ARBORTECH

Co-funded by the European Union

Arboriculture as a fundamental technique for managing urban green spaces

Project Result 3

Curriculum ‘Arboriculture for Gardeners’ VET programme for students (EQF 4)

ArborTech project has been funded with the support from the European Commission, with the reference number 2021-1-SI01-KA220-VET-000028108. The content of this website reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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Year: 2023

Project title: ArborTech - Arboriculture as an essential Technique for managing urban green areas
Agreement number: 2021-1-SI01-KA220-VET-000028108

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1. GENERAL PART

Training programme name:
‘Arboriculture for Gardeners’

EQF level: 4

Training programme description:
The goal of the training programme ‘Arboriculture for Gardeners’ is to obtain general knowledge, skills and competences and to apply the principles of the educational program through theory, practical and experimental learning in the field of arboriculture.

In the Module 1, the content on tree biology provides students with the knowledge of structure and function and the relationship between them. They learn about anatomy and morphology of individual parts of trees and biological and chemical processes that take place in those structures. Module focuses on the biology of deciduous trees and conifers. Students learn about the relationship between the root system of the trees and the soil in which the trees grow. Knowledge of the texture, structure, pH and water-holding capacity of the soil enables students to better prepare for the care of trees in an urban environment.
The Module 2 provides students how to identify ornamental woody plants (deciduous trees, conifers, shrubs, climbers), how to care for them and classify them in the plant system. Students obtain knowledge about ornamental woody plants and take into account the characteristics of individual genus, species and varieties trees in the composition of green areas. They know how to monitor and ensure the quality growth and development of ornamental woody plants and ensure adequate care. Students identify the appropriate growing place for each tree species.
In module 3 students gain knowledge in the field of phytopathology – study of diseases in plants. Module focuses on pathogenic microorganisms and abiotic factors which cause diseases in plants, the mechanism of their emergence, interaction of causes and the diseased plant and finding measures of disease control and how pathogens affect plants using enzymes, toxins or growth regulators to ensure their food.
Module 4 comprises basic legislation, standards, regulations and procedures on tree care operations and work safety. Tree care operations measures, planting, irrigation, fertilisation, pruning, canopy binding and support, tree protection during construction, soil improvement and branch removal are presented. In addition, topics on tree care techniques such as the use of appropriate equipment, tree climbing, rigging using rope techniques, rescue and working with machinery are included. Safety at work, the use of personal protective equipment (PPE), workplace preparation, workplace safety, safe working practices, traffic safety and biosecurity measures are highlighted.

Duration and methodology:
Training programme should last 70 hours throughout the growing season of trees and shrubs. In addition to the theoretical part of the programme, field training with relevant tasks is included in the field or in the dendrology laboratory. Teacher/Trainer should combine face to face teaching/learning approach with online tools to support blended learning which is available on the ArborTech e-platform compatible with the computers, tablets and smartphones.

General objectives at the level of the training programme:

- To apply the principles of the educational program 'Arboriculture for Gardeners' through theory, practical and experimental learning.
- To acquire relevant competences, knowledge and skills in the area of tree biology and soil science, identification and selection of ornamental trees, shrubs and climbers and define their care.
- Identifying diseases and pests on ornamental plants, finding solutions to problems, analysing infection phases and damage extent.
- To plan, organise and apply the principles of tree care operations and work safety and understand basic legislation, standards, regulations and procedures on tree care operations and work safety.

Duration: 70 hours

Target groups:
- Students (15-18 years)
- Employees from arboriculture services

Competences of teaching staff:
Teachers/Trainers should have a formal degree (EQF level 7) in at least one of the following fields: forestry, arboriculture, horticulture, agriculture and landscape architecture or formal degree (EQF level 6) in the field of agriculture or horticulture plus 5 years of practical experiences in the field of arboriculture.

Methods of grading:

Obligatory grading elements	**Share (minimum)**
Classroom/Field attendance	90%
Individual assignment	100%
Online sessions	100%
Self-correcting quiz	60%
Final exam	60%

List of modules:

1. Module 1: Tree biology and pedology
2. Module 2: Plant identification and selection
3. Module 3: Tree pathology
4. Module 4: Tree care operations and work safety

2. SPECIFIC PART

2.1 MODULE 1

Tree biology and pedology

Module description:

The study of tree biology is the study of structure and function and the relationship between them. Anatomy and morphology study individual parts of trees. Physiology studies the biological and chemical processes that take place in those structures. It primarily focuses on the biology of deciduous trees, but some attention is also focused on conifers. The relationship between the root system of the trees and the soil in which the trees grow has more influence on the positive growth of the trees than any other factor. Knowledge of the texture, structure, pH and water-holding capacity of the soil enables students to better prepare for the care of trees even in an urban environment.

1. GENERAL INFORMATION			
1.1. Name of the module	Tree biology and pedology	1.2. Hours	15
1.3. Training programme	'Arboriculture for Gardeners'	1.4. Credits	/
2. OBJECTIVES AND LEARNING OUTCOMES			
2.1. Objectives	2.1.1. To organise, plan and apply the elemental principles of the educational module 'Arboriculture for Gardeners'. 2.1.2. To apply the principles of arboriculture education through experimental learning. 2.1.3. To acquire relevant competences, knowledge and skills in the area of tree biology and soil science thanks to outdoor education.		
2.2. Learning outcomes expected at the level of the module (knowledge, skills, competences)			
2.2.1. Knowledge At the end of the module the participant will be able to:	2.2.1.1. Describe the anatomy and morphology of individual parts of trees. 2.2.1.2. Describe the biological and chemical processes in individual tree structures. 2.2.1.3. Explain how soil species and soil types influence tree growth and development. 2.2.1.4. Diagnose soil properties to support tree growth and development. 2.2.1.5. Recognize the factors which positively or negatively affect the root system of trees depending on soil properties. 2.2.1.6. Recognize the elemental conditions that are necessary for the growth and development of trees during their life cycle.		

	2.2.1.7. Identify trees growing in cultural landscapes, in cities and in soils with conditions less suitable for their life cycle. 2.2.1.8. Decide the need for fertilisation and soil pH adjustment for optimal tree growth and development. 2.2.1.9. Choose suitable organic and inorganic fertilisers in order to ensure necessary tree nutrition. 2.2.1.10. Identify the principles of fertiliser application in relation to the environment. 2.2.1.11. Apply adequate professional terminology, information and communication technologies, work instructions, catalogues and professional literature to ensure optimal tree nutrition.
2.2.2. Skills At the end of the module the participant will be able to:	2.2.2.1. Identify problems in the growing environment of trees. 2.2.2.2. Select suitable tree species for conditions less suitable for their life cycle. 2.2.2.3. Ensure optimal environment for the growth and development of trees based on the identified problems. 2.2.2.4. Organise effective work procedures using information and communication technologies, specific software, professional literature and technical documentation. 2.2.2.5. Keep technological and work discipline during the education.
2.2.3. Competences At the end of the module the participant will have acquired the responsibility and autonomy and will be able to:	2.2.3.1. Identify the causes of the anomaly of tree growth in an urban landscape. 2.2.3.2. Propose measures to solve the identified problems. 2.2.3.3. Coordinate, manage and ensure professional activity during the work process. 2.2.3.4. Keep measures for environmental protection in connection with the use of chemical preparations. 2.2.3.5. Adhere to the work and technological procedures, health and safety regulations.

2.3. Module content broken down in detail by session schedule (syllabus)

Session	Minutes	Content	Learning outcome (2.2.)	Teaching method	Material
1-3	135 min	Biology of trees Anatomy of tree - Basic structure - Cells and tissues - Shoot - Leaves and roots	2.2.1.1. 2.2.1.2. 2.2.1.5.	Frontal education Discussion Group work Individual work	Pictures Interactive board Flip-chart Internet
4-6	135 min	Physiology of trees - Photosynthesis, respiration, transpiration - Absorption, translocation and vascular system - Defense system - CODIT	2.2.1.2. 2.2.1.6. 2.2.1.11. 2.2.2.3.	Frontal education Group work	Pictures Interactive board Flip-chart Internet

7	45min	Pedology Soil properties Physical properties of the soil	2.2.1.3. 2.2.1.4. 2.2.1.5. 2.2.1.6. 2.2.1.7. 2.2.1.11.	Frontal education Group work	Flip chart Pictures Memo pad
8	45min	Chemical properties of the soil	2.2.1.4. 2.2.1.6. 2.2.1.8. 2.2.1.11.	Frontal education Group work	Pictures Interactive board Flip-chart Internet
9	45 min	Biological properties of the soil	2.2.1.4. 2.2.1.6. 2.2.1.8. 2.2.1.11.	Frontal education Presentation	Flip chart Pictures Memo pad
10	45 min	Soil moisture	2.2.1.4. 2.2.1.5. 2.2.1.6. 2.2.1.7.	Frontal education Group work	Pictures Interactive board Flip-chart
11-14	180 min	Tree nutrition - Requirements of trees, basic elements - Fertilisers - Soil additives, salinization - Soil and leaf analysis	2.2.1.7. 2.2.1.8. 2.2.1.9. 2.2.1.10. 2.2.1.11. 2.2.2.1.	Frontal education Group work	Pictures Interactive board Flip-chart
15	45 min	Urban soil	2.2.1.3. 2.2.1.4. 2.2.1.5. 2.2.1.6. 2.2.1.7. 2.2.1.8. 2.2.1.11. 2.2.2.2.	Frontal education	Pictures Interactive board Flip-chart
2.4. Participant responsibilities		2.4.1. Presence at the module: classroom, field and on-line sessions attendance followed by mutual learning, exchanges of experiences and cooperation. 2.4.2. Self-correcting quiz implementation.			

	2.4.3. Complete individual assignments. 2.4.4. Complete on-line survey at the end of the module. 2.4.5. Seminar paper on a selected topic.	
2.5. Evaluation methods	2.5.1. Each of learning outcomes (in 2.2.) should be evaluated with at least 1 or 2 relevant questions/tasks/assignment using an on-line self-correcting quiz (reach the minimum 60 %). 2.5.2. Recommendation: The learning process should comprise exercises, tasks, presentations, reporting etc. during which the teacher can check the student's understanding and ability to carry out relevant tasks.	
2.6. Quality assurance methods that ensure the acquisition of exit competence	2.6.1. On-line survey at the end of the module: - self-evaluation (students and teacher), - teacher evaluation (students), - learning process evaluation (students).	
3. LITERATURE AND SOURCES		
3.1. Required literature (available in the library and via other media)	**Title**	**Availability**
	Lilly, S. J. et al. (2015). Učebnica arboristiky - ISA "Arborists´Certification Study Guide. ISA Slovensko. Bratislava.	
3.2 Recommended literature	**Title**	**Availability**
	Lilly, S. J. et al. (2022). Arborists' Certification Study Guide. 4th Edition. International Society of Arboriculture. Atlanta.	

2.2 MODULE 2

Tree identification and selection

Module description:

The module teaches students to identify ornamental trees, shrubs and climbers. Further it provides information on the care and classification of ornamental plants. Students obtain knowledge about ornamental woody trees and take into account the characteristics of individual genus, species and varieties trees in the composition of green areas. They know how to monitor and ensure the quality growth and development of ornamental woody plants and ensure adequate care. Students identify the appropriate growing place for each tree species and describe different techniques of care.

1. GENERAL INFORMATION			
1.1. Name of the module	Plant identification and selection	1.2. Hours	15 hours
1.3. Training programme	'Arboriculture for Gardeners'	1.4. Credits	/
2. OBJECTIVES AND LEARNING OUTCOMES			
2.1. Objectives	2.1.1. To identify ornamental trees, shrubs and climbers. 2.1.2. To define the care of ornamental plants.		
2.2. Learning outcomes expected at the level of the module (knowledge, skills, competences)			
2.2.1. Knowledge At the end of the module the participant will be able to:	2.2.1.1. Identify ornamental woody plants (deciduous, conifers, shrubs, climbers) and classify them in the plant system. 2.2.1.2. Distinguish between native and exotic woody plants which are used for green areas. 2.2.1.3. Learn about ornamental trees and take into the account the characteristics of individual genus, species and varieties in the composition of green areas. 2.2.1.4. Define and evaluate the economic and aesthetic importance of ornamental woody plants in horticulture. 2.2.1.5. Monitor and ensure the quality growth and development of ornamental woody plants and ensure adequate care. 2.2.1.6. Identify the appropriate growing place for each tree species. 2.2.1.7. Implement appropriate maintenance measures for ornamental tree plantings.		

	2.2.1.8. Describe different techniques of care. 2.2.1.9. Develop professional responsibility and organisational culture at the workplace. 2.2.1.10. Connect theoretical and practical knowledge.
2.2.2. Skills At the end of the module the participant will be able to:	2.2.1.11. Understand binary nomenclature and ranking trees into the plant system. 2.2.1.12. Explain the meaning of the most common botanical names, pronounce and write them. 2.2.1.13. Justify the role of dendrology in horticulture. 2.2.1.14. Distinguish between the life forms of woody plants (trees, bush, semi-shrub, climbers). 2.2.1.15. Explain the characteristics (botanical description) of each group of ornamental plants. 2.2.1.16. Distinguish and recognize individual genera and their scientific names. 2.2.1.17. Value decorative and useful value of individual groups of woody plants. 2.2.1.18. Recognize individual trees in the individual vegetation period. 2.2.1.19. Distinguish between genus, species and varieties of conifers, evergreen trees, deciduous trees, shrubs and climbers. 2.2.1.20. Know the useful value of ornamental plants – resistance to the cold, environmental pollution, location, soil, harmful organisms. 2.2.1.21. Know how to protect plants from the cold, pollution and mechanical damage. 2.2.1.22. Know how to take care of ornamental plants with different techniques (pruning, clipping,…).
2.2.3. Competences At the end of the module the participant will have acquired the responsibility and autonomy and will be able to:	2.2.1.23. Recognize the useful value of individual groups of ornamental trees, shrubs and climbers. 2.2.1.24. Determine the useful and aesthetic value of ornamental woody plants. 2.2.1.25. Choose the right plant for the right place. 2.2.1.26. Use a taxonomic key to classify the plants. 2.2.1.27. Produce herbarium of woody ornamental plants. 2.2.1.28. Determine the life form of ornamental plants. 2.2.1.29. Determine the botanical name of the plant, determine the decoration value of the plant in different periods of vegetation. 2.2.1.30. Determine the characteristic form of growth – the habitus of the plant. 2.2.1.31. Produce a table of cold – resistant plants. 2.2.1.32. Classify shrubs by flowering time and determine their utility value. 2.2.1.33. Propose the basic care of ornamental plants.

2.3. Module content broken down in detail by session schedule (syllabus)					
Session	Minutes	Content	Learning outcome (2.2.)	Teaching method	Material
1	180 min	Trees. Identification of tree species (conifers, deciduous trees). Parallel to each type of plant, they learn about their care.	2.2.1.1 2.2.2.1 2.2.3.1	Frontal teaching Presentation Observation and comparison	Computer Projector Laboratory Herbarium Pictures of plants
2	180 min	Shrubs. Identification of different shrubs according to individual criteria (blooming, evergreen, plants in pots). According to the type of flowering of the shrubs, they learn about their care.	2.2.1.2 2.2.2.2 2.2.3.2	Frontal teaching Presentation Observation and comparison	Computer Projector Laboratory Herbarium Pictures of plants
3	90 min	Climbers. Recognition of different climbers and their characteristics (ways of climbing, grasping, leaning back…). While recognizing plants and their way of sprouting, learn also about the pruning methods.	2.2.1.3 2.2.1.4 2.2.1.5 2.2.2.3	Frontal teaching Presentation Observation and comparison Discussion	Computer Projector Laboratory Herbarium Pictures of plants
4	90 min	Growth requirements for trees. Nutrient and water requirements, growing conditions, position.	2.2.1.6 2.2.2.6 2.2.3.6	Frontal teaching Presentation Discussion Case studies	Field observation Worksheet
5	135 min	Exercises of pruning, cutting, clipping etc.	2.2.1.7 2.2.2.7 2.2.3.7	Frontal teaching/Field exercises Presentation/Exercises Discussion	Secateurs Pruning hand saw Work gloves

2.4. Participant responsibilities	2.4.1. Presence at the module: classroom, field and on-line sessions attendance followed by mutual learning, exchanges of experiences and cooperation. 2.4.2. Self-correcting quiz implementation. 2.4.3. Complete individual assignments. 2.4.4. Complete on-line survey at the end of the module. 2.4.5. Seminar paper on a selected topic.
2.5. Evaluation methods	2.5.1. Each of learning outcomes (in 2.2.) should be evaluated with at least 1 or 2 relevant questions/tasks/assignment using an on-line self-correcting quiz (reach the minimum 60 %). 2.5.2. Recommendation: The learning process should comprise exercises, tasks, presentations, reporting etc. during which the teacher can check the student's understanding and ability to carry out relevant tasks.
2.6. Quality assurance methods that ensure the acquisition of exit competences	2.6.1. On-line survey at the end of the module: - self-evaluation (students and teacher), - teacher evaluation (students), - learning process evaluation (students).

3. LITERATURE AND SOURCES

	Title	Availability
2.7. Required literature (available in the library and via other media)	Royal Horticultural Society. (1992). The Royal Horticultural Society Encyclopedia of Gardening. Dorling Kindersley. London.	
	Title	**Availability**
3.2 Recommended literature	Pawlak, G. (2000). Steinbachs großer Naturführer. Mosaik Verlag München.	
	Phillips, R. & Rix, M. (1994). Shrubs. Pan Books. London.	
	Pakenham, T. (2003). Bäume: Die 60 größten und ältesten Bäume der Welt. Christian Verlag. München.	
	Shigo, A. L. (1989). Tree pruning: A Worldwide Photo Guide. Shigo & Trees Associates. San Francisco.	

2.3 MODULE 3

Tree pathology

Module description:

Phytopathology (lat. "phyton" = plant; "pathos" = suffering; "logos" = study) is the study of diseases in plants. It focuses on pathogenic microorganisms and abiotic factors which cause diseases in plants, the mechanism of their emergence, interaction between causes and the diseased plant and disease control. Pathogens affect plants using enzymes, toxins or growth regulators to ensure their food. Classified as disease are morphological and physiological changes in plant characteristics, which threaten their development, decrease productivity and deteriorate the quality, resulting in plant deterioration. A disease is a pathological process which is a result of the interaction of the parasite, the host plant and the environmental factor. A disease is a series of visible and invisible responses of plant cells and tissue to pathogenic microorganisms or environmental factors which result in change of plant shape, function or integrity. The pathological process also includes the reaction of the plant to the pathogen, and that greatly depends on environmental factors.

1. BASIC INFORMATION			
1.1. Name of the module	Tree pathology	1.2. Hours	10 hours
1.3. Training programme	'Arboriculture for Gardeners'	1.4. Credits	/
2. LEARNING OBJECTIVES AND OUTCOMES			
2.1. Objectives	2.1.1. To identify diseases and pests on ornamental plants. 2.1.2. To develop a disease management plan. 2.1.3. To analyse infection phases and damage extent.		
2.2. Learning outcomes expected at the level of the module (knowledge, skills, competences)			
2.2.1. Knowledge At the end of the module the participant will be able to:	2.2.1.1. Differentiate between basic plant pathology concepts. 2.2.1.2. Define and classify pesticides. 2.2.1.3. Enumerate pesticide regulations. 2.2.1.4. Explain pesticide toxicity. 2.2.1.5. Get insight into pesticide handling safety measures. 2.2.1.6. Design direct plant protection measures. 2.2.1.7. Explain indirect plant protection measures. 2.2.1.8. Identify the most important diseases and pests. 2.2.1.9. Explain pest control measures.		

	2.2.1.10. Identify disease and damage symptoms. 2.2.1.11. Differentiate between parasitic and non-parasitic pests. 2.2.1.12. Explain biotic and abiotic plant damage. 2.2.1.13. Identify physiological plant disorders. 2.2.1.14. Perform basic methods and procedures of plant pathology diagnostics (sample preparation and analysis, pathogen isolation, microscopic preparations).
2.2.2. Skills At the end of the module the participant will be able to:	2.2.2.1. Determine the cause of plant damage. 2.2.2.2. Identify basic plant diseases and pests. 2.2.2.3. Predict recovery methods for pathogen-caused damage. 2.2.2.4. Implement adequate plant protection. 2.2.2.5. Individually prepare pathogen samples.
2.2.3. Competences At the end of the module the participant will have acquired the responsibility and autonomy and will be able to:	2.2.3.1. Define pathological state via plant inspection. 2.2.3.2. Select an adequate plant protection method according to the plant damage sample using biological principles. 2.2.3.3. Select and set plant protection devices.

2.3. Module content broken down in detail by session schedule (syllabus)

Session	Minutes	Content	Learning outcome (2.2.)	Teaching method	Material
1	45 min	Plant pathology – plant pathology – the term, plant diseases, causes and plant pests, pathogen transmission and spread. Biodiversity – importance and conservation – care for ecosystem biodiversity conservation. Plant stress - caused by abiotic and biotic factors, diseases and pests.	2.2.1.1. 2.2.1.8. 2.2.1.12. 2.2.2.1. 2.2.3.1.	Frontal teaching Presentation Discussion	Computer Projector Tree parts Paper Stationery
2	45 min	Disorders- plant damage causes, parasitic and non-parasitic diseases, symptoms of their presence. Abiotic factors – temperature, water and humidity, light, plant adaptation to abiotic factor changes, plant diseases. Biotic factors- intraspecific and interspecific relationships, diseases caused by biotic factors.	2.2.1.11. 2.2.1.13. 2.2.2.1.	Frontal teaching Group work Problem solving Presentation	Computer Projector Tree parts Paper Stationery

3	45 min	Exotic pathogens – disease causes and pests from a different climate, quarantine. Quarantine pests which appear in the EU area and others which are not yet detected.	2.2.1.11. 2.2.1.10. 2.2.2.1.	Presentation, Pair work Sample preparation Microscopic analysis Feedback	Computer Projector Parts of diseased plants Prepared samples of pests Paper Stationery Microscope Tools and materials for sample preparation Lab coat Disposable gloves and cap
4	90 min	Pathology Analysis – pathogen transmission and spread, analysis of disease causes, pest determination in the field and in laboratory conditions, parasitic and non-parasitic pests	2.2.1.11. 2.2.1.10. 2.2.1.12. 2.2.2.1. 2.2.2.2.	Presentation, Pair work Sample preparation Microscopic analysis Feedback	Computer Projector Parts of diseased plants Prepared samples of pests Paper Stationery Microscope Tools and materials for sample preparation Lab coat Disposable gloves and cap
5	45 min	Tree condition evaluation – leaf, crown and stem damage, colour change, plant vitality Plant inspection- plant inspection and determination of damage cause, fungi, bacteria, viruses or insects	2.2.1.9. 2.2.1.11. 2.2.2.1. 2.2.2.2.	Dendrology lab and field work Pair work	Parts of diseased plants Prepared samples of pests Paper Stationery Microscope

					Tools and materials for sample preparation Lab coat Disposable gloves and cap
6	90 min	Analysis – changes in ecological conditions, changes in urban forest, plant-water relations, climate and microclimate Soil Analysis – impact of micro and macro elements, drought and soil moisture, physiological plant disorders Biological analysis- biological factors which cause plant changes, soil fauna affecting plant pathology Pathological analysis – disease causes: fungi, bacteria, viruses, insects which cause plant damage, preparation of pathogen samples	2.2.1.14 2.2.1.12 2.2.1.6. 2.2.1.7. 2.2.2.2. 2.2.2.1.	Frontal teaching Group work Problem solving Presentation Dendrology lab and field work Microscopic analysis	Internet Parts of diseased plants Prepared samples of pests Paper Stationery Microscope Tools and materials for sample preparation Lab coat Disposable gloves and cap
7	90 min	Risk assessment and management – pest control, alternative methods of plant protection.	2.2.1.2. 2.2.1.3. 2.2.1.4. 2.2.1.5. 2.2.2.3. 2.2.2.4.	Frontal teaching Group work Problem solving Presentation	Various measuring devices (scale, measuring cylinder) Tools for sample preparation Brochures for plant protection product use Protective clothing

2.4. Participant responsibilities	2.4.1. Presence at the module: classroom, field and on-line sessions attendance followed by mutual learning, exchanges of experiences and cooperation. 2.4.2. Self-correcting quiz implementation. 2.4.3. Complete individual assignments. 2.4.4. Complete on-line survey at the end of the module. 2.4.5. Seminar paper on a selected topic.
2.5. Evaluation methods	2.5.1. Each of learning outcomes (in 2.2.) should be evaluated with at least 1 or 2 relevant questions/tasks/assignment using an on-line self-correcting quiz (reach the minimum 60 %).

	2.5.2. Recommendation: The learning process should comprise exercises, tasks, presentations, reporting etc. during which the teacher can check the student's understanding and ability to carry out relevant tasks.
2.6. Quality assurance methods that ensure the acquisition of exit competences	2.6.1. On-line survey at the end of the module: - self-evaluation (students and teacher), - teacher evaluation (students), - learning process evaluation (students).

3. LITERATURE AND SOURCES

	Title	Availability
3.1. Required literature (available in the library and via other media)	Butin, H. & Brand, T. (2017). Farbatlas Gehölzkrankheiten: Ziersträucher, Allee- und Parkbäume. Ulmer Verlag. Stuttgart.	https://www.ulmer.de/usd-5415942/gehoelzkrankheiten-.html
	Hartmann, G. & Butin, H. (2017). Farbatlas Waldschäden: Diagnose von Baumkrankheiten. 4. aktualisierte und ergänzte Auflage. Ulmer Verlag. Stuttgart.	https://www.ulmer.de/usd-5415958/waldschaeden-.html
	Callan, B. (2001). Introduction to Forest Diseases. Pacific Forestry Centre. Victoria.	https://www.kcgov.us/DocumentCenter/View/1374/Introduction-to-Diseases-Canadian-FSFPL-54-PDF
	Agrio, G. (2005). Plant Pathology. Elsevier Academic Press USA. Burlington.	https://booksite.elsevier.com/samplechapters/9780120445653/0120445654_FM.pdf
	Roloff, A. (2019). Baumpflege. Ulmer Verlag. Stuttgart.	https://www.ulmer.de/usd-6119797/baumpflege-.html
	Brandstetter, M. et al. (2018). Holz zerstörende Pilze. BFW. Wien.	

	Title	Availability
3.2 Recommended literature	Encouraging Participation	https://gsi.berkeley.edu/gsi-guide-contents/discussion-intro/participation/ c
	Group Work: Design Guidelines	https://gsi.berkeley.edu/gsi-guide-contents/discussion-intro/group-guidelines/
	Group Work: Techniques	https://gsi.berkeley.edu/gsi-guide-contents/discussion-intro/group-techniques
	Classroom Activities	https://gsi.berkeley.edu/gsi-guide-contents/discussion-intro/activities/

2.4 MODULE 4

Tree care operations and work safety

Module description:

The module comprises basic legislation, standards, regulations and procedures on tree care operations and work safety. Tree care operations measures; planting, irrigation, fertilisation, pruning, canopy cabling and bracing, tree protection during construction, soil improvement and tree felling are presented. In addition, topics on tree care techniques such as the use of appropriate equipment, tree climbing, rigging, aerial rescue and working with moving elevated working platforms (MEWPs) are included. Safety at work, the use of personal protective equipment (PPE), workplace preparation, workplace safety, safe working practices, road safety and biosecurity measures are highlighted.

1. GENERAL INFORMATION			
1.1. Name of the module	Tree care operations and work safety	1.2. Hours	30 hours
1.3. Training programme	'Arboriculture for Gardeners'	1.4. Credits	/
2. OBJECTIVES AND LEARNING OUTCOMES			
2.1. Objectives	2.1.1. To plan, organise and apply the principles of tree care operations and work safety.		
2.2. Learning outcomes expected at the level of the module (knowledge, skills, competences)			
2.2.1. Knowledge At the end of the module the participant will be able to:	2.2.1.1. Describe relevant legislation concerning trees in an urban environment on different hierarchical levels of government. 2.2.1.2. Understand the importance of standards and best management practice for tree care operations and work safety. 2.2.1.3. Describe different techniques and procedures for planting trees. 2.2.1.4. Recognize the signs of poor planting 2.2.1.5. Define the requirements of newly planted trees. 2.2.1.6. Describe why irrigation is essential for urban settings. 2.2.1.7. Outline the different forms of fertiliser and their advantages and disadvantages. 2.2.1.8. Describe pruning techniques and operations. 2.2.1.9. Summarise the objectives of pruning.		

	2.2.1.10. Describe the techniques and materials used in cabling and bracing. 2.2.1.11. Present an overview of how construction damage can directly or indirectly cause injury to or death of trees. 2.2.1.12. Explain different methods for soil improvement. 2.2.1.13. Summarise steps required to safely fell a tree. 2.2.1.14. Describe the preparation and procedures used before felling a tree 2.2.1.15. List common equipment, tools and machinery and their applications. 2.2.1.16. List the components of a comprehensive tree and site pre-climb assessment. 2.2.1.17. Explain various techniques for rope installation in a tree. 2.2.1.18. Describe the methods employed by tree climbers to move within a tree crown. 2.2.1.19. Understand rigging terms and concepts. 2.2.1.20. Discuss the rigging principles, as well as the tools and methods used. 2.2.1.21. Outline aerial rescue procedure. 2.2.1.22. Describe the steps of assessing an emergency situation. 2.2.1.23. Discuss advantages and limitations of MEWP use. 2.2.1.24. Explain the use of MEWP in tree work procedures. 2.2.1.25. List the components of PPE. 2.2.1.26. Summarise the fundamentals of worksite safety. 2.2.1.27. Present arguments for consistent use of preventative measures in order to avoid work related accidents. 2.2.1.28. Explain the hazard associated with work operations in traffic vicinity. 2.2.1.29. Describe biosecurity measures for reducing risk of transmitting pests and diseases. 2.2.1.30. Discuss the importance of preventative biosecurity strategies.
2.2.2. Skills At the end of the module the participant will be able to:	2.2.2.1. Orally present various viewpoints regarding urban tree related legislation. 2.2.2.2. Differentiate between a tree care standard and best management practice. 2.2.2.3. Discuss measures taken as part of establishment and early care of newly planted trees. 2.2.2.4. Determine the various planting stock types, the appropriate planting techniques for each, and the benefits and drawbacks of each. 2.2.2.5. Present the steps taken to establish and care for newly planted trees. 2.2.2.6. Design an irrigation regime for selected trees. 2.2.2.7. Discuss common issues that may arise with fertilisation. 2.2.2.8. Perform appropriate pruning operation according to objective. 2.2.2.9. Execute different types of pruning cuts and explain when to use them. 2.2.2.10. Demonstrate various techniques of cabling and bracing installation. 2.2.2.11. Analyse the impact of construction damage on trees.

	2.2.2.12. Discuss steps you can take to reduce soil compaction. 2.2.2.13. Display different types of notches and back cuts. 2.2.2.14. Perform simulated safe tree felling procedure. 2.2.2.15. Recognize various components of equipment, tools and machinery and understand how they are used. 2.2.2.16. Discuss the advantages and limitations of using various rope anchors. 2.2.2.17. Perform tree assessment for safe work and identify safety risks. 2.2.2.18. Tie various arborist knots and hitches and explain their usage. 2.2.2.19. Tie common knots used in rigging applications. 2.2.2.20. Choose the proper rigging methods for basic branch removal situations. 2.2.2.21. Organise and perform simulated aerial rescue procedures. 2.2.2.22. Assemble a rescue kit suitable for various situations. 2.2.2.23. Select an appropriate MEWP for a dedicated task. 2.2.2.24. Demonstrate MEWP set up procedure. 2.2.2.25. Perform PPE inspection. 2.2.2.26. Sketch work site organisation and suggest safety requirements. 2.2.2.27. Perform the job briefing for a specific worksite. 2.2.2.28. Demonstrate the importance to use various forms of communication when performing work in proximity to traffic. 2.2.2.29. Perform appropriate biosecurity measures for a given situation. 2.2.2.30. Demonstrate equipment and tool cleaning and disinfecting procedures.
2.2.3. Competences At the end of the module the participant will have acquired the responsibility and autonomy and will be able to:	2.2.3.1. Explain how trees in an urban environment are represented in legislation on different levels of government. 2.2.3.2. Implement appropriate standard and best management practice for selected tree care operations. 2.2.3.3. Explain the benefits and drawbacks of staking or guying newly planted trees. Explain the methods employed and when staking is suitable. 2.2.3.4. Recommend corrections for bad planting techniques. 2.2.3.5. Explain how the use of appropriate techniques affect survival and establishment of a newly planted tree. 2.2.3.6. Review the various irrigation practices and their benefits and drawbacks. 2.2.3.7. Evaluate the methods and guidelines for prescribing fertilisation. 2.2.3.8. Specify and set pruning objectives in consideration of various aspects. 2.2.3.9. Create pruning guidelines using best management practices. 2.2.3.10. Suggest and specify appropriate cabling/bracing system for a selected tree. 2.2.3.11. Define the steps to take to prevent tree damage while construction is taking place. 2.2.3.12. Provide soil improvement management plan. 2.2.3.13. Discuss the benefits and drawbacks of regularly used felling notches.

	2.2.3.14. Describe how the hinge created by the rear cut and notch influences a tree's fall. 2.2.3.15. Select appropriate equipment, tools and machinery for specific applications. 2.2.3.16. Choose suitable climbing ropes and knots for a given situation. 2.2.3.17. Compare different climbing systems. 2.2.3.18. Clarify the principles of establishing an anchor. 2.2.3.19. Select the appropriate application of different rigging equipment and techniques and describe how they increase safety and efficiency in lowering limbs. 2.2.3.20. Explain how rigging forces are affected by the methods used. 2.2.3.21. Identify the common arborist injuries and infer response priorities. 2.2.3.22. Specify the appropriate emergency response approaches. 2.2.3.23. Justify the use of MEWP. 2.2.3.24. Explain the necessity for a MEWP operator to be trained and competent. 2.2.3.25. Select appropriate components of PPE according to the type of work to be performed. 2.2.3.26. Explain worksite organisation regarding safe work practices. 2.2.3.27. Apply safe work practice for various work procedures. 2.2.3.28. Apply traffic safety measures according to relevant legislation. 2.2.3.29. Assess different biosecurity measures. 2.2.3.30. Create a biosecurity protocol for a specific situation.

2.3. Module content broken down in detail by session schedule (syllabus)

Session	Minutes	Content	Learning outcome (2.2.)	Teaching method	Material
1	45 min	Relevant legislation on different hierarchical levels of government; international, national, regional and local.	2.2.1.1 2.2.2.1 2.2.3.1	Frontal teaching Presentation Discussion	Computer Projector
2	45 min	Standards and best management practices for tree care operations and work safety in arboriculture; on different hierarchical levels of government international, national, regional and local.	2.2.1.2 2.2.2.2 2.2.3.2	Frontal teaching Presentation Discussion	Computer Projector
3	135 min	Planting techniques and procedures according to current best management practice and standards. Requirements of newly planted trees. Planting problems and symptoms of poor practice. Types of planting stock.	2.2.1.3 2.2.1.4 2.2.1.5 2.2.2.3	Frontal teaching Presentation Sample preparation Discussion	Computer Projector Pictures of trees/technique

			2.2.2.4 2.2.2.5 2.2.3.3 2.2.3.4 2.2.3.5		
4	45 min	Basic principles of water influence on plant growth and health. Factors that affect water loss from plants. Importance of irrigation for urban green spaces and description of various irrigation methods. Irrigation plan design.	2.2.1.6 2.2.2.6 2.2.3.6	Frontal teaching Presentation Discussion Case studies	Computer Projector Worksheets
5	45 min	Basic principles of plant nutrient needs, deficiencies and toxicities. Description of fertiliser sources and types. Fertilisation treatment plan design.	2.2.1.7 2.2.2.7 2.2.3.7	Frontal teaching/Field exercises Presentation Discussion	Laboratory Worksheets
6	90 min	Pruning objectives and trees' response to pruning. Procedures and techniques used in pruning. Branch removal methods and main pruning operations. General considerations.	2.2.1.8 2.2.1.9 2.2.2.8 2.2.2.9 2.2.3.8 2.2.3.9	Demonstration of various techniques of pruning Observation and field exercise Discussion	Scissors Handsaw Gloves
7	45 min	Methods for tree stabilisation and justification for their use. Trees' response to installed materials in the tree crown. Record keeping, controls maintenance and replacement.	2.2.1.10 2.2.2.10 2.2.3.10	Frontal teaching/Displays Demonstration Observation and field exercise Discussion	Worksheets
8	45 min	Assessment of construction related damage to trees. Preservation measures for trees on construction sites before, during and after construction procedures.	2.2.1.11 2.2.2.11 2.2.3.11	Frontal teaching Demonstration of various technique Observation and field exercise Discussion	Worksheets
9	45 min	Soil improvement measures that can be taken to mitigate soil compaction, nutrient deficiency and drainage problems.	2.2.1.12 2.2.2.12 2.2.3.12	Frontal teaching Presentation Observation and field exercise	Worksheets

				Discussion	
10	90 min	Tree condition and site assessment and precautions. Steps in procedure of safe tree felling. Types of notches and back cuts. Hinge function and examples of poor practice. Techniques for limbing and bucking felled trees.	2.2.1.13 2.2.1.14 2.2.2.13 2.2.2.14 2.2.3.13 2.2.3.14	Frontal teaching Presentation Field trips Discussion	Computer projector Worksheets
11	45 min	Equipment, tools and machinery for specific tree work applications. Equipment inspection, care and storage.	2.2.1.15 2.2.2.15 2.2.3.15	Frontal teaching Presentation Discussion	Computer Projector Worksheets – review questions
12	135 min	Planning and management of tree climbing. Pre-climb inspection of climbing equipment. Tree condition and site assessment and precautions. Methods and techniques for rope installation, entering and positioning in the tree. Common arborist knots and hitches.	2.2.1.16 2.2.1.17 2.2.1.18 2.2.2.16 2.2.2.17 2.2.2.18 2.2.3.16 2.2.3.17 2.2.3.18	Frontal teaching Presentation Field displays Discussion	Computer Projector Climbing equipment Worksheets
13	90 min	Planning rigging operations. Pre-work inspection of rigging equipment. Tree condition and site assessment and precautions. Rigging techniques and mechanical advantage. Anchor selection - forces and friction. System components, knots and slings.	2.2.1.19 2.2.1.20 2.2.2.19 2.2.2.20 2.2.3.19 2.2.3.20	Frontal teaching Field displays Discussion	Computer Projector Fastening and tying equipment Worksheets
14	90 min	Planning and management of aerial rescue practice. Rescue procedure and rescue plan. Risk assessment and precautions. Common rescue methods. Casualty support, control and handover. Emergency rescue from a MEWP and Aerial rescue of a climber using a MEWP.	2.2.1.21 2.2.1.22 2.2.2.21 2.2.2.22 2.2.3.21 2.2.3.22	Frontal teaching Discussion	Computer projector Field displays
15	90 min	Planning and management of MEWP use. General considerations of MEWP selection. MEWP set – up and use for tree work.	2.2.1.23 2.2.1.24 2.2.2.23	Frontal teaching Demonstration of various technique	Computer Projector

			2.2.2.24 2.2.3.23 2.2.3.24	Discussion	
16	45 min	Components of equipment that make up PPE according to specific work procedures. PPE inspection, care and storage.	2.2.1.25 2.2.2.25 2.2.3.25	Frontal teaching Demonstration of various technique Discussion	Computer Projector
17	45 min	Planning and preparation of work site. Work site risk assessment and precautions. Job briefing meeting organisation. Procedures in case of accidents.	2.2.1.26 2.2.2.26 2.2.3.26	Frontal teaching Demonstration of various technique/ Field displays Discussion	Computer Projector
18	45 min	Safe work procedures for operating machinery and tool use. Ergonomic body positioning during job execution.	2.2.1.27 2.2.2.27 2.2.3.27	Frontal teaching Display practices Discussion	Computer Projector
19	45 min	Traffic safety measures according to relevant legislation. Forms of communication when performing work in proximity to traffic.	2.2.1.28 2.2.2.28 2.2.3.28	Frontal teaching Display of different practices/Field displays Discussion	Computer Projector Worksheets
20	90 min	Biosecurity measures for reducing risk of transmitting pests and diseases. Preventative biosecurity strategies and biosecurity protocol. Equipment and tool cleaning and disinfecting procedures.	2.2.1.29 2.2.1.30 2.2.2.29 2.2.2.30 2.2.3.29 2.2.3.30	Presentation Pair work	Worksheets

2.4. Participant responsibilities	2.4.1. Presence at the module: classroom, field and on-line sessions attendance followed by mutual learning, exchanges of experiences and cooperation. 2.4.2. Self-correcting quiz implementation. 2.4.3. Complete individual assignments. 2.4.4. Complete on-line survey at the end of the module. 2.4.5. Seminar paper on a selected topic.
2.5. Evaluation methods	2.5.1. Each of learning outcomes (in 2.2.) should be evaluated with at least 1 or 2 relevant questions/tasks/assignment using an on-line self-correcting quiz (reach the minimum 60 %). 2.5.2. Recommendation: The learning process should comprise exercises, tasks, presentations, reporting etc. during which the teacher can check the student's understanding and ability to carry out relevant tasks.

2.6. Quality assurance methods that ensure the acquisition of exit competences	2.6.1. On-line survey at the end of the module - self-evaluation (students and teacher), - teacher evaluation (students), - learning process evaluation (students).	
3. LITERATURE AND SOURCES		
3.1. Required literature (available in the library and via other media)	**Title**	**Availability**
	European Arboricultural Council. (2016). European Tree Worker. 7th edition. Patzer Verlag. Hannover.	
	Lilly, S. J. et al. (2022). Arborists' Certification Study Guide. 4th Edition. International Society of Arboriculture. Atlanta.	
3.2 Recommended literature	**Title**	**Availability**
	Lilly, S. J. & Julius, A. K.. (2021). Tree Climber's Guide. 4th Edition. International Society of Arboriculture. Atlanta.	
	Jepson, J. (2018). The Tree Climber's Companion. Beaver Tree Publishing. Longville.	
	Working group "Technical Standards in Tree Work (TeST). (2021). European Tree Pruning Standard. European Arboricultural Standards (EAS).	
	Working group "Technical Standards in Tree Work (TeST)". (2022). European Tree Cabling/Bracing Standard EAS 03:2022. European Arboricultural Standards (EAS).	
	Working group "Technical Standards in Tree Work (TeST)". (2022). European Tree Planting Standard EAS 02:2022. European Arboricultural Standards (EAS).	
	Hirons, A. D. & Thomas, P. A. (2018). Applied Tree Biology. Wiley. Hoboken.	