Georg-August-Universität
Göttingen

# Modulverzeichnis

## zu der Prüfungs- und Studienordnung für den konsekutiver Master-Studiengang "Forest and Ecosystem Sciences" (Amtliche Mitteilungen 44/2020 S. 835)

# Module

# Übersicht nach Modulgruppen

## I. Master's degree programme "Forest and Ecosystem Sciences"

At least 120 C must be succesfully completed within the following regulations.

### 1. Specializations

At least 90 C must be succesfully completed within a spezialization.

#### a. Specialization "Ecosystem Analysis and Modelling"

##### aa. Mandatory modules

The following ten modules amounting to a total of 66 C must be successfully completed:



##### bb. Area of professionalisation

The successful completion of optional modules with a total scope of 24 C is obligatory, including key competencies with a scope of 6 to 12 C. The modules listed under number 2 can be selected as optional modules. Key competencies can be selected from modules listed in the Module Handbook Key Competencies issued by the Universität Göttingen.

#### b. Specialization "Ecosystem Sciences"

##### aa. Mandatory modules

The following ten modules amounting to a total of 66 C must be successfully completed:

### bb. Area of professionalisation

The successful completion of optional modules with a total scope of 24 C is obligatory, including key competencies with a scope of 6 to 12 C. The modules listed under number 2 can be selected as optional modules. Key competencies can be selected from modules listed in the Module Handbook Key Competencies issued by the Universität Göttingen.

## c. Specialization "Tropical and International Forestry"

### aa. Mandatory modules

The following nine modules amounting to a total of 60 C must be successfully completed:



### bb. Area of professionalisation

The successful completion of optional modules with a total scope of 30 C is obligatory, including key competencies with a scope of 6 to 12 C. The modules listed under number 2 can be selected as optional modules. Key competencies can be selected from modules listed in the Module Handbook Key Competencies issued by the Universität Göttingen.

## 2. Elective modules

The following list of elective modules can be selected within the area of professionalisation.

It is also possible to choose modules from the mandatory modules of the other specializations if they are not part of the mandatory modules of the own chosen specialization. Students can not chose the project modules M.FES.131 or M.FES.231 or M.FES.331 as elective modules.



## 3. Master thesis

Completion of the Master's thesis is worth 30 C.

| **Georg-August-Universität Göttingen**<br>**Module M.FES.111: Introduction to Ecological Modelling** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Basic knowledge of classic and modern approaches for modelling dynamics of populations and communities. Skilled in analytical thinking, independent application of models for practical research questions, development of simple models, and critical assessment of the possibilities and limitations of different modeling approaches. Ability to develop an effective model concept. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
|---|---|

| **Course: Introduction to ecological modelling** (Lecture, Exercise)<br>*Contents*:<br>Using examples from ecology in general and forest ecology in specific, we will cover the following modelling approaches and types: population growth (considering demographic and environmental noise, scramble and contest competition), metapopulation models, predator-prey models, forest growth models, patterns and dynamics of biodiversity, island biogeography, life tables, matrix models, individual-based models, and spatial models. We will also address how to develop a model concept. The course will consist of a mixture of lectures and hands-on work on the computer. | 4 WLH |
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| **Examination: Term paper (max. 3 pages, 50%) and written examination (45 minutes, 50%)** | 6 C |

| **Examination requirements:**<br>Term paper: Ability to develop an effective model concept.<br>Written examination: Knowledge and understanding of essential characteristics of the modelling approaches covered in class. Ability to interpret model results. Knowledge of possibilities and limitations of the models. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Kerstin Wiegand |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>20 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.112: Biodiversity Measurement** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:** | **Workload:** |
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| Genetics of populations<br>This course will teach fundamental and applied genetic principles that are essential for the management of forest and other ecosystems to maintain their long-term health and sustainability. The course explores how genetic variation and its loss affect the ability of natural populations to adapt to changing environments. The class will focus on the interrelationship between human impact and evolutionary factors acting on genetic variation patterns in natural populations. Basic principles in population genetics (e.g. measurements of genetic variation, molecular markers techniques, the Hardy Weinberg model, changes in genetic variation by mutation, gene flow, genetic drift, selection) will be presented.<br>Biodiversity of fungi<br>The fungal kingdom consists of possibly up to 5.2 million distinct species of diverse ecological functions. Species biodiversity, evolution and modern taxonomy are defined in bar-coding projects by molecular markers (ITS sequences). Fungi with saprotrophic, symbiotic or pathogenic life styles differ much in their genomes by loss, gain, multiplication and diversification of genes for proteins providing important functions to deal with their specific habitats and substrates. Students will be introduced into computorial programs and DNA and protein databases to analyse fungal molecular markers, gene structures (introns, exons) and protein products (Fasta files, Clustal, MEGA, phylogenetic trees, Blast searches, Signal P)<br>Biodiversity of communities and ecosystems<br>The students learn about fundamental concepts how communities are structured and how their diversity and composition can be analyzed. Basic concepts of community structure (abundance, evenness, rarity), of different scales of diversity (alpha, beta, gamma) as well as of the different dimension of diversity (taxonomic, functional, phylogenetic) will be introduced. Students learn how to perform basic analyses of species diversity in the software package R. | Attendance time:<br>56 h<br>Self-study time:<br>124 h |

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| **Course: Genetics of populations** (Lecture, Exercise) | 2 WLH |
| **Course: Biodiversity of fungi** (Lecture, Exercise) | 1 WLH |
| **Course: Biodiversity of communities and ecosystems** (Lecture, Exercise) | 1 WLH |
| **Examination: Term Paper (max. 20 pages)** | 6 C |

| **Examination requirements:** | |
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| Students should demonstrate sound knowledge of basic concepts in population genetics and community structure, genetic diversity parameters, different scales and dimensions of diversity , methods of fungal biodiversity assessment and of basic analysis tools for biodiversity assessment. | |

| **Admission requirements:** | **Recommended previous knowledge:** |
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| none | none |
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Oliver Gailing |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.113: Soil Hydrology** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:** | **Workload:** |
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| The course consists of three interconnected parts.<br>The theoretical background (1) describes the fundamental static and dynamic principles of soil water, starting with the special physical properties of water molecules continuing with the basic static traits of soil water, e.g. water content and the energy state. The latter is important for the understanding and calculation of soil water flow under saturated and unsaturated conditions. The water balance of the soils will be completed by the potential sinks of soil water in ecosystems, like e.g. drainage, evaporation, root water uptake, and transpiration. The theoretical lectures will be accompanied by experimental exercises (2): lab measurements of bulk density, water content, water potential, conductivity, pF-curve are important parameters describing the state of soil water. Additionally, automated soil lysimeters with or without plants will be provided to the students for self-initiated experiments. The self-measured hydrological and meteorological time series data are the basis for the third part (3), the modelling of soil water cycles. Based on the learned experimental and theoretical skills, the basic principles of soil water modelling are explained and practiced. | Attendance time:<br>56 h<br>Self-study time:<br>124 h |

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| **Course: Soil Hydrology** (Lecture, Exercise, Practical course) | 4 WLH |
| **Examination: Term Paper (max. 20 pages)** | 6 C |

| **Examination requirements:** | |
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| Theoretical and experimental skills of soil hydrology | |

| **Admission requirements:** | **Recommended previous knowledge:** |
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| none | none |
| **Language:**<br>English | **Person responsible for module:**<br>Dr. Martin Jansen |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.114: Ecosystem - Atmosphere Processes** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Unterstanding the carbon and water cycle of terrestrial ecosystems requires a solid understanding of biogeophysical and biogeochemical processes at the ecosystem – atmosphere interface. These processes are directly affected by human induced alterations of the climate system such as climate change and land use.<br>In this course, the students will learn about ecosystem – atmosphere processes based on real datasets from forests and other terrestrial ecosystems. The student will be exposed to a quantitative analysis of the data and will gain basic insights into land surface modelling considering land use as well as climate change. | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Ecosystem – Atmosphere Processes** (Lecture, Seminar) | 2 WLH |
| **Course: Ecosystem – Atmosphere Processes** (Exercise) | 2 WLH |
| **Examination: Written examination (90 minutes)** | 6 C |

| **Examination requirements:**<br>The student will learn about biogeophysical and biogeochemical processes at the ecosystem – atmosphere interface. They will have the ability to formulate these processes in the programming language R and describe them quantitatively. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Alexander Knohl |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.115: Statistical Data Analysis with R** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Introduction to R as programming language for beginners, statistical data analysis including explorative data analysis, plotting, basic tests (t, F, non-parametric), ANOVA, simple linear regression, multiple regression, analysis of residuals, ANCOVA, non-linear regression, glms with focus on logistic regression, short introduction to tidyverse and ggplot; always including introduction to theory and to practical implementation in R. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Statistical data analysis with R** (Lecture, Exercise) | 4 WLH |
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| **Examination: Written examination (120 minutes)** | 6 C |

**Examination requirements:**

- Import data into a statistics software and perform an explorative data analysis
- Display data graphically
- Select appropriate statistical approaches or models for data analysis
- Discuss the advantages and disadvantages of statistical approaches or models
- Apply statistical approaches or models to given data
- Explain and test assumptions of statistical approaches or models
- Interpret the results of the data analysis
- Suggest meaningful follow-up analyses

| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Dr. Katrin Mareike Meyer |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>30 | |

**Additional notes and regulations:**
30 students are only possible if a corresponding number of computers is available

| **Georg-August-Universität Göttingen**<br>**Module M.FES.121: Advanced Data Analysis with R** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Advanced data analysis skills with program R. Topics of this module include data management and organization, working with spatio(temporal) data, visualization of data, and applying appropriate statistical modeling techniques. Modeling starts with a thorough review of the linear model. Subsequently situations where assumptions of the linear model are violated are shown and potential solutions are discussed. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Advanced data analysis with R** (Exercise) | 2 WLH |
| **Course: Advanced data analysis with R** (Lecture) | 2 WLH |
| **Examination: Written examination (120 minutes)** | 6 C |

| **Examination requirements:**<br>• Handle and organizing data sets (merging data from multiple sources, perform subsets and filter operations, calculate new variables)<br>• Work with spatial data (vector and raster), perform basic operations.<br>• Visualize data, choose appropriate models, validation and interpretation of models, and state potential caveats of models used. | |
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| **Admission requirements:**<br>M.Forest.1115: Statistcal Data Analysisi with R | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Dr. Johannes Signer |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>30 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.122: Ecological Simulation Modelling** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>• Knowledge of the modelling techniques covered;<br>• Ability to find a suitable modeling technique for a given problem in the area of ecology and to apply it independently;<br>• Knowledge of the current state of research in ecological modelling;<br>• Critical appreciation and discussion of research results;<br>• Refined presentation techniques;<br>• Knowledge of constructive feedback techniques. | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Simulation modelling** (Lecture, Exercise) | 3 WLH |
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| **Course: Current Topics in Ecological Modelling** (Seminar) | 1 WLH |
| **Examination: Term paper (max. 10 pages, 75%) and presentation (approx. 20 minutes) with written outline (25%)** | 6 C |

| **Examination requirements:**<br>• Know, explain, apply, analyse and assess model types that are applied in ecology<br>• Know, explain, apply, analyse and assess the stages of model development along the modeling cycle<br>• Understand and summarize published model studies and point out and discuss their possibilities and limitations<br>• Moderate presentations and discussions | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
|---|---|
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Kerstin Wiegand |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>20 | |

**Additional notes and regulations:**

20 students are only possible if a corresponding number of computers is available.

Module is also applicable for other study programs, such as MSc "Biological Diversity and Ecology", MSc "Agriculture" (specialization Ressourcenmanagement).

| **Georg-August-Universität Göttingen**<br>**Module M.FES.123: Functional-Structural Plant Models** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Basic knowledge and understanding of ecophysiological foundations for FSPM (functional-structural plant models) and of the corresponding frameworks from computer science (formal grammars, rule-based programming paradigm, software tools); assessment of the possibilities and limits of FSPMs; ability to analyse an FSPM and to parameterize it based on one's own data; acquaintance with methods of simulation and visualization. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Functional-Structural Plant Models** (Lecture, Exercise)<br>*Contents*:<br>Overview about FSPMs; Lindenmayer systems, graph grammars and basic features of rule-based modelling and programming, e.g. in the language XL; software tools for FSPMs (e.g., the platform GroIMP – partially supported by eLearning units); basic knowledge about physiological processes, e.g., photosynthesis; approaches for modelling plant architecture, processes and the linkage of structure and function in plants; basics about data acquisition of morphological and physiological traits of woody plants; digital representation of measured branching systems and of selected processes; analysis, parameterization, modification and evaluation of an existing FSPM.<br>*Form:* Lectures and exercises (weekly) and practical work (measurement campaign: block course). | 4 WLH |
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| **Examination: Term Paper (max. 20 pages)** | 6 C |

| **Examination requirements:**<br>To show basic knowledge and understanding of ecophysiological foundations for FSPM (functional-structural plant models) and of the corresponding frameworks from computer science (formal grammars, rule-based programming paradigm, software tools); assessment of the possibilities and limits of FSPMs; ability to analyse an FSPM and to parameterize it based on one's own data; acquaintance with methods of simulation and visualization. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Winfried Kurth |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.124: Modern Concepts and Methods in Macroecology and Biogeography** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>The course will introduce students to the principles and modern methods in macroecology and biogeography. Students will gain a comprehensive understanding of the physical and biological processes influencing species distributions and diversity patterns worldwide. Additionally, students will be introduced to modern environmental and biodiversity modelling methods in R, which are important for analyzing and understanding the consequences of global change on species distributions. In self-directed projects, students will work with real data to solve modern macroecological problems. Through these theoretical and practical classes, students will gain a profound understanding of modern macroecological and biogeographical concepts, including threats to biodiversity and conservation prioritization. | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
|---|---|

| **Course: Modern concepts and methods in macroeco-logy and biogeography**<br>(Lecture, Exercise)<br>*Contents*:<br>Exercise = Computer course (3 WHL) and Lectures (1 WHL) | 4 WLH |
|---|---|
| **Examination: Term Paper (max. 20 pages)** | 6 C |

| **Examination requirements:**<br>Students can apply knowledge about modern concepts and methods in macroecology and biogeography. They demonstrate knowledge on how to plan, conduct and report on a macroecological analysis using modern computer software. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
|---|---|
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Holger Kreft |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.131: Project: Ecosystem Analysis and Modelling** | 12 C<br>2 WLH |
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| **Learning outcome, core skills:**<br>Usage of GIS and/or other software tools and modelling techniques to work on an interdisciplinary topic; autonomous acquisition of know-how and competencies for scientific problem solving; ability to interdisciplinary, strategic thinking; team work and organisation of tasks, scientific presentation and discussion; writing a final report in the style of a scientific article. | **Workload:**<br>Attendance time:<br>28 h<br>Self-study time:<br>332 h |
|---|---|

| **Course: Project: Ecosystem Analysis and Modelling**<br>*Contents*:<br>Each topic will be proposed by a researcher from the Faculty of Forest Sciences and Forest Ecology who will then be the principal supervisor for this topic. To ensure the interdisciplinary character of the project, a second supervisor should come from a department different from that of the principal supervisor.<br>A topic can be worked upon by a single student or (preferentially) by a team of two or three students. In the case of teamwork, the final report must contain sections which can be attributed to one individual author. | 2 WLH |
|---|---|

| **Examination: Presentation (approx. 20 minutes, 33 %) and term paper (max. 15 pages, 67%)** | 12 C |
|---|---|

| **Examination requirements:**<br>Ability to use GIS and/or other software tools and modelling techniques to work on an interdisciplinary topic; autonomous acquisition of know-how and competencies for scientific problem solving; ability to interdisciplinary, strategic thinking; team work and organisation of tasks, scientific (oral) presentation and discussion; writing a final report in the style of a scientific article. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
|---|---|
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Winfried Kurth |
| **Course frequency:**<br>each semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

**Additional notes and regulations:**
Will be coordinated by W. Kurth in the winter semester and by M. Jansen in the summer term.

| **Georg-August-Universität Göttingen**<br>**Module M.FES.211: Ecosystem Analytics** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>In order to understand how diverse living organisms in the ecosystem interact with each other and how their physical/chemical structures change, diverse analytical methods will be introduced herein. Various analytical methods for the understanding of diverse bioprocesses, e.g. the biocompounds including wood with distinct morphologies on diverse length scales ranging from molecular level through nano- to microscale will be shown using diverse methods. These include diverse spectroscopic, chromatographic, thermal and mechanical, and many other analytical methods. Based on the modification of chemical compositions of diverse material matrix in the ecosystem, the structure-functions and structure-property relationship will be further described. A few chosen relevant analytical techniques will be used for the exercises.<br>Objective of the course: The purpose of the course is to learn diverse analytical methods in details. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Ecosystem Analytics** (Lecture, Exercise) | 4 WLH |
|---|---|
| **Examination: Written examination (60 minutes, 50%) and written report (max. 25 pages, 50%)** | |

| **Examination requirements:**<br>Principles of diverse analytical methods, hand-on application | |
|---|---|

| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
|---|---|
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. rer. nat. Kai Zhang |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.221: Modern Methods in Ecology** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Ecophysiology<br>Students learn how to assess the vigor of plants by analyzing different ecophysiological parameters like photosynthesis and transpiration rate, stomatal conductance, leaf water potential and chlorophyll fluorescence. The practical course comprises an introduction into measurement technologies and conduction of an outdoor experiment to analyze the diurnal variations of those parameters. The practical course is accompanied by lectures in which the theoretical background of these parameters will be explained.<br>Diversity<br>Students learn about the use of biodiversity estimates in assessing different forest ecosystem functions. The practical part includes an individual project related to biodiversity of ectomycorrhizal fungal communities in two different habitats. The students calculate community diversity indices using R programming, compare the two fungal communities, and discuss possible implications for forest ecosystems. | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Ecophysiology** (Lecture, Exercise) | 2 WLH |
| **Course: Diversity** (Lecture, Exercise) | 2 WLH |
| **Examination: Term Paper (max. 20 pages)** | 6 C |

| **Examination requirements:**<br>Knowledge of important ecophysiological parameters, self-reliant determination of ecophysiological parameter using suitable measurement devices, precise documentation of data and interpretation of this data in the scientific context. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Andrea Polle |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>24 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.222: Community Ecology** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Students learn about modern concepts and methods in plant and animal ecology, specifically how to design and conduct field surveys, and how to collect and analyze data on community composition, functional traits, and ecological functions. The students conduct self-directed field work projects, with a focus on either plant or animal communities, and analyze the data using the software R. Topics to be addressed include: assessments of multiple dimensions (taxonomic, functional, phylogenetic diversity) and scales (alpha, beta, gamma) biodiversity, species identification, analysis of plant and animal community structure, and ecological functions based on traits and trophic interactions. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
|---|---|

| **Course: Animal diversity and ecological functions** (Lecture, Exercise) | 2 WLH |
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| **Course: Plant diversity** (Lecture, Exercise) | 2 WLH |
| **Examination: Oral presentation (max. 15 minutes, 20%) and term paper (max. 10 pages, 80%)** | 6 C |

| **Examination requirements:**<br>• Understanding concepts and methods in community ecology<br>• Ability to design and conduct field studies<br>• Analyzing and understanding patterns of diversity, community composition, functional traits, and ecological functions | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>Basic knowledge in R and basic identification skills (plants/animals) |
|---|---|
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Andreas Schuldt |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:**<br>Master: 2 |
| **Maximum number of students:**<br>40 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.223: Experimental Bioclimatology** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>The student will learn about measuring, analyzing and interpreting bioclimatological processes in terrestrial ecosystems such as air temperature, air humidity, wind velocity, air pressure, radiation and their impacts on CO2, water and energy fluxes. After a seminar part, the students will install a fully equipped meteological station and analyze the data and evaluate the meteorological conditions and ecosystem-atmosphere exchange processes of a site. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Experimental bioclimatology** (Seminar) | 2 WLH |
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| **Course: Experimental bioclimatology** (Exercise) | 2 WLH |
| **Examination: Presentation (approx. 20 minutes) with written outline (max. 2 pages) (50%) and protocol (max. 10 pages) (50%)** | |

| **Examination requirements:**<br>Understanding of bioclimatological processes and how they are measured. Ability to work with meteorological instruments, analyse and interpret data. | |
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| **Admission requirements:**<br>Ecosystem - Atmosphere Processes | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Alexander Knohl |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>25 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.224: Soil Physical and Biochemical Processes** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Flow of water in soil, soil chemistry (cation exchange capacity, soil acidification, nutrient element solubility, redox reactions), nutrient leaching losses (application of soil water flow and nutrient element chemistry), soil gas transport in soil, biochemistry of greenhouse gas production and consumption in the soil, application of stable isotopes (13C and 15N) in quantifying soil C and N cycling, landscape-scale approaches of quantifying soil biochemical processes (e.g. greenhouse gas fluxes, nutrient cycling rates). | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Soil Physical and Biochemical Processes** (Exercise) | 2 WLH |
| **Course: Soil Physical and Biochemical Processes** (Lecture) | 2 WLH |
| **Examination: Written examination (120 minutes, 50%) and term paper (max. 10 pages, 50%)** | 6 C |

| **Examination requirements:**<br>Soil water modelling and nutrient leaching calculations; field measurements and calculations of soil greenhouse gas fluxes and nutrient cycling rates; measurements of cation exchange capacity and nutrient stock calculations. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Dr. Marife Corre |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.231: Project: Ecosystem Sciences** | 12 C<br>2 WLH |
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| **Learning outcome, core skills:**<br>Using and applying modern methods in ecosystem sciences to work independently on a research project; autonomous acquisition of know-how and competencies for scientific problem solving; ability to interdisciplinary, strategic thinking; team work and organisation of tasks, scientific presentation and discussion; writing a final report in the style of a scientific article. | **Workload:**<br>Attendance time:<br>28 h<br>Self-study time:<br>332 h |
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| **Course: Project: Ecosystem Sciences** (Seminar)<br>*Contents*:<br>Each topic will be proposed by a researcher from the Faculty of Forest Sciences and Forest Ecology who will then be the principal supervisor for this topic. To support an interdisciplinary character of the project, a second supervisor may come from a department different from that of the principal supervisor.<br>A topic can be worked upon by a single student or by a team of two or three students. In the case of teamwork, the final report must contain sections which can be attributed to one individual author. | 2 WLH |
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| **Examination: Presentation (approx. 20 minutes, 30 %) and term paper (max. 15 pages, 70%)** | 12 C |

| **Examination requirements:**<br>Demonstration of ability to conduct, analyse and report on an independent scientific research project. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Alexander Knohl |
| **Course frequency:**<br>each semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Additional notes and regulations:**<br>Will be coordinated by A. Knohl in the summer semester and by A. Polle in the winter semester |
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| **Georg-August-Universität Göttingen**<br>**Module M.FES.311: Tropical forest ecology and silviculture** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>General understanding of ecological concepts regarding tropical forests and their characteristics. Critically analyse silvicultural systems considering their advantages and drawbacks. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Tropical forest ecology and silviculture** (Lecture)<br>*Contents*:<br>This course focuses on the ecology of tropical rain forests, threats to forests and options for ecologically sound land use. Lectures on forest ecology include characteristics of different tropical forest types such as lowland forest, montane forest, mangrove forest, and additionally the biodiversity of the forest, the role of fire, and the carbon balance of forests. More applied topics address silvicultural systems such as polycyclic and monocyclic management systems. | 4 WLH |
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| **Examination: Oral examination (approx. 20 minutes)** | 6 C |

| **Examination requirements:**<br>Emphasis lies on the ecology of tropical rain forests and options for ecologically sound management. Students shall know e.g. characteristics of different forest types, features of management systems and discuss land use options. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Dirk Hölscher |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.312: International Forest Policy and Economics** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>**Global environmental and forest policy:**<br>The objective is that students get basic knowledge of both the key policies related to forests and the application of the policy analysis on such issues. Students acquire comprehension about global forest related policy processes and factual knowledge about forest actors affecting the policy on a global level. The seminar combines a lead-in to global policy theory and its translation in practical, empirical knowledge about actors and processes of high importance in forestry. The different instruments for international policy formulation and implementation are discussed using case studies.<br>**International forest economics:**<br>The lecture is split in two main areas: 'International Wood Markets' and 'International Environmental and Forest Conservation'. The first part deals with the international trade with wood and wood products. International markets and the consequences of protectionism are analysed. Furthermore, aspects of international wood marketing are shown. In the second part, international environmental problems are described and possibilities as well as constraints for international co-operation are discussed. Finally, relations between environmental conservation and economic development are analysed. | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Global environmental and forest policy** (Seminar) | 2 WLH |
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| **Examination: Written examination (60 minutes)** | 3 C |

| **Course: International forest economics** (Lecture) | 2 WLH |
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| **Examination: Written examination (60 minutes)** | 3 C |

| **Examination requirements:**<br>• Understanding of the theory in policy analysis and application to international cases<br>• Knowledge of actors and instruments of international forest regimes<br>• Familiarity with international wood markets and international trade with wood and wood products<br>• Understanding of international wood marketing<br>• Ability to analyse consequences of protectionism<br>• Apply economic theory in order to analyse possible solutions towards international environmental problems<br>• Sound understanding of the relations between forest conservation and economic development | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Carola Paul |
| **Course frequency:** | **Duration:** |

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| each winter semester | 1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.313: Monitoring of Forest Resources** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Familiarize the students with the range of methods and techniques applied to forest monitoring in the preparation, planning, implementation and analysis phase. Objective is that the students are eventually in the position to carry out their own monitoring projects, and that they have the criteria to judge the quality of monitoring projects in general. Focus is on the target-oriented planning and the definition of the most appropriate sampling design and plot design that guarantees the generation of high-quality information for the decision makers in forestry. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Monitoring of forest resources** (Lecture, Exercise)<br>*Contents*:<br>Forest monitoring is a forestry discipline that aims at the comprehensive and objective characterization of the forests as a production system and/or as an ecological system in a defined geographic area, in terms of status quo and changes. Forest inventories are the core element of monitoring and they generate data and information required by foresters, forest politicians and forest researchers to support decision making.<br>The course module “Monitoring of forest resources” intends to familiarize the students with the range of methods and techniques applied to forest inventories in the preparation, planning, implementation and analysis phase. Objective is that the students are eventually in the position to carry out their own monitoring projects of forests and related resources, and that they know the criteria to judge the quality of monitoring projects in general. Focus is on the target-oriented planning and the definition of the most appropriate sampling design and plot design that guarantees the generation of high-quality information for the decision makers in forestry. That includes comprehensive presentation of statistical sampling. Examples of small and large area inventories and monitoring are presented and critically analysed. The important remote sensing applications for forest monitoring are not dealt with in detail in this module, as this topic is covered in other modules; but the relevance of integrated inventories (combining field sampling and remote sensing) is addressed. The development of forest inventories towards integrated “landscape inventories”, “multi-resource inventories”, “tree inventories” is also addressed of this course.<br>Prerequisites: Sound basis in “Forest mensuration” and basic statistics. | 4 WLH |
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| **Examination: Written exam (120 minutes)** | 6 C |

| **Examination requirements:**<br>In the module „Monitoring of Forest Resources“, the students should know and be able to manage and understand all topics that were covered in the lectures and labs. This includes:<br>• the relevance of data sources and data quality;<br>• the relevance of methodological soundness in planning, implementing and analyzing forest inventory data; | |
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- the basic principles of in planning, implementing and analyzing forest inventory data;
- important options of sampling and plot design and its characteristics (including application examples and calculation of estimates);
- the critical reading of forest inventory reports;
- the role of forest inventories when monitoring the “resource forest” and the “ecosystem forest“;
- the role of forest inventory and forest monitoring in decision processes at stand-, enterprise-, national and global level.

And, of course, calculation skills in producing sample based estimates are equally relevant.

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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>Required is a good command of forest mensuration, descriptive statistics, basic sampling statistics and cartography (along what is commonly covered in Bachelor study programs). |
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Christoph Kleinn |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.314: Forest utilization and wood processing** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Students gain knowledge of technological relevant wood properties of important commercial timbers and technology of major forest products in tropics (lumber, veneer, plywood, woodbased panels, pulp and paper). Students are able to plan, evaluate and select forest operations with respect to technical implementation, human impacts and environmental consequences. In addition, forest operations are put into the broader context of society and forest ecosystems and stresses of the human factor involved. Emphasis is directed to systems analysis and long-term perspectives. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Forest utilization** (Lecture)<br>*Contents*:<br>The module covers forest areas of the world and their characteristics with regard to forest operations, forest products, sorting of timber, fuelwood, technical systems and work methods for harvesting and other forest operations, ergonomics, occupational safety and health, appropriate technology, economic analysis of forest operations. In addition, basic elements of road planning, construction and maintenance are presented and information about recent developments (information and communication technology, GIS, logistics) are given. | 2 WLH |
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| **Course: Wood processing** (Lecture)<br>*Contents*:<br>We will impart consolidated knowledge about wood properties considering wood anatomy, wood physics, and wood chemistry including the role of water related to wood. Wood energy. Sawmill technology and wood products. Special regard on wood-based composites like particleboard, fiberboard, plywood, OSB and WPC. Wood destroying insects and fungi. Wood preservation and modification. | 2 WLH |
| **Examination: Written examination (120 minutes)** | 6 C |

| **Examination requirements:**<br>Wood processing:<br>The students should know the basics of wood properties in context with chemistry and micro-structure. They must know how to optimize the use of wood by producing convenient wood-based products and how to protect them.<br>Forest utilization:<br>The students should be able to describe and analyse the complex setting of forest operations and to find optimal solutions integrating economic, ecological, ergonomical and social aspects. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Dirk Jaeger |

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| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.321: Ecopedology of the tropics and suptropics** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>General understanding of the most important aspects of tropical and subtropical soils, their occurrence, genesis, geography, properties and use. Understanding the principles of the international FAO soil profile description and classification. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Ecopedology of the tropics and subtropics** (Lecture)<br>*Contents*:<br>Part I: General introduction in soils of the tropics and subtropics, their functions, genesis, geography and properties. Objective: general understanding of the most important aspects of tropical soils, their occurrence, genesis, properties and use. The following topics will be discussed: Introduction; Climate, water and vegetation; Weathering and weathering products, clay minerals; Soil organic matter, C and N dynamic; Soil chemical reactions, variable charge; Soil forming processes and development of soils; Water and nutrient cycling of land use systems; Tropical shield areas (example: Amazon basin); Arid shields and platforms (example: West Africa); Tropical mountain areas (example: Andes); Fluvial and coastal areas in the tropics (example: coastal areas in Asia). Part II: Introduction in the description and classification of soils, using in international system (FAO). Objective: understanding the principles of the FAO soil profile description and classification. The course consists of introductory lectures in which the principles of the FAO soil description and classification will be explained. This knowledge will be practiced using examples of soil profiles from different tropical countries. The second part consists of a practical week during which soil profile descriptions and evaluations will be exercised in the field. We will visit three contrasting sites around Göttingen where a site and soil description will be made. The work will be done in small groups. Students discuss their results in a report. | 4 WLH |
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| **Examination: Term paper (10 pages max.) and written exam (2 hours)** | 6 C |

| **Examination requirements:**<br>Kenntnis der beschriebenen Lehrinhalte, Erreichung der festgelegten Lernziele und Nachweis der angestrebten Kompetenzen. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Edzo Veldkamp |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.322: Project planning and evaluation** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>**Political evaluation**<br>Insights into the political framework of evaluation and the power and information based processes which drive any procedure of evaluation and application of the results in practice.<br>The students conduct a case study in political evaluation based on literature and an interactive game.<br>**Evaluation of rural development projects and policies**<br>In cooperation with the chair of „International Food Economics and Rural Development" this submodule teaches and trains the economic and financial assessment of rural development projects (in particular cost-benefit analysis). The methods are illustrated with examples and students learn to apply these methods in different exercises.<br>**Project planning and management**<br>Understanding theoretical concepts and practical considerations for planning and management of international forestry projects with a focus on international cooperation. A deeper understanding of the subject-matter is achieved by examples presented by guest lecturers and practitioners. | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Political evaluation** (Lecture) | 1 WLH |
| **Course: Evaluation of rural development projects and policies** (Lecture, Seminar) | 2 WLH |
| **Course: Project planning and management** (Lecture, Seminar) | 1 WLH |
| **Examination: Written examination (90 minutes, 50%) and term paper (max. 5 pages, 50%)** | 6 C |

**Examination requirements:**

- Ability to describe and explain international policy frameworks in development policy
- Capability to independently analyse policy case studies
- Have a good command of basic impact assessment and cost-benefit analysis in the context of international project evaluation
- Apply aspects of environmental and welfare economics to project case studies
- Understanding of key aspects of Sustainable Development, Capacity Development, Change management and international coordination and cooperation for successful implementation of forestry projects
- Critically analyse and develop a forestry project case study

| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Carola Paul |

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| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.323: Biometrical research methods** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Introduction in basics of statistical data analysis: Probability distribution, estimation, hypotheses testing. Understanding and application of basic techniques of descriptive and confirmative statistics: Confidence intervals, t-test, ANOVA, correlation and regression analyses. Understanding assumptions of statistical tests. Analysis of experimental data sets via the statistical program “R”. Interpretation of analysis results. Skills in describing and estimating forest stand parameters, forest structure and tree shape, and modeling of forest growth and development. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Biometric data analysis and experimental design** (Lecture, Exercise) | 2 WLH |
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| **Course: Forest dynamics** (Lecture, Exercise) | 2 WLH |
| **Examination: PC based written exam (120 minutes)** | 6 C |

| **Examination requirements:**<br>Understanding and application of basic techniques of descriptive and confirmative statistics. Analysis of given experimental data sets via the statistical program “R”, interpretation of analysis results to answer the examination questions. Knowledge of quantitative methods to describe forest density, forest structure and tree morphology. Modeling tree growth, calculating sustainable harvests for even-aged and continuous cover forests and understanding of the biological role of insects in forest ecosystems. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Dr. Irina Kuzyakova |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>30 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.324: Environmental Biotechnology and Forest Genetics** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Basic principles of population genetics are introduced, factors shaping genetic diversity of tropical forest species are discussed with emphasis on the reproduction system of tropical forest plants, and genetic diversity patterns of tropical forest trees are described. Main applications of forest genetics are mentioned: provenance research and tree breeding, genetic implications of forest management, forest reproductive material, and conservation of forest genetic resources. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Tropical Forest Genetics** (Lecture) | 2 WLH |
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| **Course: Environmental Biotechnology** (Lecture) | 2 WLH |
| **Examination: Oral examination (approx. 15 minutes)** | 6 C |

| **Examination requirements:**<br>Sound knowledge of learning contents, achievement of learning outcomes and proof of aspired core skills. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Ursula Kües |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.331: Project: Development of a forest region** | 12 C<br>7 WLH |
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| **Learning outcome, core skills:**<br>The objectives of the project are to learn how to solve problems in multidisciplinary groups and apply theoretical knowledge in a real world situation. The nature and complexity of the study influences students' organizational skills and includes project planning, application of theory to practical challenges, team work, conflict resolution and intercultural relationship development. | **Workload:**<br>Attendance time:<br>98 h<br>Self-study time:<br>262 h |
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| **Course: Project : Development of a forest region** (Lecture, Exercise, Seminar)<br>*Contents*:<br>This course aims at analysing land-use and forest related problems and includes different disciplines such as silviculture, bioclimatology, soil sciences, nature conservation and economics of the Faculty of Forest Sciences and Forest Ecology. In conclusion, a collaborative, multidisciplinary and comprehensive forest management plan will be developed. Field work for the Students' Project is usually conducted abroad and lasts approximately four weeks. Past destinations included Iran, Malawi, Sri Lanka and the Philippines. Upon returning to Göttingen, students analyse data, give presentations and write reports. | 7 WLH |
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| **Examination: Project report (20 pages max.)** | 12 C |

| **Examination requirements:**<br>Sound analysis of field data presented in a disciplinary subject report and contribution to a comprehensive, multidisciplinary forest management plan. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Dirk Hölscher |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.709: Research Internship in Data Analysis** | 6 C |
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| **Learning outcome, core skills:**<br>In the framework of a practical work of (at least) 4 weeks and under scientific supervision by a lecturer involved in the study focus “Ecosystem analysis and modelling”, the students shall gain experiences in working on a topic from the fields of data analysis, modelling and information processing, shall get acquainted with current problems, methods and workflows and will have the possibility to establish contacts for later professional work. To the latter purpose, the student will work in a company, a planning institution, a forest administration, a research institution or another organization which practises data processing with ecosystemic applications (host institution). The choice of this institution can be initialized by the student and/or by the supervising lecturer and needs the approval of the coordinator of the study focus “Ecosystem analysis and modelling”. | **Workload:**<br>Attendance time:<br>0 h<br>Self-study time:<br>180 h |
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| **Course: Research Internship in Data Analysis**<br>*Contents*:<br>At the beginning of the research internship, the supervisor states the topic which has to be worked upon and which will finally be presented in a written homework.<br>*Form:* Self-organized work on the given scientific topic under supervision. | |
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| **Examination: Term Paper (max. 20 pages)** | 6 C |

| **Examination requirements:**<br>Competencies in the application of established methods and software tools for data analysis, modelling, geodata evaluation and/or simulation on a given problem which was stated in collaboration with a national or international institution which is doing data processing with ecosystemic orientation. Presentation of the methods and results in a written homework, according to the criteria of good scientific practice. | |
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| **Admission requirements:**<br>Participation needs an individual agreement by the supervising lecturer and by the collaborating institution and should be initialized in time (at least 3 months prior to the beginning of the internship). | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Winfried Kurth |
| **Course frequency:**<br>each semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

**Additional notes and regulations:**

The research internship lasts at least 4 weeks and has to be done without interruption and in cooperation with only one host institution. After finalization, a written confirmation by the host institution has to be presented.

This module is equivalent to the corresponding German-language module „Forschungspraktikum Datenanalyse“.

| **Georg-August-Universität Göttingen**<br>**Module M.FES.710: Management of research and science policy** | 6 C<br>2 WLH |
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| **Learning outcome, core skills:**<br>The aim is to get professional knowledge and experiences how to design and management research projects. | **Workload:**<br>Attendance time: 28 h<br>Self-study time: 152 h |
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| **Course: Management of research and science policy** (Seminar)<br>*Contents*:<br>The management of research projects and transfer of scientific knowledge are analyzed based on social sciences theory of research and interdisciplinary approaches. The focus is the design of programs for research in all kind of disciplines, the implementation of programs and projects and the evaluation. In addition the transfer of scientific knowledge into practice is an important part in theoretical teaching and exercises for students.<br>The students conduct a cases study. They use literature and other written sources. Most important are the own experiences of the students with research. The cases will be discussed in the seminar and a written report will be worked out. | 2 WLH |
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| **Examination: Presentation (approx. 20 minutes) with written outline (max. 20 pages)** | 6 C |

| **Examination requirements:**<br>• Knowledge of the political theory of management of research and knowledge transfer<br>• Application in a case study | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
|---|---|
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Maximilian Krott |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>12 | |

**Additional notes and regulations:**
After successfully completing this module students can not chose M.Forst.747 anymore.

| **Georg-August-Universität Göttingen**<br>**Module M.FES.711: Exercises in Forest Inventory** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>The students shall learn to design, to implement, to document and to cause forest inventory projects autonomously and on a scientific basis. Further on, they shall develop the abilities to optimize and to develop measuring methods related to forests. Therefore, it is crucial to handle common measuring instruments and methods safely. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Exercises in forest inventory** (Lecture, Exercise)<br>*Contents*:<br>• Short repetition about the use of instruments for measuring DBH, upper diameters and heights.<br>• Planning, preparation and implementation of a sample based forest inventory, including the designing of an inventory instruction.<br>• Data management (Excel) and analysis after given tasks.<br>• Formulating a project report.<br>• Presentation of results in small groups within a seminar for examination. | 4 WLH |
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| **Examination: Oral presentation (approx. 15 minutes, 25%) with written outline (max. 15 pages, 75%)** | 6 C |

| **Examination requirements:**<br>The students shall give evidence that they know how to plan, implement and analyse a forest inventory. Such experience will be accumulated during the practical exercises. This includes<br>• design planning regarding sampling and plot design;<br>• formulation / improvement of a forest inventory field manual;<br>• data analyses and working on pre-defined questions and hypotheses;<br>• Presentation of inventory results and defending them against criticism.<br>The weighting will be done according to the reached points. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>Good command of forest mensuration and forest inventory, including calculation skills regarding analyses of inventory data. |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Christoph Kleinn |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>12 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.712: Bioclimatology and global change** | 6 C (incl. key comp.: 6 C)<br>4 WLH |
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| **Learning outcome, core skills:**<br>Scientific basis of climate and climate change, trace gas budgets of soils and whole ecosystems and the potential to sequester carbon and nitrogen in managed and unmanaged terrestrial ecosystems. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Bioclimatology and global change** (Lecture)<br>*Contents*:<br>The module "Bioclimatology and Global Change" will introduce the students to the global climate system and its interaction with the biosphere. A lecture course will focus on the scientific basis of climate and climate change covering basic physical and chemical processes governing the climate system, climate zones, modelling as well as global and regional climate phenomena with a focus on tropical climates. A seminar course will highlight trace gas budgets of soils and whole ecosystems and their potential to sequester carbon and nitrogen in managed and unmanaged terrestrial ecosystems and their vulnerability to climate change. Using journal literature the students will work out oral presentations concerning current research topics concerning the global climate system and its interaction with the biosphere. | 4 WLH |
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| **Examination: Written exam (90 minutes, 50%) and oral presentation (approx. 20 minutes, 50%)** | 6 C |

| **Examination requirements:**<br>Understanding the most relevant processes at the biosphere-atmosphere interface and of biogeochemical cycles. Being able to find, read, evaluate, and present scientific literature related to Global Change. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Alexander Knohl |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>30 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.713: Forestry in Germany** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Understanding of forestry and related industries in Germany. | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Forestry in Germany** (Excursion, Seminar)<br>*Contents*:<br>Important aspects of German Forestry are introduced to foreign students interested in the forest management as practised in Germany as well as the wood-processing industry. Contents are forest management, silviculture, forest utilization, labor science and prozess technology, forest econmics, tree improvement and genetics, forest inventory and remote sensing (forest management inventories in Germany, the German National Forest Inventory, applications of remote sensing in forestry planning in Germany) The module provides a basic understanding of the forest management in Germany including actual trends and perspectives. It is strongly suggested for foreign students who are going to undertake their project in Germany (Project: 70130 "Managing sustainable forestry systems in Germany"). The module includes various excursions. | 4 WLH |
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| **Examination: Oral presentation (approx. 15 minutes) with written outline (max. 15 pages)** | 6 C |

| **Examination requirements:**<br>The students should know and manage and understand the topics that were covered during the field trip that AWF (Forest Inventory and Remote Sensing) offers. This includes forest mensuration, forest monitoring and forest planning.<br>Show familiarity with current approaches, trends and future challenges in forestry and the wood-processing industry in Germany<br>Show understanding of the overall structure of forestry and forest research in Germany and the connection between the sub disciplines<br>Be able to communicate and critically analyse a selected aspect of German forestry in a coherent way | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>Basic knowledge in forest management, forest planning, forest inventor. |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Carola Paul |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:** | **Recommended semester:** |

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| cf. examination regulations | |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.714: Internship in forest management and research** | 6 C |
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| **Learning outcome, core skills:**<br>Students may learn about current approaches to international forestry and related fields during internships. Such internship can be conducted at a variety of institutions including other universities, forest management units, or institutions of international cooperation and development. This internship may last for at least four weeks and will be prepared together with lecturers, assisted by lecturers and afterwards discussed with them. The selection of institutions for the internship requires agreement of the coordinator of the study program Tropical and International Forestry. | **Workload:**<br>Attendance time:<br>0 h<br>Self-study time:<br>180 h |
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| **Course: Internship in forest management and research** (Internship) | |
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| **Examination: Protocol (max. 20 pages)** | 6 C |

| **Examination requirements:**<br>The report shall comprise the general goals of the host institution and describe the work actually done by the student. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Dirk Hölscher |
| **Course frequency:**<br>each semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.715: Dryland Forestry and Methods in Silviculture** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Understanding the specifics of dryland forestry as well as principles and applications of plant ecological and silvicultural methods. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
|---|---|

| **Course: Dryland forestry and methods in silviculture** (Lecture, Exercise, Seminar)<br>*Contents*:<br>The lecture focuses on land-use options emphasising the management of dry forests on a global scale. Covering approximately 30% of the global land surface, drylands pose important ecological and economic impacts, and therefore require specific approaches in management. The second focus of this module is on recent topics in silviculture and the familiarization of relevant plant ecological and silvicultural methods. This includes discussion of study designs, airborne and ground-based assessments as well as options of data analysis and presentation. Selected case studies from literature will also be analysed. | 4 WLH |
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| **Examination: Oral presentation (approx. 15 minutes, 50%) with written outline (max. 10 pages, 50%)** | 6 C |

| **Examination requirements:**<br>Knowledge on ecological and economic aspects of dryland forestry; tree ecological characteristics and management options. Analysis, presentation and discussion of case studies. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Dirk Hölscher |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.716: Bioplastics** | 3 C<br>2 WLH |
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| **Learning outcome, core skills:**<br>Students will learn recent development about the types, preparation and characterization of bioplastics. Objective of the Course: The purpose of the course is to give detailed information about Bioplastics. | **Workload:**<br>Attendance time:<br>28 h<br>Self-study time:<br>62 h |
|---|---|

| **Course: Bioplastics (Lecture)**<br>*Contents*:<br>1. Introduction to bioplastics<br>2. Applications of bioplastics<br>3. Class studies of research articles | 1 WLH |
|---|---|
| **Course: Bioplastics (Laboratory course)**<br>*Contents*:<br>1. Preparation of bioplastics<br>2. Characterization and properties | 1 WLH |
| **Examination: Oral examination (approx. 15 minutes)** | 3 C |

| **Examination requirements:**<br>Knowledge of preparation, properties and applications of bioplastics | |
|---|---|

| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
|---|---|
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. rer. nat. Kai Zhang |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.717: Nanocellulose** | 3 C<br>2 WLH |
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| **Learning outcome, core skills:** | **Workload:** |
|---|---|
| Nanocellulose: synthesis, properties and applications. Students will learn the preparation, characterization and application of nanocellulose. Objective of the course: The purpose of the course is to give detailed information about nanocellulose. | Attendance time:<br>28 h<br>Self-study time:<br>62 h |

| **Course: Nanocellulose: synthesis, properties and applications**<br>*Contents*:<br>1. Introduction to wood and plant cell wall<br>2. Biosynthesis & hierarchical structure of native cellulose from diverse sources<br>3. Preparation of nanocellulose: chemical methods<br>4. Preparation of nanocellulose: other methods<br>5. Properties of nanocellulose<br>6. Applications of nanocellulose<br>7. Class studies of research articles<br>8. Practical experiment for the preparation and | 2 WLH |
|---|---|
| **Examination: Oral examination (approx. 15 minutes)** | 3 C |

| **Examination requirements:**<br>Methods of preparation and biosynthesis of nanocellulose; properties of nanocellulose | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
|---|---|
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. rer. nat. Kai Zhang |
| **Course frequency:**<br>each summer semester; Start 2017 | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:**<br>Master: 3 |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.718: Botanical/Biogeographical excursion** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>The students have a broad and comprehensive overview of the biotic and abiotic characteristics at the excursion destination including flora, vegetation, land-use, topography, geology and climate. They have familiarized with the flora of a foreign biogeographic region and are able to identify local plant species using identification literature. In addition, they are able to plan and perform different kinds of vegetation sampling methods in the field. In the seminar, the students have prepared themselves under guidance for exploring the nature of a foreign place and are able to plan future scientific expeditions. They have gained a profound understanding of biogeographical as well as plant and vegetation ecological principles related to both general theories and the excursion destination. | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Preparation seminar for Botanical/Biogeographical excursion** (Exercise, Seminar) | 1 WLH |
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| **Examination: Presentation (approx. 20 minutes, 50%) and term paper [exkursion protocoll] (max. 10 pages, 50%)**<br>**Examination requirements:**<br>Floristic, vegetation ecological and geographical characteristics at the excursion destination; basic vegetation sampling methods; alpha, beta, & gamma diversity; plant community composition and its dependence on abiotic site conditions; biogeographic concepts. | 6 C |

| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
|---|---|
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Holger Kreft |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>15 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.719: Remote sensing image processing with open source software** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>This combined lecture and lab makes the student familiar with basic principles, techniques and applications of remote sensing. The students learn skills in digital image processing and information extraction using open source software on own laptops. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Remote sensing image processing with open source software** (Lecture, Exercise)<br>*Contents*:<br>The course introduces the theories (via lectures and literature) and applications (including computer exercises) of remote sensing workflows. Remote sensing data from different sensors (cameras, LiDAR scanners, RADAR) and platforms (satellites, aircrafts and unmanned aerial systems (UAS)) are used to develop analysis workflows for forestry and environmental monitoring applications. Common steps and methods of remote sensing analysis such as preprocessing, image enhancement, sampling of reference data, automated classification and estimation and map validation are presented. In the practical labs, students deepen their knowledge and skills with small projects such as land cover classification, individual tree detection, biomass estimation and change detection using open source technologies. | 4 WLH |
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| **Examination: Oral exam (approx. 15 minutes, 80%) and practical exam (approx. 15 minutes, 20%)** | 6 C |

| **Examination requirements:**<br>The students should know and manage and understand and have insights into all topics that are covered in the module that consists of lectures and predominantly on labs where the students learn image analysis on their own notebooks: the exam requirements include:<br>• Bases of electromagnetic radiation and its interactions with the atmosphere and terrestrial land cover types;<br>• Basic techniques of remote sensing image acquisition, pre-processing, enhancement and classification – as covered in the lectures and labs;<br>• Knowledge and skills regarding application of the software as used in the practical labs;<br>• Options of remote sensing integration into forest monitoring regarding both mapping and estimation;<br>• Assessing quality of remote sensing products, including accuracy analysis. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>Good command of forest mensuration and forest inventory, including calculation skills regarding analyses of inventory data. |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Christoph Kleinn |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>not limited | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.720: Agent-based modelling with NetLogo** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>• Comprehensive knowledge of agent-based modelling for beginners;<br>• Ability to select, conceptualize, apply, implement, and document agent-based modelling techniques in NetLogo with respect to a given question (with a focus on ecological questions);<br>• Development of an own agent-based modelling project;<br>• Development of interdisciplinary analytical thinking;<br>• Critical analysis and evaluation of the potentials and limitations of agent-based models based on the scientific literature;<br>• Refined presentation skills | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Agent-based modelling with NetLogo** (Block course, Exercise, Seminar)<br>*Contents*:<br>Computer course: Modelling with NetLogo<br>Seminar: Modelling paper classics (including ungraded student presentations on classical modelling papers) | 4 WLH |
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| **Examination: Oral Presentation (approx. 20 minutes)** | 6 C |

| **Examination requirements:**<br>Comprehensive knowledge of agent-based modelling techniques. Ability to select, conceptualize, apply, implement, and document agent-based modelling techniques in NetLogo with respect to a given question. Skills to develop a modelling project. Interdisciplinary analytical skills. Ability to critically analyze and evaluate potentials and limitations of published agent-based models. Presentation skills | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Dr. Katrin Mareike Meyer |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>20 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.721: Ecological functions of wildlife: implications for conservation and management** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:** | **Workload:** |
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| Animals fulfill various ecological roles within ecosystems. For example, many vertebrate species act as ‘mobile links’ and transport genetic material or organic matter across large spatial extends. Similarly, the presence or absence of large carnivores, or the abundance of large herbivores in an ecosystem can substantially impact its properties. While the reciprocal relationships between animals and the environment have long been recognized in ecology, we are only now realizing how important anthropogenic activities are for the functions that animals have in ecosystems.<br>The aim of the course is to provide students with an overview of the ecological functions of vertebrate animals and why considering human influences on vertebrate species can be crucial for ecosystem management and biodiversity conservation. In addition, the course will also provide students with a basic understanding on how to investigate these functions and their consequences for ecosystem functions and services | Attendance time:<br>56 h<br>Self-study time:<br>124 h |

| **Course: Ecological functions of wildlife: implications for conservation and management** (Lecture, Seminar) | 4 WLH |
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| **Examination: Oral Presentation (approx. 20 minutes)**<br>**Examination prerequisites:**<br>Written exam (30 minutes) | 6 C |

| **Examination requirements:** | |
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| To successfully complete the course, students have to demonstrate a general understanding of<br>1. functions fulfilled by vertebrates within ecosystems;<br>2. human impacts on these ecosystem functions;<br>3. how to analyze animal-ecosystem relationships;<br>4. the implications of animal-ecosystem relationships for management and conservation<br>The written exam (examination prerequisite) will take place in the first half of the semester. | |

| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Niko Balkenhol |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:** | |

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| 40 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.722: Wood Technology and Wood Products** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Knowledge of the fundamentals of wood products, including manufacturing of products drying and impregnation processes. | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Wood Technology and Wood Products** (Lecture) | 4 WLH |
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| **Examination: Written examination (60 minutes)** | 6 C |

| **Examination requirements:**<br>Detailed knowledge and understanding of production processes of wood based products including the fundamentals of wood drying and wood protection. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Carsten Mai |
| **Course frequency:**<br>winter or summer semester, on demand | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>20 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.723: Wood Science** | 6 C<br>2 WLH |
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| **Learning outcome, core skills:**<br>**Wood Science:**<br>Basics of wood anatomy, wood biology, wood physics. Knowledge of technological relevant wood properties of important commercial timbers. Knowledge of wood degradation by organisms, wood protection systems, service life prediction and durability-based design of wood products.<br>**Wood Attack & Wood Protection:**<br>Students are familiar with various wood preservatives and processes as well as novel wood modifications and can assess advantages and disadvantages as well as describe chemical, physical and anatomical changes in wood. They can analyze international usage scenarios based on geographic and climatic conditions and discuss advantages and disadvantages of using modified wood.<br>Students are able to name features of insects and list wood destroying / infesting species. They can describe hazards to wood products, identify insect infestation characteristics and assess risks from a local as well as a global perspective (e.g. distribution of certain insect species).<br>Students can list impacts / limitations of the durability of wood and discuss the relationship between wood species, location and exposure. In particular, the influence of water, light and fungi on durability can be evaluated by the students argumentatively.<br>Students are able to describe use classes and exposures according to European standards and formulate wood preservation measures for the chosen setting | **Workload:**<br>Attendance time:<br>28 h<br>Self-study time:<br>152 h |
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| **Course: Wood Science** (Lecture, Exercise)<br>*Contents*:<br>Introduction to anatomical structures and features of European, tropical and subtropical tree species. Introduction to technologically-relevant wood properties, wood processing and utilization possibilities. | 2 WLH |
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| **Course: Wood Attack & Wood Protection** ()<br>*Contents*:<br>Online module with instructional videos, comprehension questions and additional literature. The responsible teacher tutors the students and helps to understand the online module material. She / he provides students with personal feedback on their questions and academic progress. A forum for discussion is made available.<br>Introduction to the major concepts of wood degradation (temperature, water, radiation, fungi, insects). Assessment and classification as well as principles of durability of wood in different use conditions. Wood protection and preservation technology. Basic concepts and state of the art techniques of wood modification. Introduction to life cycle assessment of modified wood.<br>*Course frequency:* 90h Self study | |

| **Examination: Oral examination (approx. 20 minutes)** | 6 C |
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| **Examination requirements:**<br>Identification of important wood species by using anatomical characteristics. Understanding of the relationship between wood properties and applications. Detailed knowledge and understanding of colonization, degradation and protection of wood. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>Basic chemical knowledge and wood anatomy |
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| **Language:**<br>English | **Person responsible for module:**<br>Dr. Susanne Bollmus |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>20 | |

**Additional notes and regulations:**
This module can not be choosen from students of the "MSc Forstwissenschaften und Waldökolgie" with the specialization "Holzbiologie und Holztechnologie".

| **Georg-August-Universität Göttingen**<br>**Module M.FES.724: Agroforestry and new forests** | 6 C<br>3 WLH |
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| **Learning outcome, core skills:**<br>Better understanding of tree and crop ecological interactions in agroforestry systems, and options for reforestation in tropical regions. | **Workload:**<br>Attendance time:<br>42 h<br>Self-study time:<br>138 h |
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| **Course: Agroforestry and new forests** (Lecture, Seminar)<br>*Contents*:<br>The course aims to analyse and discuss tree-based land use systems such as agroforestry systems and plantations from different perspectives (e.g. environmental and socio-economic). An emphasis will be placed on the biological interactions of different species when grown together and the potential to restore degraded sites with sustainable land use options. Further issues to be addressed include biofuel production and climate change mitigation and adaptation in tree-based land use systems. A portion of the course comprises student-led presentations of case studies from different geographic regions that will be evaluated in their respective regional context. The presentations will be supported by recent literature and can be based either on personal preferences or chosen from a list of topics. | 3 WLH |
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| **Examination: Presentation (approx. 20 minutes, 50%) and term paper (max. 15 pages, 50%)** | 6 C |

| **Examination requirements:**<br>Knowledge of the ecological aspects of agroforestry systems and reforestation, plant species interaction and management options. Analysis, presentation and discussion of case studies. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Dr. Alexander Röll |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>25 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.725: Spatial Statistics** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>• Knowledge of statistical methods of spatial point pattern analysis<br>• Introduction to analysis software (*Programita*, *R*) to analyze spatial point pattern analysis<br>• Planning and execution of a scientific investigation based on spatial statistics<br>• Understanding of motivations, methods and interpretations of spatial point pattern analyses in different ecosystems around the world<br>• Insights into general work circumstances and career paths in different countries (Spain, Portugal, USA) | **Workload:**<br>Attendance time: 56 h<br>Self-study time: 124 h |
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| **Course: Spatial statistics** (Lecture, Exercise, Seminar)<br>*Contents*:<br>The course consists of two major parts, i.e. a lecture as well as an eLearning module. The parts complement each other and are both essential for the course. During the lecture, the statistical background is introduced. The eLearning module demonstrates how to apply methods taught during the lecture to scientific questions and real-world data sets from all around the world.<br><br>During the lecture, students are introduced to statistical methods of spatial point pattern analysis. Among others, this includes methods to describe first-order (intensity of point patterns) and second-order properties of patterns (K-, g- and 0-functions, mark-correlation functions), as well as methods to simulate null model data using Monte-Carlo simulations of point process models. All methods include tools for homogenous and heterogenous conditions. The lecture also includes a practical part, in which students are taught how to use recent software to analyze own and/or sample data sets (*Programita* and/or *R*).<br><br>In the eLearning module, international experts introduce the students to different ecosystems in different regions of the world and representative investigations. This includes methods of data sampling, data analysis, interpretation and presentation of results. In cases where the data is available, students are advised to reproduce the investigations. With regard to the oral exam they are encouraged to prepare a case study using and interpreting data from other countries. The international dimension is further strengthened by interviews with the experts, giving insights into the career and the general work circumstances in the corresponding home countries. | 4 WLH |
|---|---|
| **Examination: Oral Presentation (approx. 20 minutes)**<br>**Examination prerequisites:**<br>Written exam (30 minutes) | 6 C |

| **Examination requirements:**<br>To successfully complete the course, students have to demonstrate a general understanding of how to develop ecological questions and translate them into a protocol for statistical testing; to understand and implement advanced methods of spatial data analysis; to conduct, document and present own data collection and spatial data | |
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| analysis; to identify local ecological conditions (species properties, environmental conditions) and to discuss their potential effects on spatial point patterns; to interpret and discuss current ecological literature on spatial data analysis.<br>The written exam (examination prerequisite) will take place in the first half of the semester. | |

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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Kerstin Wiegand |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>14 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.726: Ecological Modelling with C++** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>• Implementing ecological questions in model structures<br>• Independently develop simulation models<br>• Programming with C++<br>• Proficiency in the use of software dedicated to programming C++<br>• Commenting and documenting program code | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Ecological modelling with C++** (Lecture, Exercise)<br>*Contents*:<br>The module conveys advanced knowledge of modelling ecological questions. The focus is on the implementation of ecological models with the programming language C++. The module covers the fundamentals of C++ to the degree necessary for the implementation of models. Programming skills are applied in an independent modelling project implementing an own model question. The modelling project is documented in the term paper. | 4 WLH |
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| **Examination: Term Paper (max. 20 pages)** | 6 C |

| **Examination requirements:**<br>Develop ecological questions and translate them into model structures; Read and understand C++; implement model independently. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Kerstin Wiegand |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>14 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.727: Fungal Biotechnology and DNA techniques** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>Fungal biotechnology<br>Students will be introduced into fungal isolation and culturing, DNA isolation, fungal enzyme production, environmental applications of fungal enzymes such as in wood composite production<br>Forest genetics<br>Students will be introduced into basic DNA marker techniques and concepts of ecological genetics. The relevance of genetic variation for the conservation of forest genetic resources is highlighted. | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Fungal biotechnology** (Exercise) | 3 WLH |
| **Course: Forest genetics** (Lecture) | 1 WLH |
| **Examination: Term Paper (max. 20 pages)** | 6 C |

| **Examination requirements:**<br>The students have to learn experimental laboratory techniques and analyze the resulting data. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Ursula Kües |
| **Course frequency:**<br>each winter semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>10 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.728: Tropical dendrology** | 3 C<br>2 WLH |
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| **Learning outcome, core skills:**<br>Tropical Dendrology objectives: Assessment of ecological characteristics and management of major tree species. Students will learn how to give an oral presentation. | **Workload:**<br>Attendance time:<br>28 h<br>Self-study time:<br>62 h |
|---|---|

| **Course: Tropical dendrology** (Lecture, Exercise)<br>*Contents*:<br>In the tropical rainforest 50-60.000 tree species occur. Of course, it is not possible to know all of them including their ecological characteristics. However, in the course on Tropical dendrology we will present important families to which tropical trees belong. Furthermore, we will elaborate physiological principles with respect to water, carbon and nutrient turnover by trees, and focus on the possibilities of a functional classification of trees. For selected tree species we will analyse the ecological characteristics, management options and the use in more detail.<br>*Course frequency:* each winter semester | 2 WLH |
|---|---|
| **Examination: Oral presentation (approx. 15 minutes)** | 3 C |

| **Examination requirements:**<br>Knowledge of ecological aspects and management options for tropical tree species.<br>Analysis, presentation and discussion of specific species (groups). | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Prof. Dr. Ralph Mitlöhner |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>24 | |

| **Georg-August-Universität Göttingen**<br>**Module M.FES.729: Biodiversity and ecosystem functioning** | 6 C<br>4 WLH |
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| **Learning outcome, core skills:**<br>In this course, students will learn and discuss concepts related to the relationship between biodiversity and ecosystem functioning, how this field has been developing and potential implications for the management of natural resources and conservation. Moreover, we will explore theoretical basis of biodiversity-ecosystem functioning relationships and the underlying mechanisms as well as the influence of interactions between organisms of multiple trophic levels, contrasting facets of biodiversity, and multifunctionality. Students will also be introduced to various empirical approaches used to assess the relationship between biodiversity and ecosystem functioning, from the use of experimental assemblages to monitoring studies. To become familiar with the different experimental approaches, we will visit some of the current plant biodiversity experiments in Germany. | **Workload:**<br>Attendance time:<br>56 h<br>Self-study time:<br>124 h |
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| **Course: Biodiversity and ecosystem functioning** (Lecture, Excursion, Seminar) | 4 WLH |
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| **Examination: Presentation (approx. 20 minutes, 40%) and project report (max. 15 pages, 60%)** | 6 C |

| **Examination requirements:**<br>In self-directed projects, students are expected to develop research questions in the biodiversity-ecosystem functioning framework using their knowledge on concepts and theoretical basis of biodiversity and ecosystem functioning and design a methodological approach to assess it. Moreover, students are expected to lead discussions on biodiversity and ecosystem functioning related topics and develop their critical thinking. | |
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| **Admission requirements:**<br>none | **Recommended previous knowledge:**<br>none |
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| **Language:**<br>English | **Person responsible for module:**<br>Dr. Nathaly Guerrero |
| **Course frequency:**<br>each summer semester | **Duration:**<br>1 semester[s] |
| **Number of repeat examinations permitted:**<br>cf. examination regulations | **Recommended semester:** |
| **Maximum number of students:**<br>20 | |