively participate in lectures, practical exercises and field classes. Take midterm exams, or written and oral exams.</td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Pentek, T., 2012: Forest accessibility (.pptx and .pdf lectures 1-15), Faculty of Forestry, University of Zagreb.</td><td colspan="2"></td><td colspan="2">YES, Merlin</td></tr>
<tr><td colspan="5">Pentek, T. 2002: The computer models for forest roads network optimization with regard to the dominant influential factors. Doctoral thesis, Faculty of Forestry, University of Zagreb, Zagreb, pp 1-271, chosen chapters.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Pičman, D., 2007: Forest roads (university textbook), Faculty of Forestry, University of Zagreb, pp 1-460, chosen chapters.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">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, chosen chapters.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Scientific and professional papers on the subject issues of domestic and foreign authors published in scientific journals and conference proceedings.
2. Šikić, D. i dr., 1989: Tehnički uvjeti za gospodarske ceste, Znanstveno vijeće za promet JAZU, Zagreb, pp 1-40, chosen chapters.
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.</td></tr>
</table>

4. 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.
5. 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.
6. Đuka, A., Poršinsky, T., Vusić, 2015: DTM models to enhance planning of timber harvesting. Bulletin of the Faculty of Forestry - University of Belgrade, 2015 (2015), 35-44.

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Assist. Prof. Dinko Vusić, PhD. Assist. Prof. Andreja Đuka, Ph.D.	1.7. Number of ECTS credits	4
1.2. Course title	Forest products	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+16
1.3. Course code	33905	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	The aim of this course is to inform students with all forest products and their use with special emphasis on the quality of wood forest products. Students will acquire the knowledge and skills necessary for the preparation, execution 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	A1. independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem analysed in different ways B8. measure and evaluate quality parameters of timber assortments and interpret their size and meaning B10. apply knowledge related to forest main and secondary forest products and their shipment from the place of production to the market via forest soil, skid trails and the network of forest and public roads C2. organise and conduct sale of timber assortments and timber products on domestic and worldwide market
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Present the division of forest products and standardization of products and development of standardization (standards and norms, classification and reporting of primary forest products according to UNECE / FAO methodology, nomenclature of commercial tree species, classification of trees according to norms, wood and non-wood forest products, legal and by-law acts, European (CEN) and International (ISO) product and Procedures standardization) Analyze methods of forest products records (traditional and current methods, methods of measurement according to HRN and HRN EN normative systems, methods of measurement and expression of results) Classify wood forest products according to the HRN normative system - wood for technical use, wood for chemical use and firewood, and HRN EN normative system - roundwood and HRN EN ISO for solid biofuels (wood defects, quality grading, minimum dimensions and allowed defects, quality assurance system) Valorize other forest products (fruits and seeds of forest trees, shrubs and ground vegetation, aboveground commercial mushroom species, underground commercial mushroom species, medicinal plants, edible plants, game).
2.5. Course content	Lectures

(syllabus)	1. Division of forest products. Classification and presentation of quantities of wood forest products according to UNECE / FAO methodology. 2. Legal and bylaw basis of documentation for monitoring the production of wood assortments. 3. Balance of wood forest products. 4. Historical overview of product standardization; customs, standards and norms. European (CEN) and international (ISO) standardization of products and procedures; working bodies, the sequence of adoption of normative documents and their application. 5. Forms and usable properties of wood forest products throughout history - dynamics of change with reference to the degree of development of techniques and technologies. 6. Traditional and modern methods of product records. Measurement methods according to HRN and HRN-EN normative systems; reduction of bark, allowance and bonification. Measuring instruments. Measurement methods and presentation of results. 7. Wood defect according to HRN normative system. 8. Features of wood according to HRN EN normative system. 9. Classification of wood forest products according to the HRN normative system. Quality grades of deciduous roundwood; minimum dimensions and permissible defects. 10. Classification of wood forest products according to the HRN normative system. Quality classes of coniferous roundwood; minimum dimensions and permissible defects. 11. Classification of wood forest products according to the HRN normative system. Types and quality classes of cordwood; minimum dimensions and permissible defects. 12. Classification of wood forest products according to the HRN-EN normative system. Quality classes of roundwood; minimum dimensions and permissible defects. 13. Classification of wood forest products according to the HRN-EN normative system. Types and quality classes of energy wood. 14. Non-wood forest products. Fruits and seeds of forest trees, shrubs and ground vegetation. Aboveground commercial mushroom species . Underground commercial mushroom species. Healing herbs. Game. Eco certification. 15. Market and mods of forest products sale. Exercises 1. Sequence of documentation for production monitoring and invoice preparation. Computerized production record systems; productivity calculation and invoice issuing. 2. Records of wood assortments using computer systems. 3. Preparation of documentation for the sale of wood assortments. 4. Shipping of wood assortments using computer systems. 5. Complaint and reclassification of wood assortments. 6. Measurement of wood assortments according to HRN and HRN-EN normative systems and determination of quantity. 7. Wood defects (HRN) - recognition. 8. Wood defects (HRN) - measurement. 9. Wood features (HRN EN) - recognition. 10. Wood features (HRN EN) - measurement. 11. Determination of total aboveground biomass and expansion factors. 12. Assessment of tree quality and assortment structure of stands. 13. Simulation of bucking (to standard lengths and to quality) and value of roundwood. 14. Processing and analysis of data from fieldwork. 15. Certification of forest products - preparation of documentation. Field work: Quality assessment of standing trees. Selection of the most suitable processing method. Bucking and records of wood assortments; the concept of maximum natural utilization and the concept of maximum financial utilization. Computer records of products. Total aboveground biomass. Assortment structure; assortment tables, assessment results and felling plan performance.		
2.6. Format of instruction	☒ lectures	☐ independent	2.7. Comments:

<table>
<tr><td></td><td colspan="3">☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3"></td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>YES</td><td>ECTS credits (total)</td><td colspan="2">4</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Ordinarily participation and active participation in classes. Examination.</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="4">Zečić, Ž., Vusić, D., 2018: Šumski proizvodi - Predavanja i vježbe (interna skripta), Šumarski fakultet. Zagreb</td><td colspan="2">NO</td><td colspan="3">YES, Merlin</td></tr>
<tr><td colspan="4">Zečić, Ž., Vusić, D., 2020: Katalog drvnih šumskih proizvoda. Sveučilište u Zagrebu Šumarski fakultet, 1–217.</td><td colspan="2">YES</td><td colspan="3"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Prka, M., 2010: Bukove šume i bukovina bjelovarskog područja. Hrvatsko šumarsko društvo, Ogranak Bjelovar, 1–252.</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Assist. Prof. Marko Vucelja, PhD. Prof. Boris Hrašovec, PhD. Prof. Danko Diminić, PhD. Assist. Prof. Milivoj Franjević, PhD. Valentina Lovrić BSc Linda Bjedov, PhD.	1.7. Number of ECTS credits	4
1.2. Course title	Integrated forest protection	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+16
1.3. Course code	33906	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	To solve protection problems it is necessary to include all the components which affect certain plants and a forest as a whole. Best solutions are obtained by their integration in time and space. It is also necessary to know all the technical means for carrying out specific protection measures. Good results are obtained by proper connection of all the factors which endanger plants and habitats in order to take safe protection measures.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B2. implement forest management programs B5. manage protection of forests from abiotic and biotic factors, and organise procedures in protection of forests B12: apply knowledge related to the methods for preparing and planning technical works in forestry B16. develop current technologies as well as implement new technologies
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Describing the protection measures in ash and oak forests (protection measures against the pathogens, determining the number of populations of defoliants, large game and small rodents, calculating the pest's critical numbers). Presenting the protection measures in common beech, fir and spruce forests (protection measures against different pests, determination of the bark beetles abundance). Valorizing the protection measures in Mediterranean forests (abiotic and biotic factors, organization of fire protection). Suggesting the use of different machinery in forest protection (Techniques and Technologies). Design and present a forest protection plan regarding the current pest population. Determining the pest abundance and protective measures. Classify different devices in plant protection (pressure atomizer, rotary, pneumatic).
2.5. Course content (syllabus)	Forest protection is a comprehensive unit which primarily relies on the forest entomology, forest phytopathology, forest growing, but also on all other disciplines. Its integrity results from it. The task of the subject is to show students the connection and interdependence of

	certain disciplines in the common solution of protective tasks. For this purpose, the influence and protection of forests from the harmful influence of abiotic factors will be examined (extremely high and low temperatures, wind, water, air and soil pollution). Apart from that, weeds in forests and nurseries, on one side as harmful and on the other as useful plants (in certain conditions) are dealt with. Relying on the knowledge of biology of harmful insects and pathogen fungi, integrated protection methods are indicated, as well as the knowledge and application of plant protection products. Damages caused by wild game and small rodents are particularly dealt with, as well as methods of protection from them. Regarding forest fires, the forest economic factor will be greatly dealt with as preventions of forest fire occurrence and models of evaluation of the danger of forest fire occurrence. Lectures: 1. History, meaning and importance of forest protection 2. Complexity of forest protection in relation to other disciplines 3. The importance of forest buffer zones against the weather extremes 4. Negative impact of extreme temperatures and protective measures 5. Protection against the wind 6. Protection against rain, flood and snow 7. Forest weeds and their control 8. Pest population dynamics 9. Pest control methods 10. Protection against fungi 11. Protection against wildlife 12. Small rodents, population density determination and control 13. Protective measures in nurseries and forest plantations 14. Special protection measures in regular, selective and Mediterranean forests 15. Forest fires Excercises: 1. Determination of gypsy moth (Lymantria dispar L.) population density (introduction and preparation) 2. Determination of gypsy moth (Lymantria dispar L.) population density (field work) 3. Determination of gypsy moth (Lymantria dispar L.) population density (analysis of samples prediction for the next vegetation period) 4. Aerial treatment 5. Determination of pest attack symptoms on samples in the laboratory 6. Seedling and sapling protection from oak mildew 7. Identification and protection measures against most common pathogenic fungi on common beech and silver fir 8. Identification and protection measures against most common pathogenic fungi on pine needles 9. Protection measures against decay fungi 10. Interactive quiz – identification and protection measures against pathogenic fungi in different forest ecosystems 11. Basic characteristics of the most common species of small rodents (subfam.Murinae and Arvicolinae) in lowland forest ecosystems in Croatia (systematics and biology) 12. Positive and negative impact of small rodents in Croatian forest ecosystems (ecological, economic, health aspect) 13. Monitoring of abundance and damage from small rodents in forest ecosystems (review of monitoring methods, previous experiences, the importance of establishing systematic monitoring in the future) 14. Principles of integrated protection and review of preventive and repressive measures against small rodents 15. Basic characteristics of hard ticks (fam. Ixodidae) (biology, morphology, most common species, monitoring, health aspect, personal protection)

2.6. Format of instruction	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *online in entirety* ☒ partial e-learning ☒ field work			☒ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)			2.7. Comments:		
2.8. Monitoring student work	Class attendance	YES		Research	YES		Oral exam	YES	
	Experimental work	YES		Report		NO	(other)		
	Essay		NO	Seminar paper	YES		(other)		
	Preliminary exam	YES		Practical work	YES		(other)		
	Project	YES		Written exam	YES		ECTS credits (total)	4	
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities	Regular attendance and active participation in lectures. Taking exam.								

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Altenkirsh, W., Majunke, C., Ohnesorge, B., 2002: Waldschutz auf ökologischer Grundlage. Eugen Ulmer Verlag, Stuttgart, Deutschland. ISBN 3-8001-3684-8, 434 str.	NO	Yes, e-learning platform "Merlin"
	Vucelja, M., Bjedov, L., Margaletić, J., 2020: Unapređenje metodologije sustavnog monitoringa sitnih glodavaca i zaštite od njihova štetnog utjecaja u poplavnim šumama Hrvatske. U: Oršanić, M. (ed.) Ekologija, obnova i zaštita poplavnih šuma Posavine. Sveučilište u Zagrebu, Šumarski fakultet, Zagreb, 277-368.	YES	Yes, e-learning platform "Merlin
	Glavaš, M., Margaletić, J., 2001: Štete od životinja. U: Prpić, B. (ur.), Obična jela (Abies alba Mill.) u Hrvatskoj, 626–629.	YES	Yes, e-learning platform "Merlin
	Margaletić, J., 2003: Štete i zaštita od glodavaca. U: Matić, S. (ur.), Obična bukva (Fagus sylvatica L.) u Hrvatskoj, 574–579.	YES	Yes, e-learning platform "Merlin
	Glavaš, M., Margaletić, J., 2003: Zaštita šuma hrasta lužnjaka. U: Klepac, D., Čorkalo-Jemrić, K., (ur.), Retrospektiva i perspektiva gospodarenja šumama hrasta lužnjaka u Hrvatskoj, 167–183.	YES	Yes, e-learning platform "Merlin
	Margaletić, J., 2005: Glodavci i divljač kao uzročnici šteta u poplavnim šumama. U: Vukelić, J., (ur.), Poplavne šume u Hrvatskoj, 412–422.	YES	Yes, e-learning platform "Merlin
	Bonnie J. Mills, 1996: Laboratory animal management. National Academy Press, Washington, 167 pp	NO	Yes, e-learning platform "Merlin

	Lacey, E.A., Patton, J.L., Cameron, G.N., 2000: Life underground the biology of subterranean rodents. The University of Chicago Press, Chicago and London, 449 pp	NO	Yes, e-learning platform "Merlin
2.12. Optional literature	Margaletić, J., 2003: Promjene u sastavu šumskih populacija sitnih glodavaca nakon mehaničkih zahvata u staništu. Zbornik radova seminara "DDD i ZUPP – stručnost prije svega", 117–122. Margaletić, J., 2004: Dinamika populacija šumskih glodavaca u Hrvatskoj. Šumarski list (11–12): 599–607 Margaletić, J., Grubešić, M., Dušak, V., Konjević, D., 2006: Activity of European beavers (Castor fiber L.) in young pedunculate oak (Quercus robur L.) forests. Veterinarski arhiv, 76 (Suppl.): 167–175. Margaletić, J., Kišasondi, A., 2007: Ekologija i ponašanje šumskih glodavaca. Zbornik radova seminara "DDD i ZUPP – 60. obljetnica ustroja suvremene djelatnosti dezinfekcije, dezinsekcije i deratizacije u Republici Hrvatskoj", 431–452. Margaletić, J., Jurjević, V., Glavaš, M., Hrašovec, B., Diminić, D., 2007: Analiza suzbijanja gubara (Lymantria dispar L.) tijekom 2005. godine u državnim šumama Hrvatske. Šumarski list, 131(11-12): 539–548. Margaletić, J., Glavaš, M., Hrašovec, B., Kišasondi, A., 2007: Poznavanje osjetila njuha i sluha kod šumskih glodavaca u cilju kvalitetne primjene mjera zaštite. Glasilo biljne zaštite, 6: 380-386. Hrašovec, B., Kasumović, L., Franjević, M., 2011: Prezimljavanje smrekova pisara (Ips typographus) u smrekovim šumama sjevernoga Velebita. Croatian Journal of Forest Engineering, 32: 221-222. Vucelja, M., Margaletić, J., Bjedov, L., Šango, M., Moro, M., 2014: Štete od sitnih glodavaca na stabljici i korijenu hrasta lužnjaka (Quercus robur L.). Šumarski list, 138(5-6): 283-291. Vucelja, M., Margaletić, J., Bjedov, L., Mioč, T., Bedeković, L., Boljfetić, M., Mirčetić, A., 2014: Prevencija šteta od sitnih glodavaca iz podporodica Murinae i Arvicolinae u šumama hrasta lužnjaka (Quercus robur L.). Zbornik radova seminara "DDD i ZUPP – jučer, danas, sutra", 275–286. Vucelja, M., Margaletić, J., Bjedov, L., Mioč, T., Bedeković, L., Boljfetić, M., Mirčetić, A., 2014: Prevencija šteta od sitnih glodavaca iz podporodica Murinae i Arvicolinae u šumama hrasta lužnjaka (Quercus robur L.). Zbornik radova seminara "DDD i ZUPP – jučer, danas, sutra", 275–286. Margaletić, J., Vucelja, M., Turk, N., 2015: Primjena repelenata u zaštiti šuma od sitnih glodavaca. Zbornik radova seminara "DDD i ZUPP – važnost u izvanrednim okolnostima", 231–240. Margaletić, J., Hrašovec, B., Diminić, D., Beuk, A., 2015: Zaštita šuma hrasta lužnjaka (Quercus robur L.) protiv biotičkih štetnika na području Uprave šuma Podružnica Vinkovci u razdoblju od 2009. do 2011. godine. Zbornik radova sa znanstvenog skupa "Proizvodnja hrane i šumarstvo-temelj razvoja istočne Hrvatske", 375–393. Dautbašić, M., Mujezinović, O., 2016: Integralna zaštita smrče-smjernice. Univerzitet u Sarajevu, Šumarski fakultet, 164 str. Bjedov, L., Vucelja, M., Margaletić, J., 2016: Priručnik o glodavcima šuma Hrvatske, 55 str. Margaletić, J., Vucelja, M., Turk, N., Markotić,A., Boljfetić, M., 2017: Pregled mjera zaštite šuma protiv sitnih glodavaca u Republici Hrvatskoj u razdoblju od 1995. do 2015. godine. Zbornik radova seminara "DDD i ZUPP", 311–323. Margaletić, J., Vucelja, M., Turk, N., Markotić, A., Boljfetić, M., 2017: Pregled mjera zaštite šuma protiv sitnih glodavaca u Republici Hrvatskoj u razdoblju od 1995. do 2015. godine. Zbornik radova seminara "DDD i ZUPP", 311–323.		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Igor Anić, PhD. Associate Prof. Stjepan Mikac, PhD	1.7. Number of ECTS credits	5
1.2. Course title	Silviculture	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+24
1.3. Course code	33907	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	This course is established in the science and practice of close-to-nature silviculture, which has been here developed under the name of "Zagreb school of silviculture". It is conceived as the forest silviculture that directs the stand development by the principles of primary forest development, but based on the criteria emerging from management targets. The course trains students for independent silvicultural stand analysis, silvicultural procedures in all types of forest stands, and independent solution of silvicultural problems with making decisions on the implementation of the silvicultural procedures in all types of forest management
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B2. implement forest management programs B5. manage protection of forests from abiotic and biotic factors, and organise procedures in protection of forests
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Valorize of virgin forest and close to nature forest management (development cycle, texture and structure, comparison of structure, production, regeneration and selection in the rainforest and the management forest). Suggest the silvicultural procedures in forest stands (the principles of rationalization in silviculture, method of classifying trees in the stands, the method of thinning, the thinning intensity, Assmann's theory) Present special forest regeneration methods (biological, ecological and silvicultural preconditions of natural regeneration and their impact on the success of natural regeneration, comparison of generative and vegetative and natural, artificial and combined regeneration, regeneration theory on small surfaces, theory of combined regeneration methods - additive and substitution combinations). Valorize special methods of forest management and silviculture forestry in the conditions of habitat change (two-layered high forest, high forest with reserves, pioneering and transitional forest management). Present conversions (replacement, conversion of coppice forest to high forest, conversion of coppice with standard forest to high forest). Compare silvicultural techniques by forest stands and sustainability (silvicultural planning, forest biodiversity, concept of permanent forest).
2.5. Course content (syllabus)	Lectures (30 hours):

	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

<table>
<tr><td></td><td colspan="9">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 (30 hours):

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 method)
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 (24 hours):

1. Silvicultural planning and dieback of trees and stands
2. Silvicultural planning in selection management
3. Silvicultural features on selected vegetation profile</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">5</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in all forms of teaching. Preparation of reports from exercises and fieldwork. Taking preliminary exam. Taking exam.</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Anić, I., 2020: Silvikultura (predavanja). Interna skripta, Šumarski fakultet Sveučilišta u Zagrebu.</td><td colspan="2">NO</td><td colspan="2">YES, Merlin</td></tr>
</table>

	Anić, I., S. Mikac, 2020: Silvikultura (vježbe i terenska nastava). Interna skripta, Šumarski fakultet Sveučilišta u Zagrebu.	NO	YES, Merlin
2.12. Optional literature	Anić, I., S. Matić, M. Oršanić, Ž. Majer, 2005: Pomlađivanje i njega šuma poplavnih područja. U: J. Vukelić (gl. ur.), Poplavne šume u Hrvatskoj, Akademija šumarskih znanosti, Zagreb, str. 263 – 276. Matić, S., I. Anić, M. Oršanić, S. Mikac, 2011: Njega i obnova šuma hrvatskoga Sredozemlja. U: S. Matić (ur.), Šume hrvatskog Sredozemlja, Akademija šumarskih znanosti, Zagreb, str. 375 – 386. Matić, S., I. Anić, M. Oršanić, 2003: Uzgojni postupci u bukovim šumama. U: S. Matić (ur.), Obična bukva (Fagus sylvatica L.) u Hrvatskoj, Akademija šumarskih znanosti, 340 – 369, Zagreb Matić, S., I. Anić, M. Oršanić, 2001: Uzgojni postupci u prebornim šumama. U: B. Prpić (ur.), Obična jela (Abies alba Mill.) u Hrvatskoj, Akademija šumarskih znanosti, 407–460, Zagreb. Roehrig, E., N. Barthsch, B. v Luepke, 2006: Waldbau auf oekologischer grundlage. Ulmer verlag, Stuttgart, 479 p.		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Professor Mario Božić, PhD Assist. Prof. Ernest Goršić, PhD	1.7. Number of ECTS credits	5
1.2. Course title	Forest Management	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+16
1.3. Course code	225891	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	The basic goal of the subject is to introduce students with basics of tree and stand growth and increment. Special attention will be given to influence of forest mechanization implematation during exploatation on tree growth as well as regulationg tree mixture ratio on value of wood stock produced. Students will be introduced to forest management plans (Forest management plan, Forest management program, Forest annual plans and General forest management plan) the way of making them and recognizing their importance for sustainable forest management. Accordingly, the emphasis will be put on technical and and financial components of the plans and their importance for planing implementation in logging works.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem analysed in different ways B2. implement forest management programs B4. organise and perform forest planning works C1. plan, organise and works of organization of production in forestry C6. manage tasks of county and national institutions competent for forestry; inspection services D1. conduct businesses of scientific and professional associate in scientific-research institutions in the field of forestry D2. conduct courses in professional secondary and other similar schools D4. professionally and scientifically upgrade through different educational ways and postgraduate study		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	To analyze growth and increment of individual trees (height growth and increment dynamics, diameter, cross section area, volume increment, value of certain tree species) 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, measurement and stand volume increment determination methods). To formulate forest management planning (management programs, general forest management plan, spatio-temporal forest management, management planning in even-aged, uneven-aged and mixed stands – forest and stand level) To evaluate limiting factors when prescribing performing tree felling (age structure, maximum felling intensity, forest accessibility, health status, calamities, market, regulation tracking and implementation, revision and aditional plan revision).		
2.5. Course content	CLASSES		

(syllabus)	1. Introduction.Tree growth space. Getting information on tree and stand increment. Growth and increment of individual trees. 2. Height growth and increment. Diameter growth and increment. 3. Growth and increment of tree volume and value. 4. Development and increment of even aged stands. 5. Development and increment of uneven aged and selection stands. 6. Influence of management actions on increment of trees and stands. 7. Methods of measurement and absolute volume increment determination. 8. Forest management plans (Forest management plan or forest management program, general forest management plan) 9. Temporal and spatial forest management. 10. Forest management planing in even aged stands. (stand and forest level): stock volume, species mixture ratio, maturity, sustainability. 11. Forest management planing in even aged stands. (stand and forest level): normality, felling volume and its value. 12. Forest management planing in selection stands. (stand and forest level): stock volume, species mixture ratio, felling dimension maturity, sustainability. 13. Forest management planing in selection stands. (stand and forest level): normality, felling volume and its value. 14. Forest management planing in uneven aged stands. 15. Limiting factors in proscribing felling volume and its realization: stand structure, accessibility, market, natural disturbance. Conduction evidence and tracking regulation fulfilment. Forest renewal, revision, irregular forest plan revision. PRACTICE (computer, field work, laboratory) 1. Introduction. Instruments for measurement and growth analysis. 2. Problems in defining annual diameter increment (false and missing tree rings). 3. Influence of tree damaging on increment. 4. Analysis of increment cores in even aged stands. 5. Analysis of increment cores in selection stands. 6. Equalization of increment in even aged and selection stands. 7. Calculation of increment. 8. Calculation of increment in even aged stands based on Meyer differential method. 9. Calculation of increment in even aged stands based on table of increment percentage method. 10. Calculation of data collected in even aged stand field practice . 11. Calculation of data collected in even aged stand field practice – continued.. 12. Calculation of data collected in even aged stand field practice – comparison between data collected from the plots with regulation from forest management plan. 13. Calculation of data collected in selection stand field practice. 14. Calculation of data collected in selection stand field practice – continued. 15. Calculation of data collected in selection stand field practice –comparison of data between plots and with regulation from forest management plan. Field practice 1. DAY In an area of even aged stands on Faculty research facility Lipovljani - Management unit „Opeke“ students will be introduced to its structural indicators and relationship to model stands (growth tables). Critical review on current stand condition will be made as well as on suggested management guidlines and felling volume. Moreover, students will be introduced to irregular stand age structure issue in mentioned management unit. In one of the stands on one hectare plot size students will measure structural indicators, calculate them and compare them with model stands on the basis of which felling volume will be proscribed. After that, one hectare plot will be inspected and estimated if precribed felling volume can be realized. 2. DAY

<table>
<tr><td></td><td colspan="9">In an area of selection stands on Faculty research facility Zalesina - Management unit „Belevine“ and „Kupjački vrh“ students will be introduced to its structural indicators and relationship to model stands (normality). Critical review on current stand condition will be made as well as on suggested management guidlines and felling volume. Moreover, students will be introduced to irregular stands age structure issue in mentioned management units. In one of the stands on one hectare plot size students will measure structural indicators, calculate them and compare them with model stands on the basis of which felling volume will be proscribed. After that, one hectare plot will be inspected and estimated if precribed felling volume can be realized.
Students will be introduced to issues of felling volume distribution according to log structure. It will be pointed out that logging and related forest works can cause damage to stem and root of the trees which consequently reduces tree and stand increment.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">5</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Continuous attending and active engagement in lectures and exercises, making and submitting of exercises in required time scedule. Passing the colocviums and exams.</td></tr>
<tr><td rowspan="4">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="4">Klepac, D., 1963: Rast i prirast šumskih vrsta drveća i sastojina,299 pp., Znanje, Zagreb.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="4">Klepac, D., 1965: Uređivanje šuma,340 pp., Znanje, Zagreb.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="4">Božić, M., Goršić, E.: Presentations from classes and practice.</td><td colspan="2"></td><td colspan="2">Merlin</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">Management unit plans or programs</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Tomislav Sinković, PhD	1.7. Number of ECTS credits	2
1.2. Course title	Mechanical technologies of wood processing	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33949	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	Knowledge about mechanical technologies of wood processing. Wood as final product of forestry and properties of wood importante for mechanical technologies of wood processing. The influence of phisycal and mechanical properties of wood on sawmilling. Technologyes of sawmilling. Products of sawmilling. Veneer. Technologyes of veneers productions. . The influence of phisycal and mechanical properties of wood on veneeers productions. Plywood. Phisycal and mechanical properties of plywood. Composite boards. Phisycal and mechanical properties composite boards. Hydrothermic wood processing. . The influence of phisycal and mechanical properties of wood on hydrothermic wood processing
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. organise and perform tasks of greater complexity in forestry, from forest office and forest management unit as the lowest forestry structural units along the vertical B8. measure and evaluate quality parameters of timber assortments and interpret their size and meaning C2. organise and conduct sale of timber assortments and timber products on domestic and worldwide market
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Defining basic procedures of mechanical processing of wood. Determination and valuation of timber or logs for mechanical processing of wood Determination and evaluation of wood quality fromthe field of mechanical processing of wood. Determination and valuation of wood defects in mechanical processing of wood Valuation and comparative analysis of the properties and aspects of trees for mechanical processing of wood
2.5. Course content (syllabus)	1. Lectures: Basic primary technologies of mechanical wood processing and their task. 1 hour 2. Lectures: Wood as a final product of forestry and input raw material for primary mechanical technologies. 1 hour 3. Lectures: Comparison of properties of wood important in forestry and properties important for primary wood processing. 1 hour 4. Lectures: Sawmill wood processing. 1 hour 5. Lectures: Raw material and its characteristics in sawmill wood processing. 1 hour 6. Lectures: Types of sawmill technologies. 1 hour 7. Lectures: Sawmill products. 1 hour 8. Lectures: Comparative advantages and disadvantages of the most common methods of sawmill wood processing. 1 hour 9. Lectures: Utilization in sawmill wood processing. 1 hour 10. Lectures: Technology of veneer production and veneer sheets. 1 hour 11. Lectures: Characteristics of raw materials of this type and basic properties of veneer sheets. 1 hour

<table>
<tr><td></td><td colspan="9">12. Lectures: Technology of production of boards from chopped wood. 1 hour
13. Lectures: Characteristics of raw materials of this type and basic properties of chipboard. 1 hour
14. Lectures: Comparative analysis of basic properties of sawmill products, veneer panels and chipboard. 1 hour
15. Lectures: Comparative analysis of the properties of wood processed in primary wood processing. 1 hour</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td>YES</td><td></td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Passing the exam.</td></tr>
<tr><td rowspan="5">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Brežnjak, M.:Pilanska tehnologija drva I i II dio, Zagreb,1997/2000, str. 1-212/1-215</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Horvat, I. i sur.: Osnove nauke o drvu i izrada proizvoda iz masivnog i usitnjenog drva, Zagreb, 1985, str. 1-87.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Krpan, J.:Tehnologija furnira i ploča, Zagreb,1970. str. 1-283.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Teaching materials available on the Merlin system</td><td colspan="2"></td><td colspan="2">YES, Merlin</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Kollmann, F.R., Cote, W.A.Jr.: Solid wood, New York, 1968, str. 1-592.
2. Giordano, G. :Techologia del legno 2.,Le lavorazioni industriali, Torino, 1974, str. 1-1269.
3. Tsoumis, G.: Science and Technology of Wood, New York,1991, str. 1-233.</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Assist. Prof. Milivoj Franjević, PhD.	1.7. Number of ECTS credits	2
1.2. Course title	Forest fires	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33950	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION			
2.1. Course objectives	Forest fires are a regular occurrence in all forests and areas, and especially in Mediterranean countries. In our country, forest fires are also pronounced in the coastal area and on the islands. Therefore, the permeation of knowledge on this issue is focused on the forests of the Adriatic area. The course should address human factors, climate factors and vegetation as a whole.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. organize and implement tasks of greater complexity in forestry than forestry and districts as the lowest forest structural units vertically B5. implement protection of forest protection from abiotic and biotic factors and organize forest protection procedures B16. improve existing technologies as well as introduce new technologies		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Categorize a specific forest fire according to the learned typology. Analyze statistical numerical and graphical data on fire records at the year level. Interpret fire seasons based on insights into all parameters that affect the frequency and intensity of forest fires Evaluate the prepared risk maps and critically challenge or confirm them based on your own insight into the available data. Actively monitor and apply new legal and organizational solutions and accordingly adapt the existing system of firefighting activities at the level of forestry, forest administration, companies, forest owners.		
2.5. Course content (syllabus)	Students get acquainted with the problems of forest fires in Croatia and with world experiences related to forest fires, especially in the Mediterranean countries of the European Union. The course covers a number of factors important for this issue, such as: legislation, methods of assessing the risk of forest fires in the US, EU and the world, types of forest fires, the importance of vegetation, habitat conditions, soil, relief, geological background and climate for formation forest fires, forest management and combustible material, preventive role of foresters and their tasks during fires, damages caused by fires in general, remediation of burned areas and restoration		
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:

<table>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures and exercises, preparation and presentation of seminar work. Exam.</td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Grupa autora, 2003: Zaštita šuma od požara. iproz CIP Zagreb</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Grupa autora, 1987: Osnove zaštite šuma od požara. Zagreb</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Mattia, F., Galellini, B., Malasapina, A., Pontani, D., 2002: Italy Forest Fires in 2001. State Forestry Corps</td><td colspan="2"></td><td colspan="2">WEB</td></tr>
<tr><td colspan="5">Vajda, Z., 1973: Nauka o zaštiti šuma. Školska knjiga Zagreb, 482 str</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Zakonski propisi zaštite šuma od požara:
Zakon o šumama (NN 13/02)
Zakon o zaštiti šuma od požara (NN 58/93)
Zakon o vatrogastvu (NN 106/99)
Pravilnik o zaštiti šuma od požara (NN 26/03) i dr.</td><td colspan="2"></td><td colspan="2">WEB</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">Pentek T., Nevečerel H., Ecimović T., Lepoglavec K., Papa I., Tomašić Ž., 2014: Strategijsko planiranje u Republici Hrvatskoj- rasčlamba postojećeg stanja kao podloga za buduće aktivnosti: Nova mehanizacija šumarstva 35(1): 63-78ž
Mattia, F., Galellini, B., Malasapina, A., Pontani, D., 2002: Italy Forest Fires in 2001. State Forestry Corps.</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Associate Prof. Hrvoje Nevečerel, Ph. D. Assist. Prof. Kruno Lepoglavec, PhD.	1.7. Number of ECTS credits	2
1.2. Course title	Forest fire-prevention infrastructure	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33951	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	The task and the objective of this subject is to inform students about all the components in establishing the optimum network of the forest fire-prevention infrastructure on the terrain with a special emphasis on forest fire-prevention roads. Acquired knowledge will enable students to analyse the existing and plan the future forest fire-prevention infrastructure network with the final objective of carrying out the efficient preventive and repressive fight against forest fires in forests of the Mediterranean 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	B7.choose mechanical means and technologies based on cost analysis and other criteria B14. apply knowledge of techniques and technologies of forest opening and construction of forest roads
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Identify the factors that affect on forest fire and protection problems (forest fire protection measures with emphasis on preventive, technical measures). Present forest fire roads - planning, construction, and maintenance/reconstruction (basic forest fire fighting infrastructure components: forest fire-fighting roads, floodplains, water reservoirs, manual reservoirs, observation systems, connection systems, and their planning, construction and maintenance/reconstruction). Present machines for construction and maintenance/reconstruction of forest fire roads and fire trucks (machines, techniques and technologies for construction and maintenance/reconstruction of forest fire roads and characteristics of fire trucks).
2.5. Course content (syllabus)	Lectures: 1. Introduction - Forest fire protection measures. Preventive technical measures for forest protection from forest fire (2 hours). 2. Forest firefighting infrastructure - Forest firefighting roads, forest firefighting paths and trails, water wells, manual reservoirs, observation points, communication systems and other firefighting infrastructure. Basic functions of forest fire roads. Technical characteristics of forest fire roads (2 hours). 3. History of forest fire roads - Classification of forest roads according to the functional principle, primary task and place of construction. Forest fire roads as a separate category of forest roads - definition and special features (2 hours). 4. Technology and methodology for the construction of forest firefighting infrastructure - Applicable construction techniques. Means of transport (2 hours).

<table>
<tr><td></td><td colspan="9">5. Use of GIS technologies in fire protection - Network analyzes in GIS. Computer simulation of forest fire infrastructure efficiency. Identification of endangered areas in the out-of-reach zone. Fire decision-making system. (3 hours).
6. Planning of forest fire roads - Classical and modern methods of optimizing forest fire infrastructure. Multicriteria decision making in the optimization process (2 hours).
7. Construction and maintenance/reconstruction of forest fire roads and fire trucks - machines for construction and maintenance/reconstruction of forest fire roads. Price and sources of financing the construction of forest fire transport infrastructure. Fire wheeled vehicles. Fire extinguishers (2 hours).</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Passing the exam.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="3">Title</td><td colspan="3">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td></td><td colspan="3">Class lectures on Forest fire-prevention infrastructure in .pptx and .pdf format</td><td colspan="3">NO</td><td colspan="3">YES, Merlin</td></tr>
<tr><td></td><td colspan="3">Pičman, 2011: Internal script from the subject Forest fire-prevention infrastructure in .pdf format</td><td colspan="3">NO</td><td colspan="3">YES, Merlin</td></tr>
<tr><td></td><td colspan="3">Kruno Lepoglavec, Josip Žaček, Hrvoje Nevečerel, Ante Seletković, Zdravko Pandur, Marin Bačić, 2017: Surface Accessibility with Spatial Analysis During Fire Extinguishing Procedures: Example on the Island of Vis. Seefor 8 (2): 107-115.</td><td colspan="3">NO</td><td colspan="3">YES, Merlin https://www.seefor.eu/vol-8-no-2-lepoglavec-et-al-surface-accessibility.html</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Akay A.E., Wing M.G., Sivrikaya F., Sakar D., 2012: A GIS-based decision support system for determining the shortest and safest route to forest fires: a case study in Mediterranean Region of Turkey. Environ. Monit. Assess. 184 (3): 1391-1407.
2. Bilandžija, J. 1988: Organizacija preventivnih mjera zaštite šuma od šumskog požara, Zbornik radova »Drugo savjetovanje o naučno-istraživačkom radu Šumarskog instituta Jastrebarsko», Jastrebarsko, XXIII (75) s. 205-213.
3. Chuvieco E., Salas J., 1996: Mapping the spatial distribution of forest fire danger using GIS. Int J. Geograph Inf. Sci. 10 (3): 333-345.
4. Pičman, D., Pentek, T. 1998: Raščlamba troškova izgradnje šumskih protupožarnih cesta i mogućnosti njihova smanjenja, Mehanizacija šumarstva 23 (3-4), Zagreb, Hrvatska, s. 129-137.</td></tr>
</table>

	5. Roland V., Marić I., Milošević R., 2015: Application of GIS technology in firefighting. Vatrogastvo i upravljanje požarima (Fire fighting and management), 1(5): 57-71. 6. Šćepanović J., Bučan P., Kovačević I., 2012: Analysis of intervention fire extinguishing "DES" Split. Vatrogastvo i upravljanje požarima (Fire fighting and management) 2 (2): 67-80.

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Marijan Šušnjar, PhD.	1.7. Number of ECTS credits	2
1.2. Course title	Alternative forest vehicle drives	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	225900	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the course is to acquire knowledge about the development of new energy sources and propulsion in modern generations of forest vehicles that are encouraged by European regulations. Students will be introduced to technical solutions for the construction of alternative drives, basic features, production and principles of operation of different types of energy storages, the possibility of using new generations of forest vehicles in forest works to judge their environmental, energy and ergonomic suitability.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	B6. Recommend and select mechanical means, techniques and standard and state-of-the-art technologies in forestry, primarily in the extraction of wood from natural, one-time and selective stands, crops, plantations and energy forests B.16. Improve existing technologies as well as introduce new technologies		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	to judge the need to use hybrid forest vehicles to analyze the general and operational characteristics of energy storages to select optimal alternative drives for different types of forest vehicles and for different forest works to compare the advantages and disadvantages of technologies in the application of the new generation of forest vehicles. to critically judge the cost-effectiveness of using alternative forest vehicle drives		
2.5. Course content (syllabus)	1. Autonomous driving of forest vehicles 2. Hybridization of forest vehicles - types and characteristics of hybrid drives 3. Electro-hydraulic drives 4. Electric motors and energy tanks (batteries) 5. Electromobility 6. Mechatronics and control systems for hybrid and electric drives 7. Performance of hybrid and electric forest vehicles 8. Benefit assesment of hybrid drives 9. Application of hydrogen as a fuel in forest vehicles 10. Hydrogen production, distribution and storage 11. Hydrogen fuel cells in forest vehicles 12. Energy balance of alternative forest vehicle drives 13. Environmental and ergonomic suitability of alternative forest vehicle drives 14. Possibilities of application of alternative drives of other vehicles in protected areas of nature 15. Robotics in forestry		
2.6. Format of instruction	☒ lectures	☐ independent	2.7. Comments:

	☐ seminars and workshops ☐ exercises ☐ *online in entirety* ☒ partial e-learning ☐ field work			assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)					
2.8. Monitoring student work	Class attendance	YES		Research		NO	Oral exam		NO
	Experimental work		NO	Report		NO	(other)		
	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam		NO	Practical work		NO	(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	2	
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities	Regular attendance and active participation in lectures. Taking the exam.								

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Šušnjar, M.: Lectures	NO	YES, Merlin
	Hellström, T., Ringdahl, O., 2011: Intelligent vehicles in forestry. Umeå University. 1-46.	NO	YES
	Finpro, 2010: Ev technologies in working machinery – Global view. 1-62	NO	YES
	Frano Barbir: Vodik i gorivni članci [Priručnik] Tehnička škola Ruđera Boškovića u Zagrebu 1-34.	NO	YES
	Hybrid technology in forest machines. Logset report, 1-19.	NO	YES

2.12. 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.
Kovač, A., 2018: Uloga vodikovih gorivnih članaka u procjeni razvoja prometnog sektora u republici hrvatskoj Radovi Zavoda za znanstveni rad HAZU Varaždin; br. 29, 2018., str. 349-359.
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.
Mol1, C., O'Keefe, M., Brouwer, A.; Suomela, J., 2010: Trends and insight in heavy-duty vehicle electrification. World Electric Vehicle Journal Vol. 4.1-12.
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.
Professor Ashok Jhunjhunwala, A., 2019: Fundamentals of Electric Vehicles: Technology and Economics. Indian Institute of Technology, Madras Lecture 4 Introduction 1-9.
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.

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Assist. Prof. Kristijan Tomljanović, PhD	1.7. Number of ECTS credits	2
1.2. Course title	Hunting management planning	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	225901	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	1.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	Students get acquainted with hunting management plans and studies. Current laws, directives and other conditions under which hunting management plans for hunting grounds, farms and protected nature objects are adopted. The aim is to prepare and train students to independently develop and implement hunting management plans, game breeding plans and game protection plans.
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	A.1 independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem analysed in different ways A.3 apply simpler methods of operation research C.6 manage tasks of county and national institutions competent for forestry; inspection services D.3 conduct businesses and tasks in publicist writing and media connected with forestry D.4 professionally and scientifically upgrade through different educational ways and postgraduate study
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. Explain the problems of large and small game management in open hunting grounds, game farms, within protected and specially regulated facilities. 2. Establish standards for the development of hunting management plans and studies, interpret the capacity of habitats, population structures of individual species of game and other animal species 3. Define habitat conditions, species preference, population density, population and biological growth, anthropogenic and all other impacts on wildlife and other animal species. 4. Introduction to the potential of game as non-wood forest products through the value of shooting, trophies and produced game meat. 5. Explain management under special conditions, Management Plans and action plans for protected game species.
2.5. Course content (syllabus)	Through fifteen thematic units, students learn about the types of hunting grounds, the conditions of management in protected and all other facilities, the procedure for preparing hunting studies and the procedure for their adoption and approval. Lectures: 1. Introductory lecture, course content and literature (L - 1h) 2. Types and division of hunting grounds (L - 1h) 3. Hunting management plans (L - 1h) 4. Game breeding program (L - 1h)

<table>
<tr><td></td><td colspan="9">5. Game protection program (L - 1h)
6. Defining surface structure, data and sources (L - 1h)
7. Parent fund, breeding / increment and economic capacity (L - 1h)
8. Population pyramids, project planning and fund development (L - 1h)
9. Feeding and nutrition of game (L - 1h)
10. Hunting management and hunting technical facilities (L - 1h)
11. Records, minutes and forms (L - 1h)
12. Carrying out hunting studies (L - 1h)
13. Legislation (L - 1h)
14. Management plans and action plans (L - 1h)
15. Directives, orders and red books (L - 1h)</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Taking the exam.</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="4">Mustapić, Z., i suradnici., 2004: LOVSTVO priručnik. Hrvatski lovački savez Zagreb, 597 str</td><td colspan="2">YES</td><td colspan="3">YES</td></tr>
<tr><td colspan="4">Andrašić, D., 1984: Zoologija divljači i lovna tehnologija. Skripta, Sveučilište u Zagrebu Šumarski fakultet, Zagreb, 294 str.</td><td colspan="2">YES</td><td colspan="3">YES</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">www.propisi.hr (Croatian laws and regulations related to hunting management)</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Tibor Pentek, Ph.D. Assist. Prof. Ivica Papa, Ph.D.	1.7. Number of ECTS credits	6
1.2. Course title	Forest road design	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+32
1.3. Course code	33908	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	The basic objective and tasks of this subject, through theoretical and practical knowledge and skills inform students about the procedure of designing forest roads, methods and techniques of collecting, processing and critical result interpretation. It is also necessary to make students capable for independent work of complete project documentation of forest roads using various working methods.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B3. manage and make independent professional (business) decisions form the field of timber harvesting, forest opening, designing of forest road network and forestry entrepreneurship B12. apply knowledge related to the methods for preparing and planning technical works in forestry B14. apply knowledge related to the methods, techniques, and technology of opening of forests, i.e. designing and constructing a network of forest roads B15. design a network of forest roads
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Explain forest road design and the basicelements of the transport of timber(determine the towing capacity for motor vehicles, resistance to the motion of vehicles, trucks, truck units, primary and secondary legislation, ordinances, guidelines, regulations, etc., direct/indirect pole setting for forest roads, design procedure for forest roads, documentation for forest road design). Analyze the detailed positioning plan of the forest road and use computer programs for the design of forest roads (zero line, operational and axial polygon of the forest road, design software, develop the final design for a forest road). Describe the staking out of main points and the methods for staking out detailed points of horizontal curves, transition curves and serpentines, detailed construction marking of the forest road cross-sections for the beginning of construction in the field. Explain the longitudinal section, the cross section and the lower layer of a forest road (written and graphical longitudinal cross section, design the incurved grade level, curved grade level, select the vertical curve radius, normal/type/orientation cross sections, advantages and disadvantages, possible problems and restrictions in the application of type-cross sections in specific cases). Recommend the structures for the safety/protection of the lower structure of a forest road and drainage facilities (retaining walls, types and forms of retaining walls, stability check and dimensioning of the retaining walls, combination retaining and revetment walls, the effects of water on forest roads, surface and underground drainage facilities for forest roads). Evaluate the pavement construction and the causes of damage on forest roads (dimensioning of pavement constructions, stone pavements, causes of damage on forest

	roads, develop the final design of a forest road, positioning of road structures, final adjustments to the detailed positioning/situation plan)
2.5. Course content (syllabus)	Lectures 1. Forest road design – general introduction. Basic components of the design stage for forest roads – general introduction. Technical characteristics of forest roads in Croatia. Technical characteristics of trucks and truck units. Resistance to the motion of vehicles. 2. Collection of general data. Forest road routing – methods and procedures. Direct pole setting. Indirect pole setting. Classical method for terrain measurements. Contemporary method for terrain measurements tachymeters and GPS receivers. 3. Development of the forest road design – methods and procedures. The complete (full) design procedure. Abbreviated design procedure. Basic types of forest road designs. Conceptual design – description, design method and main components. General design – description, design method and main components. Final design - description, design method and main components. 4. Characteristic sections of forest roads. Forest road positioning plan. Main elements of the horizontal curve. Selection of horizontal curve radius. Different types of horizontal curves. Special types of horizontal curves. 5. Serpentines. The passage of motor vehicles through the curve. Widening of pavements on curves. Transition curves. Crossings (intersections) with forest roads and public roads. 6. Methods for staking out horizontal curves. Methods for staking out detailed points on horizontal curves. Methods in the case of an inaccessible high point. Staking out with rectangular coordinates. Staking out using the polar method. Staking out using the tangent offset method. Staking out using the chord offset method. Staking out using chords. The quarter method. 7. Graphical longitudinal section. Incurved grade level. Slope of grade level – reproduction and calculation. The largest, the smallest and the optimum slope of grade level. The rules for the designing of the curved grade level. Vertical curve – selection of the vertical curve radius. The distance between vertical curves. Resolving specific problems and cases. 8. Normal cross sections. Fill, cut, mixed. Rock cross section. Passing-by areas – main types and technical conditions. Turning points - main types and technical conditions. Landings. 9. Structures for the safety/protection of the lower level. Retaining walls. Revetment walls. Surface and underground drainage facilities. Pipe culverts. Cross ditches. Fords. Rainwater ditches. Curbs. Drainage. 10. Lower layer of forest roads. Earth works in forest road construction. Basic terms in geomechanics. Different methods for the calculation of cross sections. Graphical cross sections. 11. Calculation of the volume of earth works. Earth volume diagram. Equalizing and transport of materials. Balancing of the graphical longitudinal section, graphical cross section and the diagram of earth volume. 12. Upper layer of forest roads. Dimensioning methods for pavement structures. Earth pavements. Stone pavements. Modern pavements. 13. Bill of quantities – basic components and design method. Cost estimate - basic components and design method. 14. Zero-line handover report. Marking and securing of the route profile of a forest road in the field (design phase). Handover report for the forest road route with layout. Marking of the forest road route for the start of construction. 15. Legal basis for forest road design. Technical requirements for forest road design. The Civil Engineering Act. The Forests Act. The Ordinance on Forest Maintenance. Authorizations of the Chamber of Engineering in Forestry and Timber Technology. Forest road design in protected areas. Special conditions of nature protection. Practical exercises 1. Introduction. Forest road design software – a brief overview of the existing software with an emphasis on possibilities, advantages and disadvantages of different programs. 2. Basic principles of working with the “CESTA” software. Work with Menus. (General principles of working with Menu functions). User interface.

<table>
<tr><td></td><td colspan="9">3. 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).
4. 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).
5. 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).
6. Control method for the calculation of altitudes. Insertion of altitudes and cross sections in route layouts.
7. Principles of working with the CS (cross section) Menu. Definition of road sections and insertion of construction material categories. Linking field and design data.
8. Editing the profile and adjusting the settings of a selected forest road category.
9. Principles of working with the VS (vertical section) Menu. Fitting the incurved grade level. Vertical curves – curved grade level.
10. 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).
11. Description of the calculation of earth volume. Defining the minimum distance for transport. Earth volume diagram. Editing the curved grade.
12. Positioning of the road structures. Passing-by areas, landings, turning points. Editing the situational design. Drawing up of the road stakeout.
13. 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).
14. Technical report. Drawing up the bill of quantities. Drawing up the cost estimation. Defining the components for print.
15. Drawing up the situation plan. Principles of working with printouts of graphical elements. Printing the written and graphical elements.

Field classes
In field classes students apply the knowledge acquired in lectures and practical exercises using a specific example of forest road design. Using a GPS device students determine cardinal points of the future forest road route, calculate the slope of individual segments and design the zero-line polygon. Furthermore, 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.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☒ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td>YES</td><td></td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits</td><td colspan="2">6</td></tr>
</table>

<table>
<tr><td></td><td colspan="7">(total)</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="7">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="7">Regularly attend and actively participate in lectures, practical exercises and field classes. Take midterm exams, or written and oral exams.</td></tr>
<tr><td rowspan="4">2.11. Required literature (available in the library and/or via other media)</td><td colspan="3">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="3">Pentek, T., 2014: Forest road design (.pptx and .pdf lectures 1-15), Faculty of Forestry, University of Zagreb.</td><td colspan="2">NO</td><td colspan="2">YES, Melin</td></tr>
<tr><td colspan="3">Pičman, D., 2007: Forest roads (university textbook), Faculty of Forestry, University of Zagreb, pp 1-460, chosen chapters.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="3">Šikić, D. i dr., 1989: Tehnički uvjeti za gospodarske ceste, Znanstveno vijeće za promet JAZU, Zagreb, pp 1-40, chosen chapters.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="7">1. Scientific and professional papers on the subject issues of domestic and foreign authors published in scientific journals and conference proceedings.
2. Anon., 2002: Forest Road Engineering Guidebook, B.C. Ministry of Forests, p. 1-208, chosen chapters.
3. Anon., 2011: Colorado Forest Road Field Handbook, Colorado State Forest Service, p. 1-142, chosen chapters.
4. Babić, B., 1997: Projektiranje kolničkih konstrukcija, HDGI Zagreb, s. 1-197, chosen chapters.
5. Dragčević V., Korlaet Ž., 2003: Osnove projektiranja cesta, University of Zagreb, Faculty of Civil Engineering, (university textbook) p. 1-93, chosen chapters.
6. Dragčević, V., Rukavina, T., 2006: Donji ustroj prometnica, University of Zagreb, Faculty of Civil Engineering, (university textbook) p. 1-187, chosen chapters.
7. Korlaet Ž., 1995: Uvod u projektiranje i građenje cesta. University of Zagreb, Faculty of Civil Engineering, (university textbook) p. 1-208, chosen chapters.
8. Lacrombe, G., 1999: Forest Roading Manual, Liro Forestry Solutions, New Zeland, p. 1-404, chosen chapters.
9. Ryan, T. et al., 2004: Forest Road Manual, Guidelines for the design, construction and management of forest roads, COFORD, Dublin, p. 1-156, chosen chapters.</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Associate Prof. Stjepan Posavec, Ph.D. Assist. Prof. Karlo Beljan, PhD	1.7. Number of ECTS credits	5
1.2. Course title	Economics of forest company	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+8
1.3. Course code	225892	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	When starting the production process, ie undertaking a business venture, it is necessary to gain the knowledge necessary for the production of goods or services, which will be advantageous in the market. The course analyzes the basic concepts of microeconomics and the role of the forest company. Students get acquainted with the elements and method of making a business report in forestry. Introduction with the characteristics and analysis of investments in forestry.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B1.organise and perform tasks of greater complexity in forestry, from forest office and forest management unit as the lowest forestry structural units along the vertical C1.plan, organise and works of organization of production in forestry C4.plan and calculate production, calculate basic indicators of successful buisness, compose basic financial reports, recognise and analyse types of costs
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	To analyse capital and investments in forestry (meaning of the capital in forestry, fixed property and working capital in forestry, categories and importance of investments in forestry). To present costs, calculation and cost management in forestry (costs in production processes, types and methodes of calculation, price structure in creation of specific calculation for characteristic productions and forest products) To compare economic analyse of bussiness performance in forest company and business indicators (balance sheet, profit and loss account, cash flow, debt ratio, liquidity, activity, profitability, investment and market value). To estimate specifics of planning processes and business plan (economic statements, influence of forest management planning on business results, functioning of investemnts and business plans in forest management, goals, contents and shape of the business plan). To compare economic policy insstruments and processes of strategic planning (monetary system, fiskal system, overseas relations and income policy, environmety analyses, added value chain analyse, controlling instruments)
2.5. Course content (syllabus)	Lectures: 1. Definition and subject of economics 2. Historical development of the economy 3. The meaning of the forest as capital 4. Capital and investments in forestry 5. Depreciation of assets in forestry 6. Costs and cost management

<table>
<tr><td></td><td colspan="9">7. Cost break even point
8. Cost calculations in forestry
9. Product price structure
10. Contribution margin
11. Business analysis of the company, financial reports
12. Business performance indicators
13. Specifics of planning in forestry
14. Business plan of the forestry company, strategic planning, controlling
15. Economic policy instruments, macroeconomic indicators

Exercises:
1. Types and ways of using a compounding interest rate and net present value
2. Calculation of depreciation in forestry,
3. Calculation of the rate of return on investment (ROI), the rate of return on capital (ROE) in forestry
4. Analysis of fixed, variable and total costs
5. Calculation of break even point
6. Cost calculation methods in forestry
7. Calculation using an equivalent number
8. Analysis of the business performance of the forestry company
9. Economic indicators of the forestry company
10. Business plan for forestry investments
11. Analysis of the portfolio of business activities in forestry
12. Accounting standards, financial reports
13. Application of cost management in business process
14. Justification of investment projects in forestry
15. Examples of budgeting and controlling in forestry

Field work:
1. Review of the connection between the forestry and wood processing sectors. Business plan and justification of investment on the example of forestry company and wood processing company in practice.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">4</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Ordinarly participation and active participation in classes, excercises and field trip. Individual preparation and excercise submition. Examination.</td></tr>
</table>

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Figurić, M.: UVOD U EKONOMIKU ŠUMSKIH RESURSA, Šumarski fakultet, Zagreb, 1998	YES	
	Figurić, M.: MENADŽMENT TROŠKOVA U DRVNOTEHNOLOŠKIM PROCESIMA, chosen fields, Šumarski fakultet, Zagreb, 2003.	YES	
	Posavec, S.; Kajba, D.; Beljan, K.; Boric, D.: Economic analysis of short rotation coppice investment: Croatian case study, AUSTRIAN JOURNAL OF FOREST SCIENCE, 2017, volume 134, 163-176	YES	
	Kajanus, M.; Leban, V.; Glavonjic, P.; Krc, J.; Nedeljkovic, J.; Nonic, D.; Nybakk, E.; Posavec, S.; Riedl, M.; Teder, M.; Wilhelmsson, E.; Zalite, Z.; Eskelinen, T.: What can we learn from business models in the European forest sector: Exploring the key elements of new business model designs. FOREST POLICY AND ECONOMICS, 2019. volume 99, 145-156	NO	researchgate
	Posavec, S., Avdibegović, M., Bećirović, Dž., Petrović, N., Stojanovska, M., Marčeta, D., Pezdevšek Malovrh, Š. 2016: Private forest owners willingness to supply woody biomass in selected South-Eastern European countries, Biomass & bioenergy, 81, 144-153.	NO	researchgate
2.12. Optional literature	Samuelson, P., Nordhaus, W.: EKONOMIKA, Mate, Zagreb, 1992, str. 1-800. KLEMPERER, W.D.: FOREST RESOURCE ECONOMICS AND FINANCE, McGraw-Hill Book Comp., New York,		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Associate Prof. Stjepan Posavec, Ph.D. Assist. Prof. Karlo Beljan, PhD	1.7. Number of ECTS credits	3
1.2. Course title	Marketing in forestry	1.8. Number of hours in semester (L+E+F+e-learning)	30+15+0
1.3. Course code	33910	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO
2. COURSE DESCRIPTION			
2.1. Course objectives	Aquaint with role and importance of marketing in forestry, and green marketing. Implementation of marketing-mix in forestry, and goods and services in forestry. Marketing strategy and marketing plan in forest resource economics.		
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	B11. apply knowledge related to marketing of forest main and secondary forest products C1: plan, organise and works of organization of production in forestry C2. organise and conduct sale of timber assortments and timber products on domestic and worldwide market		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	To determine importance, role and social responsibility of marketing in forestry (importance of marketing management, welfare marketing, green marketing, consumerism). To present research and market segmentation, supply and demand rules, (area and marketing plan, factors and characteristics of marketing information systems, analyse and behavior of competitors, development of new products and services, market, prices and elasticity) To present product, production program, price construction and distribution. Evaluate promotion and marketing of goods and services in forestry (economic propaganda, sales improvements, personal sale model and publicity, importance of forest products certification in company market strategy)		
2.5. Course content (syllabus)	Lectures: 1. Importance and role of marketing in forestry 2. Concept and market environment, marketing mix 3. Social responsibility in marketing, green marketing 4. Market research 5. Marketing information system 6. Market segmentation 7. Supply and demand laws 8. Product, production program in forestry 9. Price formation 10. Brend, trade mark 11. Promotion in forestry 12. Marketing of goods and services in forestry 13. Distribution 14. Marketing strategy, forest products and services positioning		

<table>
<tr><td></td><td colspan="9">15. Marketing plan, portfolio analyse

Exercises:
1. Marketing management case in forestry,
2. Marketing mix in forestry
3. Example of social responsible marketing in forestry
4. Ways and goals of green marketing in forestry
5. Preparation for market research
6. Research of supply and demand for non-wood forest functions in practice
7. Research of supply and demand for non-wood forest functions in practice
8. Identification of market segments in selection of targeted markets
9. Selection of price formation methods
10. Case of brend and trademark creation in forestry
11. Selection of distribution canals in retail and wholesale
12. Cases of promotion activities of main forest products
13. Cases of promotion activities of secondary forest products
14. Marketing plan elements and portfolio analyse
15. Creation of marketing plan based on case-study</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☒ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td colspan="2">3</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Ordinarly participation and active participation in classes, excercises. Individual preparation and excercise submition. Examination.</td></tr>
<tr><td rowspan="4">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Sabadi, R.: OSNOVE TRGOVAČKE TEHNIKE, TRGOVAČKE POLITIKE I MARKETINGA U ŠUMARSTVU I DRVNOJ INDUSTRIJI, Šumarski fakultet, Zagreb, 1988, pages 1-254.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Previšić, J., Ozretić Došen, Đ.: Marketing, Adverta d.o.o., 2004, Zagreb</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Posavec, Stjepan; Pezdevšek Malovrh, Špela, 2020: Market Value and Timber Assortment Sale Models - Comparative Study, Management Aspects in Forest Based Industries / Jelačić, Denis (ur.). Zagreb:</td><td colspan="2">YES</td><td colspan="2"></td></tr>
</table>

	WoodEMA i.a., 2020. str. 17-37, ISBN:978-953-57822-7-8		
2.12. Optional literature	1. Kotler, P.: UPRAVLJANJE MARKETINGOM 1 i 2, Informator, Zagreb, 1989, str. 1-813. 2. SAMUELSON, P.A. NORDHAUS, W.: EKONOMIJA, Mate, Zagreb, 1992 3. Marušić, M., Vranešević, T.: Istraživanje tržišta, Adeco d.o.o., 1997, Zagreb		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Mario Šporčić, PhD Prof. Ivan Martinić, PhD Assist. prof. Matija Landekić, PhD Matija Bakarić, PhD.	1.7. Number of ECTS credits	5
1.2. Course title	Production organization in forestry	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+24
1.3. Course code	33913	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	Develop knowledge and skills of planning, preparation, organization, management, analysis and critical thinking in forest production and business. Develop skills in shaping the requirements and possibilities of forest work, multi-criteria decision-making in forestry, human resource management and integrating these knowledge and skills in improving the overall organization of work and production in forestry.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A3. apply simpler methods of operation research B1. organise and perform tasks of greater complexity in forestry, from forest office and forest management unit as the lowest forestry structural units along the vertical C1. plan, organise and works of organization of production in forestry C5. manage the most complex tasks in all forms of forest organizations, forest and hunting advisory service; forest entrepreneurship D5. gather, process and interpret reference sources and prepare simpler written professional or scientific paper
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Interpret the physiological and ergonomic aspects of forest work (physiology of work, ergonomic research in forestry, work load and energy consumption of forest workers, work ability). Analyze the elements and phases of the work preparation and work standards in forestry (objectives and tasks, elements and stages of preparation process, specificity and implementation in forestry, content and structure of work norms, forms of work norms, verification of achievement, application in forestry, rates). Present planning and management systems in individual segments of forestry production (features, elements, annual planning, functional and revier forest management system, public and private stakeholders in forestry operations, truck transport of wood) Present the assessment of production and business efficiency in forestry – methods and approaches (features, application of classical methods i.e. indicators and non-traditional approaches in forestry, advantages and disadvantages, ecological efficiency of organizations, indicators of eco efficiency, multi-criteria models in forestry, multicriteria decision-making methods, feasibility studies). Comment on the role, tasks and responsibilities of the manager in a forestry organization (fundamentals of managerial accounting, human resources and forestry personnel, work stress)
2.5. Course content	Lectures

(syllabus)	1. Physiology of work - problems, tasks and goals of work physiology, types of work demands, energy and mechanical work, factors that influence work ability. 2. Human physiology and the workload of forest workers – structure and functions of human body, organic systems, constitution, musculoskeletal system, energy consumption and physical load of forest workers. 3. The energy foundation of physical activity and labor ability of the worker - energetics of the man organism, energy processes, needs and capacities, factors that determine working ability. 4. Ergonomic aspect in the organization of forest work - physical and organizational ergonomics, ergonomic aspects of the forestry production elements, methods and research results. 5. Working norms and rates in forestry - the reasons for norms in forestry work, content, structure and forms of norms, the relationship between work study and physical workload, production capacity, rates. 6. Biomechanics of forest work - the basics of biomechanics, methods of research, motion study in forestry, basic body positions and body parts movements in the efficient work of forest workers. 7. Preparation of forestry work - importance of work preparation, objectives and tasks, technological, biological, technical, organizational, economic and operational work preparation in forest harvesting. 8. Planning in forestry - strategic, tactical and operational planning in forestry, specifics and requirements of forest production, basic information on the system of planning in Croatian forests Ltd. 9. Revier system of forest management – functional, reference and revier (district) system in forestry, implementation and status of the revier organization in HŠ d.o.o., structure of work, tasks and resposibilities of revier managers. 10. Certification of forest contractors - the profile and structure of the forestry contractors, models and conditions for certification of contracting organizations and forest workers, Forestry Chamber, licensing of entrepreneurs. 11. Work stress - symptoms and categories of stress, factors influencing stress, types of personality. 12. Manager in a forestry organization - the role and tasks of forestry experts as managers, organizers, strategists, leaders, communicators, innovators, etc. 13. Multi-criteria decision making in forestry - Multicriteria models and methods as a support in forestry planning and decision making. 14. Commercial function in forest company - an overview of production-business process on the example of a selected forest site. 15. Human resources management - personnel function in the organization, jobs and tasks of people management, job design, use of human resources, etc. Exercises 1. Methods of work physiology and the ability to apply tests, functional diagnostics, assessment of physical training, work ability, condition. 2. Performing some physical exercise tests (step test, Lorenz test, Harvard test). 3. Determining the basic energy indicators of physical activity and working ability of workers, measuring heart rate, oxygen intake, etc. 4. Analysis of energy and ergonomic requirements in forest work, classification of physical load and categorization of forest work by weight / load, individual task. 5. Application of norms and rates in forestry, illustration of the importance, role and task of working norms and norms on the examples from forestry practice with the task. 6. Determination of basic body positions, structure of movement during forest work and postural load of forest workers, application of OWAS and REBA methods. 7. Calculating the elements of organizational and technological preparation of the work site, example and task. 8. Depiction of the procedures for making the annual business plan and application of HsPPU, HsPPI, HsGPPs programs with individual task.

<table>
<tr><td></td><td colspan="9">9. Planning and execution of silviculture works, drawing up an annual work plan with example and assignment.
10. Analysis of licensed forest contractors, search of existing databases, evaluation and selection of contractors.
11. Applying a model for determining the level of stress, ERI questionnaire.
12. Organization of work and management accounting, systematic comparison of actual and planned costs of materials and labour used during production periods, example with task.
13. Application of multi-criteria models in examples from forestry practice, AHP and DEA methods.
14. Documents in forestry production, display of standard documentation and instruments for monitoring, control and records of forest production.
15. Techniques of selection and testing of employees with examination of judgements skills.

Field work
1. Organization of work on forest revier (district)
2. Preparation of forestry work
3. Organizing and executing forest operations in emergency conditions</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">5</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures, exercises and field work. Taking the exam.</td></tr>
<tr><td rowspan="5">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Šporčić, M., 2007: Ocjena uspješnosti poslovanja organizacijskih cjelina u šumarstvu neparametarskim modelom. Disertacija, Šumarski fakultet Sveučilišta u Zagrebu.</td><td colspan="2">YES</td><td colspan="2">YES</td></tr>
<tr><td colspan="5">Posarić, D., 2007: Vodič za revirničke poslove. Hrvatske šume d.o.o. Zagreb.</td><td colspan="2">NO</td><td colspan="2">YES</td></tr>
<tr><td colspan="5">Šporčić, M., 2003: Uspostava modela potvrđivanja izvoditelja šumskih radova. Magistarski rad, Šumarski fakultet Sveučilišta u Zagrebu.</td><td colspan="2">YES</td><td colspan="2">YES</td></tr>
<tr><td colspan="5">Kangas, A., Kurttila, M., Hujala, T., Eyvindson, K., Kangas, J., 2015: Decision</td><td colspan="2">NO</td><td colspan="2">YES</td></tr>
</table>

	Support for Forest Management. Springer International Publishing Switzerland.		
2.12. Optional literature	Spinelli, R. (ed.), 2018: Forest Operations, Engineering and Management. MDPI, Basel, Switzerland. Schmithüsen, F., Kaiser, B., Schmidhauser, A., Mellinghoff, S., Perchthaler, K., Kammerhofer, A.W., 2014: Entrepreneurship and management in forestry and wood processing: Principles of business economics and management processes. Rutledge, London-New York. Martinić, I., Vondra, V., Šporčić, M., 2007: Razvoj novoga koncepta za unapređivanje šumarske tehnike u Hrvatskoj – područja mogućega doprinosa. Nova mehanizacija šumarstva 28, (pos. izd. 1): 107-113. Srića, V., 2003: Inventivni menadžer u 100 lekcija. Znanje d.d. Zagreb, 1-292. Martinić, I., 1996: Ekonomski i organizacijski kriteriji za oblikovanje šumskih radova. Glas. šum. pokuse 32(1996): 215299.		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Marijan Šušnjar, PhD. Assist. Prof. Zdravko Pandur,PhD. Marin Bačić, BSc.	1.7. Number of ECTS credits	3
1.2. Course title	Ergonomics of forest machines	1.8. Number of hours in semester (L+E+F+e-learning)	15+15+8
1.3. Course code	225893	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	Students are introduced to the technical and technological ergonomic factors of forest machines. The way of their recognition and measurement, as well as technical legislation and applicable standards. Students learn about the choice of measures and means of protection.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B6. recommend and choose forest machines, techniques and standard technologies used in forestry above all in timber harvesting from natural forests, even-aged and unevenaged stands, culture, plantation, and energy forests C3. organise and manage work safety in forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Get acquainted with ergonomics as a skill. To determine the ergonomic and safety factors of forest machines. Measure ergonomic factors (cab access, cab dimensions, visibility, machine seat, controls, machine control, machine operation information, working position, winch, noise, vibration, air conditioning, gases and particles, lighting, manuals and instructions, maintenance, maintenance index). Create an ergonomic profile of the forest machine (use of ergonomic checklist). Adopt protection and improvement measures, select adequate means of protection.
2.5. Course content (syllabus)	Lectures 1. The concept and meaning of ergonomics. Development of scientific discipline. Forms of workload of forestry workers. Definitions of basic terms. 2. Ergonomic factors of forest machines. Ergonomic checklist. 3. Access to the machine cab. Machine cabin. FOPS, ROPS and OPS. 4. Visibility. Seat and hand rest. 5. Control levers. Machine control. 6. Information on the operation of the machine. Sound and light signals. 7. Operator position. 8. Winch. Forces when pulling the rope. 9. Noise of forest machines 1. Noise sources. Characteristics. Measurement method. Harmfulness and consequences., 10. Noise of forest machines 2. Method of expressing values. Filters. ISO standards. Frequency analysis. Measures and means of protection. 11. Vibrations of forest machines 1. Sources of vibrations. Characteristics. Measurement method. Harmfulness and consequences.

<table>
<tr><td></td><td colspan="9">12. Vibrations of forest machines 2. Ways of expressing values. WAS and A (8) values. ISO standards and EU directives. Frequency analysis. Measures and means of protection.
13. Air conditioning, gases and particles.
14. Lighting. Manuals and instructions.
15. Machine maintenance. Maintenance index.

Exercises
1. Ergonomic checklist. Seat reference point. Class. Ergonomic profile of the machine. Scoring system. Basic information about the machine.
2. Cabin access. Measurement and evaluation.
3. Cabin dimensions and design. Measurement and evaluation.
4. Visibility. Measurement and evaluation.
5. Seat and armrests. Measurement and evaluation.
6. Controls and operation of the machine. Measurement and evaluation.
7. Information on the operation of the machine. Measurement and evaluation.
8. Operator position. Measurement and evaluation.
9. Winch operation. Measurement and evaluation.
10. Forest machine noise. Measurement and evaluation.
11. Forest machine vibrations. Measurement and evaluation
12. Air conditioning. Gases and particles. Measurement and evaluation.
13. Lighting. Manuals and instructions. Measurement and evaluation.
14. Maintenance. Maintenance index. Evaluation.
15. Final ergonomic profile of the machine.

Field work: Skidder factory Hittner</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">3</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Laying the exam, exam.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Šušnjar, M., Pandur, Z., - Prezentacije predavanja i vježbi iz predmeta Ergonomija šumskih strojeva</td><td colspan="2">NO</td><td colspan="2">YES, Merlin</td></tr>
<tr><td colspan="5">European ergonomic and safety guidelines for forest machines 2006 - ErgoWood</td><td colspan="2">NO</td><td colspan="2">YES, WEB</td></tr>
</table>

	Almqvist, R. Gellerstedt, S., Tobish, R. , 2005: Ergonomic Checklist for Forest Machines. A handbook produced by ErgoWood, a project co-financed by the European Commission Swedish University of Agricultural Sciences, Uppsala, Sweden, 1-23	NO	YES, WEB
	EU-OSHA, 2008: Occupational safety and health in Europe's forestry industry. European agency for safety and health at work. 1-13.	NO	YES, WEB https://osha.europa.eu/en/publications/e-facts/efact29/view.
	Horvat, D., Šušnjar, M., 2003: Temeljni sigurnosni i tehnički zahtjevi ISO normi za konstrukciju skidera, studija, str 1-98.	NO	YES, Merlin
2.12. Optional literature	Gellerstedt, S., Lidén, E., Bohlin, F., 2005: Health and Performance in Mechanised Forest Operations. Editors: Sten Gellerstedt, Swedish University of Agricultural Sciences. A handbook produced by ErgoWood, a project co-financed by the European Commission Swedish University of Agricultural Sciences, Uppsala, Sweden, 1-45. Lewark, S., 2005: Scientific reviews of ergonomic situation in mechanized forest operations. Swedish University of Agricultural Sciences, Uppsala, Sweden, 1-182. Tobisch, R., Hultåker, O., Walkers, M., Weise, G., 2005: Improvements of ergonomic assessment procedures for forest machines. Swedish University of Agricultural Sciences, Uppsala, Sweden, 1-62. Directive 2002/44/EC Of the European Parliament and of the Council: The mimimum health requirement regarding the exposure of workers to the risks arising from physical agents (vibration). Official Journal of the European Communities, 177.p.		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	. Assist. Prof. Dinko Vusić, PhD.	1.7. Number of ECTS credits	3
1.2. Course title	Forest biomass for energy	1.8. Number of hours in semester (L+E+F+e-learning)	15+15+0
1.3. Course code	225894	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	The aim of this course is to inform the students with the characteristics of forest biomass for energy, the harvesting and the use of forest biomass as a renewable energy source and the quality of solid biofuels.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B3. manage and make independent professional (business) decisions form the field of timber harvesting, forest opening, designing of forest road network and forestry entrepreneurship B6. recommend and choose forest machines, techniques and standard technologies used in forestry above all in timber harvesting from natural forests, even-aged and unevenaged stands, culture, plantation, and energy forests B8. measure and evaluate quality parameters of timber assortments and interpret their size and meaning B16. develop current technologies as well as implement new technologies
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Present production potential and forms of forest biomass for energy (sources and origin of biomass, energy forests, forms of biomass for use and trade, standards for solid biofuels from forestry, quality testing of wood chips). Evaluate technologies and techniques of harvesting forest biomass as a solid biofuel (transport of compressed and comminuted biomass, storage, areas of application and use of forest biomass, structure of energy wood and brushwood by stand age and tree species, establishment and production of wood biomass in short rotation coppice). Evaluate the environmental suitability, use and storage of forest biomass for energy (reduction of greenhouse gas effects by using biomass, legal acts, energy plants, heat, cogeneration and trigenation plants, forest wood biomass for pellet, briquette, charcoal production).
2.5. Course content (syllabus)	Lectures 1. Basic features of energy wood. Moisture content, ash content and calorific value. 2. Classification of energy wood. Normative system for solid biofuels. 3. Theoretical, technical and economic potential of forest biomass for energy. 4. Review of trends in the production and use of forest biomass. 5. Ecological advantage of using energy wood. 6. Forest biomass as a raw material for the production of pellets, briquettes and charcoal. Default and variable characteristics of the raw material - the impact on product quality. 7. Use of wood chips in power plants. Influence of energy quality on the efficiency of power plants. 8. Mechanized production of chopped firewood. 9. Production of wood chips. Raw material characteristics and comminution methods.

<table>
<tr><td></td><td colspan="9">10. Transport of energy wood. Influence of shape and physical characteristics on transport efficiency.
11. Energy wood storage. Natural drying, dry matter loss and energy density.
12. Energy wood harvesting systems in early thinnings.
13. Energy wood harvesting systems in shelterwood fellings.
14. Energy wood harvesting systems in forest plantations.
15. Energy wood harvesting systems in SRC.

Exercises
1. Sampling of solid biofuels. Development of a sampling plan and preparation of a laboratory sample.
2. Determination of bulk density of wood chips.
3. Determination of the moisture content of wood chips.
4. Determination of the ash content of wood chips.
5. Paricle size distribution analysis of wood chips.
6. Presentation and recalculation of results. Conversion factors.
7. Preparing a product declaration.
8. Determining the basic quality parameters of chopped firewood.
9. Calculation of chipping productivity and costs. Selection of the optimal method and means of comminution.
10. Transport of wood chips. Selection of the optimal means of long-distance transport based on the cost breakeven point. Influence of moisture content on costs.
11. Determining the optimal storage time of wood chips - the point of maximum energy density.
12. Calculation of the productivity breakeven point when using accumulation cutting heads.
13. Optimization of a partially mechanized wood chips harvesting system.
14. Optimization of mechanized wood chips harvesting system.
15. Comparative analysis of energy wood harvesting systems in SRC.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">3</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Ordinarily participation and active participation in classes. Examination.</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="4">Zečić, Ž., 2018: Šumska biomasa za energiju (interna skripta), Šumarski fakultet. Zagreb</td><td colspan="2">NO</td><td colspan="3">YES, Merlin</td></tr>
</table>

	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.	NO	YES, web
2.12. Optional literature	1. Hakkila, P., 1989: Utilization of Residual Forest Biomass. Springer-Verlag, Berlin, 1–568. 2. Aguilar, F. X., 2014: Wood Energy in Developed Economies: Resource Management, Economics and Policy. Routledge, London and New York, 1–338. 3. Zečić, Ž., Vusić, D., 2020: Katalog drvnih šumskih proizvoda. Sveučilište u Zagrebu Šumarski fakultet, 1–217.		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	. Assist. Prof. Dinko Vusić, PhD.	1.7. Number of ECTS credits	2
1.2. Course title	Forest products trade	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33947	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	The objective of this subject is to inform student about the form and place of the forest product sale.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem analysed in different ways B1. organise and perform tasks of greater complexity in forestry, from forest office and forest management unit as the lowest forestry structural units along the vertical C2. organise and conduct sale of timber assortments and timber products on domestic and worldwide market C5. manage the most complex tasks in all forms of forest organizations, forest and hunting advisory service; forest entrepreneurship
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Analyze the prices of forest products over the past few years according to the price list, domestic and international auctions and plan the sale price of all forest products according to market forecasts. Organize the sale of certain quantities of forest products according to the place of sale; standing volume, felled (and processed) volume, at the landing. Plan and manage the delivery of wood assortments according to the deadlines of contracted customer agreement.
2.5. Course content (syllabus)	Lectures 1. Introductory lecture. Definition, task and division of trade. 2. Development of trade in forest products. 3. Market - concept, types, features and dynamics. 4. Price development; the impact of trends in the European and world markets on wood prices. 5. Market forecast - goal of forecast, types of forecasts, forecasting methods. 6. Theory and practice of price formation of forest products. Prices formed on the basis of actual costs, prices formed on the basis of the value of raw materials, controlled government prices. 7. Trading techniques - places of trade in forest products, types and means of transport of forest products. 8. International rules for the interpretation of trade terms -Incoterms. 9. Trading techniques - forms of sale of forest products (price list, subsidy, auction, stumpage sale, free sale, etc.).

<table>
<tr><td></td><td colspan="9">10. Types of contracts. General terms of the contract, product preparation, quality and quantity, deadlines, delivery, methods of payment, bank guarantees, disputes and more.
11. National product classification and customs tariffs.
12. UNECE / FAO methodology for classification of wood assortments.
13. Statistics of trade in wood assortments.
14. Energy wood market. Influence of quality on price formation.
15. Balance of forest products.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Ordinarily participation and active participation in classes. Examination.</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Sabadi, R., 1998: Osnove trgovačke tehnike, trgovačke politike i marketinga u šumarstvu i drvnoj industriji, Šumarski fakultet Sveučilišta u Zagrebu, Zagreb, 1-254.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Zečić, Ž., 2018: Trgovina šumskim proizvodima (interna skripta), Šumarski fakultet. Zagreb</td><td colspan="2">NO</td><td colspan="2">YES, Merlin</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Zečić, Ž., Vusić, D., 2020: Katalog drvnih šumskih proizvoda. Sveučilište u Zagrebu Šumarski fakultet, 1–182.
2. Sabadi, R., 1992: Ekonomika šumarstva. Školska knjiga Zagreb, 1-280.
3. UNECE: Forest Products Annual Market Review (zadnje izdanje).</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Tibor Pentek, Ph.D.	1.7. Number of ECTS credits	2
1.2. Course title	Technologies of Forest Road Construction	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33952	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	The basic aim and task of this subject are to inform students about technical, technological and legislative components of the complex procedure of construction/reconstruction and maintenance/repair on forest roads in various terrain conditions. The acquired knowledge will enable students to plan, organise and control the realisation of construction/reconstruction and maintenance/repair on forest roads form taking over a building site till taking over a construction object.
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	B7. select and choose mechanical means based on cost analysis and other criteria B14. apply knowledge related to the methods, techniques, and technology of opening of forests, i.e. designing and constructing a network of forest roads
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Recommend options and select suitable, optimal technology for construction/reconstruction and maintenance/repair of forest roads. Recommend and select the most suitable class and type of construction equipment for various type of works during construction/reconstruction and maintenance/repair of forest roads. Anticipate difficulties that can occur during the construction/reconstruction of forest roads in flat areas and hilly and mountainous areas (slopes) and recommend measures to avoid/minimize them.
2.5. Course content (syllabus)	Lectures 1. Introduction. Position of the working stages construction/reconstruction and maintenance/repair of forest roads in the complex process of establishing optimal forest road network in the field. Basic definitions and terms. 2. Basic components and sub-components in the working stages of construction/reconstruction on forest roads in detal. Legal and technical bases necessary for starting with the working stages construction/reconstruction and maintenance/repair on forest roads. 3. Main groups of working stages for construction/reconstruction of forest roads. Preparatory works. 4. Procedures on the lower road layer. Machinery for earthworks. 5. Machinery for stoneworks. Soil compaction machines. Basics knowledge of rock blasting. 6. Procedures on soil stabilization/improvement - basic concepts and stabilization types. Mechanical soil stabilization. Classical and modern chemical soil stabilization. Soil stabilization by geosynthetics and geocells. 7. Procedures on the objects of underground and ground drainage. Concrete and rocky works.

<table>
<tr><td></td><td colspan="9">8. Procedures on the upper road layer. Rolling roadway construction. Connected roadway construction.
9. Soil and landslides recovery. Construction of objects on forest road route. Other procedures.
10. Technologies for construction/reconstruction of forest roads. Possible, suitable and optimal technologies for construction/reconstruction of forest roads. Criteria for selection the optimal technology for construction/maintenance of forest roads.
11. Technology of construction/reconstruction of forest roads in flat terrain. The most important problems during forest road construction in the lowland area.
12. Technology of construction/reconstruction of forest roads in highly and mountainous areas (sloped terrain). The most important problems during forest road construction in the highly and mountainous areas (sloped terrain).
13. Forest road maintenance - types and definitions. Regular maintenance. Investment maintenance. Periodical maintenance.
14. Damage on forest roads. Causes of damage on forest roads. Damage to lower layer of forest roads. Maintenance of the lower layers of forest roads.
15. Damages to upper layer of forest roads. Maintenance of the upper layer of forest roads.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regularly attend and actively participate in. Take the written and oral part of the exam.</td></tr>
<tr><td>2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td>Availability via other media</td></tr>
<tr><td></td><td colspan="5">Anon., 2002: Forest Road Engineering Guidebook, B.C. Ministry of Forests, pp. 1-208, chosen chapters.</td><td colspan="2">NO</td><td>YES, web</td></tr>
<tr><td></td><td colspan="5">Lacrombe, G., 1999: Forest Roading Manual, Liro Forestry Solutions, New Zeland, pp. 1-404, chosen chapters.</td><td colspan="2">NO</td><td>YES, web</td></tr>
<tr><td></td><td colspan="5">Ryan, T. et al., 2004: Forest Road Manual, Guidelines for the design, construction and management of forest roads, COFORD, Dublin, pp. 1-156, chosen chapters.</td><td colspan="2">NO</td><td>YES, web</td></tr>
<tr><td></td><td colspan="5">Slunjski, E. 1995: Strojevi u građevinarstvu, Hrvatsko društvo građevinskih inženjera, Zagreb, pp. 1-250.</td><td colspan="2">YES</td><td></td></tr>
</table>

2.12. Optional literature	1. Scientific and professional papers on the subject issues of domestic and foreign authors published in scientific journals and conference proceedings. 2. Anon., 2011: Colorado Forest Road Field Handbook, Colorado State Forest Service, p. 1-142, chosen chapters. 3. Cornell, J., Mills, K. 2000: Forest Road Management Guidebook, Oregon Department of Forestry, p. 1-32. 4. Pičman, D., Pentek, T. 1996: Soil Stabilization whit lime in forest road building, Mehanizacija šumarstva 21 (2), Zagreb, Hrvatska, pp. 83-85. 5. Pičman, D., Pentek, T. 1996: A supplement to the information on using the machine for forest road stabilization with lime, Mehanizacija šumarstva 21 (2), Zagreb, Hrvatska, pp. 87-96. 6. Pičman, D., Pentek, T. 1996: The use of RRP soil stabilization materials in forest road building, Šumarski list vol. 120 (11-12), Zagreb, Hrvatska, pp. 469-476. 7. Pičman, D., Pentek, T. 1996 The possibility oft the application oft the agent WEGS for the soil stabilization during forest roads building, Mehanizacija šumarstva 21 (2), Zagreb, Hrvatska, pp. 97-102. 8. Pičman, D., Pentek, T. 1997: Different possibilities of application of geo-synthetics as a method of soil stabilization in forest road construction, Šumarski list vol. 121 (7-8), Zagreb, Hrvatska, pp., 383-389. 9. Pičman, D., Pentek, T. 1998: Technology of work in in stabilisation of forest roads with cement, Šumarski list, vol. 122, br. 7-8, Zagreb, pp. 353-358.

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Associate Prof. Stjepan Posavec, Ph.D.	1.7. Number of ECTS credits	2
1.2. Course title	Evaluation of forest resources	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33953	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	NO

2. COURSE DESCRIPTION	
2.1. Course objectives	Information on classical and modern methods of establishing forest values, ways of calculation and differences. Real estimate of stand and forest management unit value. Calculation of remuneration for individual forest 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	A2. explain position and trends of forestry profession in the country and worldwide B1. organise and perform tasks of greater complexity in forestry, from forest office and forest management unit as the lowest forestry structural units along the vertical B11. apply knowledge related to marketing of forest main and secondary forest products C4. plan and calculate production, calculate basic indicators of successful business, compose basic financial reports, recognise and analyse types of costs
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	To decompose ways and goals of forest value calculation and analyse total economic value concept. Critical judgment of traditional and modern methods of calculation with and without demand curve, for environmental products and services values. To reassess different methods and models of estimation forest values in Croatia with goal of calculation total economic value of forest management unit
2.5. Course content (syllabus)	Lectures: 1. Goals and therm of evaluation in forestry 2. Problem matter of economic evaluation in forestry 3. Traditional forest evaluation methods 4. Modern forest evaluation methods 5. Total economic forest value 6. PES model, payment for ecosystem services 7. Importance and role fo forest value i bioeconomy concept

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

				paper					
	Preliminary exam		NO	Practical work		NO	(other)		
	Project		NO	Written exam		NO	ECTS credits (total)	2	
2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.								
2.10. Student responsibilities	Ordinarily participation and active participation in classes. Examination.								

2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Posavec, Stjepan; Pezdevšek Malovrh, Špela, 2020: Market Value and Timber Assortment Sale Models - Comparative Study, Management Aspects in Forest Based Industries / Jelačić, Denis (ur.). Zagreb: WoodEMA i.a., 2020. str. 17-37, ISBN:978-953-57822-7-8	YES	
	Posavec, S., Beljan, K. 2013. Forest products production and sale trends in Croatia, Markets for wood and wooden products, ur. Jelačić, D., Zagreb, 2013., str 95-105, ISBN978-953-57822-0-9	YES	
	Figurić, M.: UVOD U EKONOMIKU ŠUMSKIH RESURSA, Šumarski fakultet, Zagreb, 1998	YES	
	SABADI, R.: VREDNOVANJE ŠUMA U NJIHOVOJ UKUPNOSTI, Hrvatske šume, Zagreb, 1997	YES	
	Posavec, S.: Jurjević, P., Prpić, B., Vuletić, D., Jakovac, H., Posavec, S., 2011.: Procjena vrijednosti općekorisnih funkcija sredozemnih šuma primjenom šumarskih ekoloških i klasičnih ekonomskih načela, Šume hrvatskoga Sredozemlja, Matić, S. (ur.), Zagreb, Akademija šumarskih znanosti, 2011. Str. 516-523. ISBN 978-953-985715-6	YES	
2.12. Optional literature	1.SABADI, R.: EKONOMIKA ŠUMARSTVA, Školska knjiga Zagreb, 1992. 2.KLEMPERER, W.D.: FOREST RESOURCE ECONOMICS AND FINANCE, McGraw-Hill Book Comp., New York, 1996.		

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Tomislav Poršinsky, Ph.D. Assist. Prof. Andreja Đuka, Ph.D.	1.7. Number of ECTS credits	2
1.2. Course title	Planning of technological operations	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33955	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	Development of competent knowledge for carrying out contemporary operative tasks of wood utilisation and for inclusion in research tasks.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	B1. organise and perform tasks of greater complexity in forestry, from forest office and forest management unit as the lowest forestry structural units along the vertical B3. manage and make independent professional (business) decisions form the field of timber harvesting, forest opening, designing of forest road network and forestry entrepreneurship B6. recommend and choose forest machines, techniques and standard technologies used in forestry above all in timber harvesting from natural forests, even-aged and unevenaged stands, culture, plantation, and energy forests B7. select and choose mechanical means based on cost analysis and other criteria B12. apply knowledge related to the methods for preparing and planning technical works in forestry C1. plan, organise and works of organization of production in forestry
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Analyse elements of strategic-tactical planning of timber harvesting (terrain classification for forestry operations and mobility model of a cable skidder). Evaluate the tactical-operational planning of timber harvesting operations (components of tactical-operational planning of timber harvesting, timber harvesting operations in space and time, operational planning and supervision of timber harvesting procedures, logistics of timber harvesting in a harvester – forwarder system) Determine the cost calculations for timber harvesting (types of costs and methods of cost calculations)
2.5. Course content (syllabus)	Lectures: 1. Levels of planning technological operations 2. Harvesting operations in space and time 3. Deviation of execution from the felling plan (with example) 4. Descriptive terrain classification for performing harvesting operations 5. Skidder mobility model (input data – dimension, mass and tyre characteristics) 6. Skidder mobility model (connecting approaches vehicle – terrain and wheel – soil) 7. Functional terrain classification 8. Operational planning of timber harvesting – Logging Plan 9. Logistics in harvester-forwarder harvesting system 10. Supervision and quality control of working operations

<table>
<tr><td></td><td colspan="9">11. Cost calculations of harvesting procedures
12. Calculation of timber harvesting systems
13. Wood Chain Manager (example of Web-based tools)
14. Break-even analysis
15. Example of product rationalisation
16. Example of procedure rationalisation</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Making seminar work. Taking exam.</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Poršinsky, T., Đuka, A.: Presentations of lectures from the course Planning of technological operations</td><td colspan="2">NO</td><td colspan="2">YES, Merlin</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Forbig, A., Büttner, I., 2013: Forstmaschinen vorauskalkulieren. Kwf Merkblatt Nr. 17/2013: 1–35. (http://www.kwf-online.org/uploads/media/Kalk_KWF-Schema.xlsx).
2. Pentek, T., Poršinsky, T., Šušnjar, M., Stankić, I., Nevečerel, H., Šporčić, M., 2008: Environmentally Sound Harvesting Technologies in Commercial Forests in the Area of Northern Velebit – Functional Terrain Classification. Periodicum Biologorum 110(2): 127–135.
3. Prka, M., Poršinsky, T., 2009: Structure Comparison of Technical Roundwood in Even-Aged Beech Cutblocks by Assortment Tables with Application of Standards HRN (1995) and HRN EN 1316-1:1999. Šum. list 133(1–2): 15–25.
4. Poršinsky, T., Đuka, A., Busić, O., 2014: Influence of Prescribed Method of Roundwood Scaling on Timber Transport. Nova meh. šumar. 35: 1–9.
5. Poršinsky, T., Zec, S., 2015: Croatian Chamber of Forestry and Wood Technology Engineers Issued Their First Professional Guidelines. Nova meh. šumar. 36: 91–102.
6. Đuka, A., Poršinsky, T., 2015: Analysis of Terrain Roughness in Terms of Harvesting Operations. Nova meh. šumar. 36: 43–52.
7. 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.
8. 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.</td></tr>
</table>

	9. Poršinsky, T., Petreković, V., Đuka., A., 2020: Bark Thickness of Wild Cherry in Timber Scaling. Šum. list 144(1–2): 7–14. 10. Triplat, M., Krajnc, N., 2020: Assessment of Costs in Harvesting Systems Using WoodChainManager Web-based Tool. Croat. j. for. eng. 41(1): 49–57.

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Mario Šporčić, PhD	1.7. Number of ECTS credits	2
1.2. Course title	Innovations in forestry	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	33956	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	Develop the basic knowledge and skills necessary to recognize the importance of innovation as a key factor in competitiveness, creating economic growth, employment and development in forestry. Develop the ability to creatively solve problems, induce inventiveness and creativity, facilitate the production of ideas, evaluation and selection of ideas.
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	B13. manage forest, human resource, and technical potential during performance of forest works C1. plan, organise and works of organization of production in forestry C5. manage the most complex tasks in all forms of forest organizations, forest and hunting advisory service; forest entrepreneurship
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Depict the state of innovation and innovativeness in forestry (significance, role and division of innovations, stages of innovation process, innovation systems and monitors, company-level innovations, factors of innovation activity, conditions for innovation activity, innovation behavior, sources of impulses and information for innovation, support and innovation constraints) Explain creativity and inventiveness (features of creativity and inventiveness, process and stage of creative thinking, characteristics of creative people, techniques of encouraging creative thinking, evaluation and choice of ideas/solutions) Expose institutional support for innovation activities and examples of good practice.
2.5. Course content (syllabus)	1. Introduction, concept and definition of innovation, role and significance of innovations 2. Types of innovation, innovation processes, factors that encourage/inhibit innovation 3. Regional and sectoral innovation systems, the position of forestry 4. European innovation policy, the position of forestry 5. Innovation monitors and indicators, EIS, GEM 6. Innovation and creativity, evaluation and choice of ideas 7. Individual techniques of stimulating creativity 8. Group techniques of stimulating creativity 9. European initiatives, projects and actions on forestry innovations, COST E51, Innoforce 10. State of the innovations in European forestry 11. Innovation activities and innovation behavior of forest owners, managers and forest companies 12. Legal framework for innovations in Croatia, intellectual property, laws, regulations, the position of forestry 13. Examples of innovation from European forestry practice, case studies 14. Examples of innovation from Croatian forestry, case studies 15. State and level of innovations in Croatian forestry

<table>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td></td><td>NO</td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Taking the exam.</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="4">Rametsteiner, E., Weiss, G., Kubeczko, K., 2005: Innovation and entrepreneurship in forestry in central Europe. Brill Academic Publishers, Leiden-Boston.</td><td colspan="2">NO</td><td colspan="3">YES</td></tr>
<tr><td colspan="4">Srića V., 2003: Kako postati pun ideja. M.E.P. Consult, Zagreb.</td><td colspan="2">NO</td><td colspan="3">YES</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">Šporčić, M., Landekić, M., Ćosić, M., Bakarić, M., 2017: Inovacijske nagrade u šumarstvu. Nova mehanizacija šumarstva 38: 79-90.
Posavec, S., Šporčić, M., Antonić, D., Beljan, K., 2011: Poticanje inovacija - ključ razvoja u hrvatskom šumarstvu. Šumarski list 135 (5-6): 243-256..
Šporčić, M., Landekić, M., Marjanović, M., 2012: Vodič za prikupljanje podataka i interpretaciju inovacija u šumarstvu. Nova mehanizacija šumarstva, vol. 33: 79-94.
Martinić, I., Šporčić, M., Vondra, V., 2006: Inovacijski procesi kao ključ provedbe Hrvatske šumarske politike. Glasnik za šumske pokuse, pos. izdanje 5: 703-715.
Srića, V., 2003: Inventivni menadžer u 100 lekcija. Znanje d.d. Zagreb.</td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Prof. Tibor Pentek, Ph.D.	1.7. Number of ECTS credits	2
1.2. Course title	Supervision of forest road construction	1.8. Number of hours in semester (L+E+F+e-learning)	15+0+0
1.3. Course code	225902	1.9. Expected enrolment in the course	10
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Elective	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	

2. COURSE DESCRIPTION	
2.1. Course objectives	The main objective and task of this subject is to teach the students the organization and management procedures of construction/reconstruction and maintenance/repair of forest roads, and the supervision (control) procedures of construction/reconstruction and maintenance/repair of forest roads. Acquired theoretical and practical knowledge will enable students to organize, lead and supervise the operations on construction/reconstruction and maintenance/repair of forest roads.
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	B12. apply knowledge related to the methods for preparing and planning technical works in forestry B13. manage forest, human resource, and technical potential during performance of forest works B14. apply knowledge related to the methods, techniques, and technology of opening of forests, i.e. designing and constructing a network of forest roads
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Preparation of technical documentation necessary for the implementation of the public tender procedure for the selection of the most favourable contractor for the construction/reconstruction and maintenance/repair of the forest road. Prepare the professional part of the contract for construction/reconstruction and maintenance/repair of the forest road. Making supervision of construction/reconstruction and maintenance/repair of forest roads as a construction site manager. Conduct supervision/control and handover report of construction/reconstruction and maintenance/repair of forest roads as a supervising engineer.
2.5. Course content (syllabus)	Lectures 1. Introduction. Legal (primary) framework, secondary legislation and technical documentation necessary for conducting and supervising construction/reconstruction and maintenance/repair of forest roads. 2. Participants in the process of construction/reconstruction and maintenance/repair of forest roads, required qualifications, basic tasks and area of responsibility. 3. Preparation and implementation of the procurement procedure and selection of the most favourable contractor. 4. Contract of working operation, analysis and clarification of basic components. Preparation of the Contract of working operations with emphasis on the professional part. 5. Procedure for introducing the contractor with the working tasks. Making appropriate handover report. 6. Organization and management of construction/reconstruction and maintenance/repair of forest roads.

<table>
<tr><td></td><td colspan="9">7. Building diary - analysis and explanation of basic components. Guidance of the building diary.
8. Building book - analysis and explanation of basic components. Preparation of the building book.
9. Temporary and completed situation - analysis and clarification of basic components. Preparation of temporary and completed situation and complete accompanying documentation.
10. Supervision of construction/reconstruction and maintenance/repair of forest roads. Building diary control and verification.
11. Building book control and verification. Control and verification of temporary and completed situation and complete accompanying documentation.
12. Handover report of construction/reconstruction and maintenance/repair of forest roads - analysis and clarification of basic components. Preparation of the handover report.
13. Final report of the supervising engineer - analysis and clarification of the basic components.
14. Preparation of the supervising engineer final report - part 1
15. Preparation of the supervising engineer final report - part 211. Innovation activities and innovation behavior of forest owners, managers and forest companies</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Regular attendance and active participation in lectures. Taking the exam.</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">Pičman, D., 2007: Forest roads (university textbook), Faculty of Forestry, University of Zagreb, pp 1-460, chosen chapters.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td colspan="5">Šikić, D. i dr., 1989: Tehnički uvjeti za gospodarske ceste, Znanstveno vijeće za promet JAZU, Zagreb, pp 1-40, chosen chapters.</td><td colspan="2">YES</td><td colspan="2"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">1. Scientific and professional papers on the subject issues of domestic and foreign authors published in scientific journals and conference proceedings.
2. Anon., 2002: Forest Road Engineering Guidebook, B.C. Ministry of Forests, p. 1-208, chosen chapters.
3. Anon., 2011: Colorado Forest Road Field Handbook, Colorado State Forest Service, p. 1-142, chosen chapters.</td></tr>
</table>

	4. Babić, B., 1997: Projektiranje kolničkih konstrukcija, HDGI Zagreb, s. 1-197, chosen chapters. 5. Dragčević V., Korlaet Ž., 2003: Osnove projektiranja cesta, University of Zagreb, Faculty of Civil Engineering, (university textbook) p. 1-93, chosen chapters. 6. Dragčević, V., Rukavina, T., 2006: Donji ustroj prometnica, University of Zagreb, Faculty of Civil Engineering, (university textbook) p. 1-187, chosen chapters. 7. Korlaet Ž., 1995: Uvod u projektiranje i građenje cesta. University of Zagreb, Faculty of Civil Engineering, (university textbook) p. 1-208, chosen chapters. 8. Lacrombe, G., 1999: Forest Roading Manual, Liro Forestry Solutions, New Zeland, p. 1-404, chosen chapters. 9. Ryan, T. et al., 2004: Forest Road Manual, Guidelines for the design, construction and management of forest roads, COFORD, Dublin, p. 1-156, chosen chapters.

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Professor Tomislav Poršinsky, PhD Assistant Professor Andreja Đuka, PhD Assistant Professor Zdravko Pandur, PhD Assistant Professor Dinko Vusić, PhD Marin Bačić, PhD	1.7. Number of ECTS credits	6
1.2. Course title	Environmentally sound technologies	1.8. Number of hours in semester (L+E+F+e-learning)	30+30+24
1.3. Course code	225895	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	2
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	The development of competent knowledge for carrying out complex operative and environmentally acceptable professional solutions, independent decision-making and involvement in research tasks.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A2. explain position and trends of forestry profession in the country and worldwide B6. recommend and choose forest machines, techniques and standard technologies used in forestry above all in timber harvesting from natural forests, even-aged and unevenaged stands, culture, plantation, and energy forests B14. apply knowledge related to the methods, techniques, and technology of opening of forests, i.e. designing and constructing a network of forest roads B16. develop current technologies as well as implement new technologies
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	Analyse soil compaction and rutting (soil bearing capacity, critical comment on methods of measuring soil bearing capacity, soil penetration resistance and cone index, wheel index, assessment of vehicle mobility according to WES method, soil compaction – reasons and consequences). Present and describe stand damage (type of erosion processes and consequences for forest stand, soil erosion as a result of timber harvesting operations, erosion intensity in different timber harvesting systems, methods and measures for the protection of waterways). To evaluate the environmental benefits of forest machines (environmental pollution with exhaust gases and pollutants from forest machines, impact of working conditions on fuel consumption, ecological norms for exhaust gases, technical solutions for reducing the amount of harmful exhaust gases, energy balance, ecologically acceptable wood harvesting technologies, application of bio-fuels and bio-oils in forest vehicles). To analyse development of forest vehicles (development and construction of forest vehicles with hybrid drive, remote monitoring systems for forest machines and vehicles).
2.5. Course content (syllabus)	Lectures 1. Introduction to ecologically acceptable harvesting – scope and goal. 2. Forest soil as basis for vehicle mobility (structure and composition, stress, moisture content, bearing capacity methods).

<table>
<tr><td></td><td colspan="9">3. Vehicle-soil interaction 1 (load distribution, tyres and semi-tracks)
4. Vehicle-soil interaction 2 (assessment of traction characteristics based on wheel numeric, contact pressure).
5. Soil rutting and compaction during timber extraction
6. Damage to standing and young trees during harvesting operations and forest road construction
7. Protection of watercourses during harvesting operations
8. Soil erosion during timber extraction and erosion on forest roads
9. Life cycle analysis
10. Harvesting operations in NATURA preservation areas
11. Remote monitoring of machine operation (FMS)
12. Energy balance of wood products (EROI)
13. Biofuels and biooils
14. Rehabilitation of damaged stands
15. Development of forest machines

Practical lessons – excercises
1. Peparation for the measurement exercise "Measurement of forest soil bearing capacity indicators".
2. Measurement exercise "Measurement of forest soil bearing capacity indicators".
3. Processing and analysis of data from the measurement exercise "Measurement of forest soil bearing capacity indicators".
4. Load distribution on the axles (wheels) of timber extraction vehicles
5. Models of the contact surface of the driving system (tyres, semi-tracks) and forest soil.
6. Nominal ground pressure and wheel numeric.
7. Computer application "Profor"
8. Preparation for fieldwork "Checklist for environmental impact assessment in forestry".
9. Preparation for fieldwork "Assessment of stand damage".
10. Analysis of data from fieldwork "Assessment of stand damage".
11. Preparation for the measurement exercise "Energy Balance - EROI"
12. Measurement exercise "Energy balance - EROI"
13. Processing and analysis of data from the measurement exercise "Energy Balance - EROI"
14. Preparation for the measurement exercise "Analysis of exhaust emissions of combustion engines"
15. Measurement exercise and data processing "Combustion engine exhaust gas analysis"

Students acquire practical skills through fieldwork measurements: "Checklist for environmental impact assessment in forestry", "Assessment of stand damage" and "Sanation of stand damage".</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☒ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td>YES</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>YES</td><td></td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td>YES</td><td></td><td>ECTS credits (total)</td><td colspan="2">6</td></tr>
</table>

2.9. Assessment methods and criteria	Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.		
2.10. Student responsibilities	Regular attendance and active participation in lectures, exercises and field teaching. Laying the exam, exam		
2.11. Required literature (available in the library and/or via other media)	Title	Availability in the library	Availability via other media
	Poršinsky, T., Đuka, A., Pandur, Z.: Presentations of lectures, practical lessons – excercises and preparation materials for fieldwork measurements from the course Environmentally sound technologies Sutherland, B.J., 2003: Preventing Soil Compaction and Rutting in the Boreal Forest of Western Canada: A Practical Guide to Operating Timber-Harvesting Equipment. FERIC Advantage 4(7): 1–52. Poršinsky, T., Pentek, T., Bosner, A., Stankić, I., 2012: Ecoefficient Timber Forwarding on Lowland Soft Soils. In: Global Perspectives on Sustainable Forest Management (ed: C. A. Okia), In Tech, 275–288. ISBN 978-953-51-0569-5 Bosner, A., Poršinsky, T., Stankić, I., 2012: Forestry and Life Cycle Assessment. In: Global Perspectives on Sustainable Forest Management (ed: C. A. Okia), In Tech, 139–160. ISBN 978-953-51-0569-5 Pandur, Z., Šušnjar, M., Zorić, M., Nevečerel, H., Horvat, D., 2015: Energy Return on Investment (EROI) of Different Wood Products (ed: M. Zlatić), In Tech, 165–184. ISBN 978-953-51-2175-6	NO	YES, Merlin or web
2.12. Optional literature	1. Horvat, D., Poršinsky T., Krpan, A., Pentek T., Šušnjar M., 2004: Suitability Evaluation of Forwarders Based on Morphological Analysis. Strojarstvo 46(4–6): 149–160. 2. Poršinsky, T., Horvat, D., 2005 Wheel Numeric as Parameter for Assessing Environmental Acceptability of Vehicles for Timber Extraction. Nova meh. šumar. 26: 25–38. 3. Poršinsky, T., Ožura, M., 2006: Damage to standing trees in timber forwarding. Nova meh. šumar. 27: 41–49. 4. Poršinsky, T., Sraka, M., Stankić, I., 2006: Comparison of Two Approaches to Soil Strength Classifications. Croat. j. for. eng. 27(1): 17–26. 5. Poršinsky, T., Šušnjar, M., Đuka, A., 2012: Determination of Load Mass Distribution and Skidding Factors. Nova meh. šumar. 33: 35–44. 6. Poršinsky, T., Moro, M., Đuka, A., 2016: Maneuverability Characteristics of Cable Skidder. Šum. list 140(5–6): 259–272. 7. Poršinsky, T., Matas, J., Horvat, D., Đuka, A., 2020: Tyres of Forestry Vehicles. Šum. list 144 (9–10): 509–522. 8. Pandur, Z., Poršinsky, T., Šušnjar M., Zorić, M., Vusić, D., 2014: Soil Disturbance during Timber Forwarding in Cut-Blocks of Common Oak. Nova meh. šumar. 35: 23–34. 9. Zorić, M., Šušnjar, M., Pandur, Z., Mihaljević, K., 2014: Fuel Consumption and Greenhouse Emission in Timber Haulage in Croatian Forestry Potrošnja goriva i emisija stakleičkih plinova pri kamionskom prijevozu drva u hrvatskom šumarstvu. Nova meh. šum. 35: 89–97.		

	10. Pandur, Z., Šušnjar, M., Bačić, M., Lepoglavec, K., Nevečerel, H., Đuka, A., 2018: Fuel Consumption of Forwarder in Lowland Forests of Pedunculate Oak. SEEFOR 9(1): 73–80. 11. Đuka, A., Vusić, D., Horvat, D., Šušnjar, M., Pandur, Z. and Papa, I., 2017. LCA Studies in Forestry–Stagnation or Progress?. Croat. j. for. eng. 38(2): 311–326. 12. Đuka, A., Poršinsky, T., Pentek, T., Pandur, Z., Janeš, D., Papa, I., 2018: Soil Measurements in the Context of Planning Harvesting Operations and Variable Climatic Conditions. SEEFOR 9(1): 61–71.

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)		1.7. Number of ECTS credits	4
1.2. Course title	Professional practice	1.8. Number of hours in semester (L+E+F+e-learning)	15 days
1.3. Course code	225913	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION			
2.1. Course objectives	The aim of the course is to gain experience and insight into the activities of companies that employ masters of forestry engineering in jobs that require the specified profile of experts. Within the course, students will connect the previous knowledge acquired during their studies with the performance of specific work tasks related to the part of the profession in which the company is engaged, and learn the importance of developing business responsibility, communication skills and teamwork.		
2.2. Enrolment requirements and/or entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem analysed in different ways B2. implement forest management programs B13. manage forest, human resource, and technical potential during performance of forest works C1. plan, organise and works of organization of production in forestry D5. gather, process and interpret reference sources and prepare simpler written professional or scientific paper		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. independently and responsibly perform entrusted professional tasks in forestry 2. apply in practice the knowledge and skills necessary for the implementation of the entrusted tasks 3. apply in practice legal regulations from the forestry sector 4. present professional issues in writing		
2.5. Course content (syllabus)	During the implementation of the professional practice, the student will, on the basis of a previously defined task, and according to the instructions and under the supervision of a mentor in the company, perform professional forestry work for which he is in charge. When performing professional work, the student will, in accordance with the instructions and in agreement with the mentor in the company, independently study the relevant professional literature, business documentation and legislation in the forestry sector. The results of the completed professional practice will be presented by the student to the mentor at the faculty in the form of a written report.		
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:

<table>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>YES</td><td></td><td>Research</td><td></td><td>NO</td><td>Oral exam</td><td></td><td>NO</td></tr>
<tr><td>Experimental work</td><td></td><td>NO</td><td>Report</td><td></td><td>NO</td><td>Written report</td><td>YES</td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td colspan="2">4</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Perform entrusted professional tasks during the implementation of professional practice. Upon completion of the professional practice, prepare a written report.</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td colspan="2">Availability in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="4">Professional practice handbook</td><td colspan="2"></td><td colspan="2">YES</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9"></td></tr>
</table>

COURSE DECRIPTION

1. GENERAL INFORMATION			
1.1. Course lecturer(s)		1.7. Number of ECTS credits	20
1.2. Course title	Master thesis	1.8. Number of hours in semester (L+E+F+e-learning)	
1.3. Course code	225897	1.9. Expected enrolment in the course	25
1.4. Study programme	Graduate	1.10. Level of application of e-learning (level 1, 2, 3)	
1.5. Course type	Compulsory	1.11. Language of instruction	Croatian
1.6. Year of the study	2.	1.12. Possibility of instruction in English	YES

2. COURSE DESCRIPTION	
2.1. Course objectives	Master thesis is a comprehensive and highly independent task in which the student must demonstrate knowledge of the basics of the profession and scientific research work in defining hypotheses and research goals, research planning, data collection and processing and writing a scientific paper. It includes expanding and deepening knowledge from the content of the curriculum, individual engagement on problem topics, gaining experience in writing professional papers, ability to apply scientific methods and tools in problem processing and writing, ability to independently use relevant domestic and foreign literature published in the cited sources.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	A1. independently gather data, statistically process, present and analyse data, discuss and conclude based on analysed data and distinguish possibilities of different interpretation of the same problem analysed in different ways D5. gather, process and interpret reference sources and prepare simpler written professional or scientific paper
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	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 master thesis in stages 3. independently design the methodology of research work 4. apply the methodology of writing a professional and scientific work 5. present the work in written and oral form, using the skills of concise interpretation of results and conclusions, and provide guidelines for future development of the topic of the paper
2.5. Course content (syllabus)	Master thesis is an individual written work based on 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 20 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).

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

<table>
<tr><td rowspan="4"></td><td>work</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>NO</td><td>Seminar paper</td><td></td><td>NO</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>NO</td><td>Practical work</td><td>YES</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>NO</td><td>Written exam</td><td></td><td>NO</td><td>ECTS credits (total)</td><td colspan="2">20</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is conducted in accordance with Assessment methods and criteria for the current academic year.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">Apply for the topic of the thesis, conduct research and prepare the paper in accordance with the Instructions for the design of the thesis. Attend consultations and present the progress in conducting research and drafting the paper. Respect and follow the instructions of the mentor. Adhere to the principles of ethical approach in writing the thesis. Prepare a presentation and defend the thesis before the appointed committee.</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Availability in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="5">Ordinance on the preparation and defense of the master thesis at the graduate studies of the University of Zagreb, Faculty of Forestry and Wood Technology</td><td colspan="2"></td><td>YES, web</td></tr>
<tr><td colspan="5">Instructions for the preparation of the bachelor and master thesis</td><td colspan="2"></td><td>YES, web</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9"></td></tr>
</table>