Course name:
TREE-RING DATING

ECTS	2
Course status	*optional, facultativ*
Course final assessment /evaluation of outcomes	*graded credit*
Prerequisite	graduated first degree programs such as Bachelor (BA or BSc.) degree in forestry, environmental protection and related fields and graduates of the academies of fine arts or archeology

Main field of study*: *Forestry

Educational profile	General academic
Code of studies and education level	MSc
Semester of studies	winter / summer
Language of instruction	English

Course offered by:

Name of faculty offering the course	Faculty of Forestry
Name of department offering the course	Department of Forest Ecosystems Protection
Course coordinator	Bartłomiej Bednarz PhD, DSc. Eng.

Learning outcomes:

Symbol of outcome	Description of the learning outcome	Reference to main field of study outcomes	Area symbol*
KNOWLEDGE – student knows and understands			
LES_TREEDAT_W01	basic knowledge of dendrochronology in the world and in Poland, and defines concepts in the field of annual rings analysis. Characterizes and distinguishes research materials and is able to assess their usefulness in dendrochronological studies. Is able to describe the methods used in dendrochronology and knows the techniques of sampling from live trees and historical material. Describes the consequences of sampling for living trees and historical objects.	LES2_W04 LES2_W05 LES2_W06	RL
LES_TREEDAT_W02	basic knowledge of the principles of analysis of research material in dendrochronology. Knows the tools and techniques for preparing material for dendrochronological studies. Describes the principles of counting tree-rings as well as techniques and devices used to measure the tree-ring widths.	LES2_W04 LES2_W05 LES2_W06	RL
LES_TREEDAT_W03	the principles of tree-ring widths analysis and dating in dendrochronological practice. Defines the theoretical basis for creating curves illustrating the variability of ring widths, including real, absolutely dated and standardized chronologies.	LES2_W04 LES2_W05 LES2_W06	RL
LES_TREEDAT_W04	the wood dating methods and defines the most common factors affecting the accuracy of dating. Selects the right tools and methodology for dendrochronological dating. Lists examples of the	LES2_W04 LES2_W05 LES2_W06	RL

	use of wood dating in architecture, art, lutherie, painting, architecture as well as administrative and judicial proceedings.		
SKILLS – student is able to			
LES_TREEDAT_U01	correctly select, use and maintain tools used in field work. Correctly choosing trees for sampling and acquires material for dendrochronological analyzes. Uses alternative, uninvasive methods of data collection to analyze the tree-rings of structural and historic wood. Colect samples from alive trees and historical wood. Correctly labeling and protects research material during transport and storage.	LES2 _U04	RL
LES_TREEDAT_U02	prepare wood samples for dendrochronological analyzes and is able to correctly make the cross-section of tree-rings. Can use a variety of methods to highlight the tree-rings boundaries. Measure the annual rings using traditional methods and based on digital image analysis.	LES2 _U04	RL
LES_TREEDAT_U03	digitize tree-rings and supports digital incremental tools. Measures, transforms and analyzes data using the programs CooRecorder, CDendro. Verifies the results obtained by dendrochronological analysis for the occurrence of measurement errors. Is able to transform data and create individual and site, real and normalized tree-ring chronology.	LES2 _U04	RL
LES_TREEDAT_U04	perform dating by visual method and using the programs CDendro and CooRecorder. Assesses the correctness of dating based on statistical indicators. Is able to determine the degree of similarity by using percentage similarity index, correlation coefficients and t- test. Prepares opinions and expertise in the field of dendrochronological dating.	LES2 _U04	RL
SOCIAL COMPETENCIES – student is ready to:			
LES_TREEDAT_K01	constantly update his knowledge. Can interact, work and coordinate the performance of tasks in the group.	LES2 _K01	RL
LES_TREEDAT_K02	underline the importance and understand the non-technical aspects and effects of the activities carried out and its impact on the environment and the associated responsibility for decisions. Is able to think and act in an entrepreneurial way.	LES2 _K02	RL

Teaching contents

Lectures	**6 hours**
Topics	General introduction to dendrochronology. Dendrochronology in the world and in Poland, and as a scientific discipline and method. Basic concepts in dendrochronology. Research material and its characteristics. The state of preservation of historical wood and its usefulness in dendrochronological research. Sampling for the construction of tree-ring chronologies from trees and historical material. Material analysis - tools, instruments, anatomical techniques, sample transport and storage. Consequences of sampling for living trees and wooden objects. Preparation of the samples for tree-ring widths measuring - tools and techniques of preparation. Strategies for preparing wood samples

	for dendrochronological analyzes. Rules for the correct execution of the cross-section of tree-rings. Practical ways to enhance the pattern of tree-rings. Measurement of the tree-ring widths - techniques and devices. Construction of curves illustrating the variability of the tree-ring widths - raw, absolutely dated and standardized chronologies. Wood dating methods. Problems in dendrochronological dating. Factors affecting the dendrochronological dating success. Methodology of wooden objects sampling for dating. Analysis of the tree-ring widths and dendrochronological dating in practice. Selected computer programs used to dendrochronological dating procedures.
Accomplished learning outcomes	LES_TREEDAT_W01, LES_TREEDAT_W02, LES_TREEDAT_W03, LES_TREEDAT_W04, LES_TREEDAT_K01,
Means of verification, rules and criteria of assessment	Based on lecture attendance, the proportion of the mark for lecture attendance in the final course evaluation is 10%.
Classes:	**14 hours**
Topics	Strategies of wood samples preparing for dendrochronological analyzes. The rules for the correct execution of tree-ring cross-section. Principles of the correct measurement of tree-rings using traditional methods and based on digital image analysis. Tree-ring digitizing methods. Measurement, transformation and analysis of data using CooRecorder® and CDendro® programs. The most common errors made during tree-rings measurements and their verification. Measurement data transformation in the Tucson standard. Transformation of the tree-ring widths data and the construction of a real and standardized individual and site chronologies. Dating by visual method and supported by use of CDendro® program. Assessment of dating accuracy on the basis of statistical indicators. Methods for determining the degree of similarity in the tree-ring chronologies comparison (percentage similarity and correlation coefficients, t-test coefficient). Principles of preparing opinions and expertise in the field of dendrochronological dating.
Accomplished learning outcomes	LES_TREEDAT_U01, LES_TREEDAT_U02, LES_TREEDAT_U03, LES_TREEDAT_U04, LES_TREEDAT_K02,
Means of verification, rules and criteria of assessment	Completion of projects (dating of selected objects) for assessment, evaluation of activity and skills, the share of a mark from the exercise in the final evaluation is 70%.
Field exercises	**10 hours**
Topics	Principles of using the Pressler drill, its sharpening and maintenance. Alternative, minimally invasive methods of collecting data as a part of the tree-ring widths analysis of the construction and historic wood. Principles of proper selection of trees for dendrochronological research and collection of material for dendrochronological analyses. Sampling the trees. Historical wood sampling techniques for dendrochronological dating. Preparation and securing of cores. Preservation of the collected material. Correct labelling and securing the material during transport and storage. Preliminary wood preparation for the analysis of the tree-ring widths.
Accomplished learning outcomes	LES_TREEDAT_U01, LES_TREEDAT_K01, LES_TREEDAT_K02,
Means of verification, rules and criteria of assessment	Assessment of group activity and skills, the participation of the positive grade from the completion of the exercises in the final evaluation is 20%.

References:

Basic	Schweingruber F.H. (1983). Tree Rings. Basics and Applications of Dendrochronology. Kluwer Academic Publishers, Dordrecht, Holland. Schweingruber F.H. (1993). Trees and Wood in Dendrochronology. Morphological, Anatomical, and Tree-Ring Analytical Characteristics of Trees Frequently Used in Dendrochronology. Springer-Verlag, Berlin Heidelberg, New York, London Paris Tokyo, HongKong Barcelona Budapest. Ważny T., (2001). Dendrochronologia obiektów zabytkowych w Polsce. Muzeum Archeologiczne w Gdańsku, Gdańsk. Zielski A., Krąpiec M. (2004). Dendrochronologia. PWN, Warszawa.
Supplementary	Bednarz, Z., 1998. Przykład wykorzystania metod dendrochronologicznych do datowania obiektów sztuki lutniczej. Sylwan 142 (7):89-97. Baillie, M.G.L., 1982. Tree ring dating and archaeology. London, Canberra: Croom Heim. Eckstein, D., Ważny, T.„Bauch, J., Klein, P., 1986. New evidence for the dendrochronological dating of Netherlandish paintings. Nature 320:465-466.

Structure of learning outcomes

Area of academic study: R – Agricultural sciences, L - Forestry	2	ECTS

Structure of student activity

Contact hours		35	hrs.	1.4	ECTS**
Including:	lectures	6	hrs.		
	classes and seminars	24	hrs.		
	consultations	3	hrs.		
	participation in research	…	hrs.		
	obligatory traineeships		hrs.		
	participation in examination	2	hrs.		
e-learning		…	hrs.	….	ECTS**
student own work		15	hrs.	0.6	ECTS**

*Areas of academic study in the fields of: H- humanities; S - social studies; P – biological sciences; T – technological sciences; M- medical, sport and health sciences; R – Agricultural, forestry and veterinary sciences; A – the arts
** stated with an accuracy to 0.1 ECTS, where 1 ECTS = 25 - 30 hours of classes